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# Applying “Designerly Framing” to Understand Assisted Feeding as Social Aesthetic Bodily Experiences

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What could it mean to take a designerly perspective of a robotic eating aid to get a more holistic understanding of meals as social and embodied experiences? In this article, we provide a new perspective of bodily experiences of assisted feeding. We apply “designerly framing” in the context of meals and Human Robot Interaction (HRI) and contribute with insights for researchers with backgrounds other than design into how “designerly framing” can foreground social and aesthetic use. The study focuses on experiences of assisted feeding of five people with impairments in their arms or hands. All of the subjects have long-term experience of meal assistance, and four also have experience of using a robotic eating aid. The data collection comprises seven interview sessions held in peoples homes, a functional analysis of the meal experience, and a workshop held at a design agency. The “designerly framing” is also supported by a theoretical framework describing different types of use to open the meal as a design space. This complements and extends existing knowledge on acceptance and abandonment of assistive technology (AT) and assistive robotics for the meal.

CCS Concepts: • **Human-centered computing** → **Accessibility design and evaluation methods**; **Empirical studies in accessibility**; **HCI theory, concepts and models**;

Additional Key Words and Phrases: Robotic eating aid, HRI, accessibility, meal assistance, designerly framing, aesthetic bodily use, social bodily use, practical use, experience, qualities

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## 1 INTRODUCTION

In the silent film *Modern Times* starring Charlie Chaplin, Little Tramp is strapped in an automated innovation; a feeding machine. The feeding machine is supposed to be a time-saving device, so workers can continue working over their lunch breaks. The machine spills soup in his lap, puts cream cake in his face, and feeds him hysterically rapidly with anything on the plate, including bolts. The scene ends with the written words “It’s no good—it isn’t practical”. The overall message of the film is essentially to show the struggle to eschew alienation and maintain some kind of

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humanity in a modern mechanized world [99]. The conclusion “it isn’t practical” illustrates a total ignorance of human values, reducing a human to efficiency and effectiveness at work.

Today, personal assistance in meals may be considered expensive for society, but the abandonment of **assistive technology (AT)** or robotic solutions is also expensive [77]. Overall, abandonment of AT is not only an ineffective use of limited funds in society but may also decrease a person’s functional abilities, freedom, and independence [77]. Taking the starting point in new technological possibilities may not take sufficient consideration of the disabled people’s perspective [37]. As individuals may get reduced personal assistance when adapting their surroundings to fit their disability, replacing a flexible and caring personal assistant with a limited robotic solution may lead to a fear of a decreasing life quality. This suggests the importance for **Human Robot Interaction (HRI)** and assistive robots to address critical questions such as non-use and abandonment situations, to support people with disabilities, their assistants, and other stakeholders such as industry, social insurance care agencies, and municipalities.

There is an underrepresented yet growing body of research in HRI that critically addresses the need for more experience-oriented, humanistic, designerly, and critical perspectives in robotic research [41, 60, 62–64, 82, 85]. This concerns exploring alternative design epistemological grounds in HRI (e.g., [62]), to pose critical questions [85] or raise matters of care such as social justice and diversity [55]. A related transformation has already happened in the field of **Human Computer Interaction (HCI)** [10, 81, 92], raising issues about situatedness, embodiment, particularities of context of use, meaning creation, values [92], and the value of design research to produce intermediate knowledge [45]. Such research has for example critically addressed designerly approaches to understand human pleasure as an essential need [4] and phenomenological perspectives of experiences as the lived body [92]. There is a trend to design for rich body experiences i.e., soma design where a researcher use their own body as performative (i.e., bodystorming) or a sensing body (i.e., kinesthetic creativity) to understand experience (see e.g., [42, 43, 92, 93]). Other approaches are design-led inquiry, e.g., investigating methods trigger memories and maintain identity to support people with dementia, focusing on the self as a social and a relational concept [103]. Moreover, there is critical inquiry focusing on the relation between design methods and ethics in knowledge creation [33] and a post humanistic perspective arguing that user centered design practices and methods can be unsituated and problematic [102].

HRI is now following a similar designerly trend [62–64, 82, 85], exemplified by research presenting designerly ways of knowing, approaches and epistemology [62], raising critical questions about embodiment and human pleasure [64], and critical perspectives of design processes and human configurations in HRI [55, 60, 85]. Researchers have contributed with user centered design methods in HRI for several years (see e.g., [56–58, 103]). Participatory design activities have emerged in the field of assistive and healthcare robotics, such as collaborative map making [56], artifact analysis (using pictures of robots) [58] and mutual learning processes of co-design in workshops with caretakers, researchers and staff for aging adults with depression [57]. Similar efforts have focused on collaboratively envisioning different types of robot solutions to assist caregivers and care recipients with **activities of daily living (ADL)**, medication management, and scheduling (IADL) [69]. There is also work on feeding assistance that considers diverse stakeholders, including caregiver perspectives (e.g., [7, 57]).

Robots can be understood as a promising and advanced kind of AT. Such assistive robots are intended to be used by people with disabilities (due to age, illness, accidents, etc) for assistive or rehabilitative purposes, and are part of a larger domain of healthcare robotics [56, 80]. Some assistive robotic devices do only one task, such as feeding assistance, where a robotic arm moves food from the plate to the user’s mouth (e.g., [7, 59]). Such solutions can assist people with impairment in their arms or hands, who would otherwise need another person to feed them or they

would have to eat with their lips directly from the plate. This can be compared to social assistive robots that are intended for cognitive and social support, typically referred to as service robots or companion robots within the area of healthcare robotics [80]. Finally, social assistive robots have been investigated as more holistic solutions that provide both cognitive and physical assistance for people with cognitive and physical impairments [69, 95]. Examples of such solutions are the care robot Hobbit [28] and Care-O-Bot [51].

Many different types of robots are abandoned for various reasons [21]. Acceptance and user motivation are major challenges for assistive robot solutions intended for people with disabilities and aging people [12, 29, 80, 95]. Even though research on assistive robotics has been conducted for many years to support people with different types and severity of disabilities, such robotic solutions are rarely adopted [56, 80]. Abandonment and discontinuance apply to many types of AT [2, 50, 79, 87]. Robotic researchers have pointed out possible reasons for rejection, such as usability issues, poorly designed hardware, stigmatizing and stereotyped presentation of aging people in the framing of the technology, and embarrassment [13, 56]. However, even if some work in HRI has pointed out the need to understand abandonment in a larger context, e.g., from the perspective of an ecology of products (see [29]), abandonment has not previously been addressed in an overarching framework of aesthetic and social use. Several classical and dominating frameworks to understand technology and robotic acceptance (such as TAM [20] and UTAUT [40, 100]) essentially take a usability perspective, rather than bodily aesthetic experiences and social needs as the primary perspective.

In the forthcoming, we will present how designerly framing can provide a more holistic perspective to understand different types of meal situations beyond the usability needs of a robotic eating aid. In this article, we apply “designerly framing” in the context of assisted meals and HRI to support more embodied perspectives of assisted feeding. Even if interaction is essentially embodied, this perspective is far from well understood, and there is a constant need for a theory that can support new perspectives [92]. Essentially, designerly framing (and reframing) is well established in the design literature, pointed out as a tacit design skill among expert designers (e.g., [16, 17, 26]) but has not yet been explicitly articulated in HRI. This article contributes a detailed analysis of how aesthetic and social qualities affect rejection and abandonment, while also proposing how designerly framing can be conducted to understand design opportunities for an eating aid. This is a novel approach in HRI and in research about eating aids, and adds to previous work on healthcare robotics in HRI. Reframing has previously been mentioned in the context of aging people and HRI, addressing a deficit model of aging as a problematic dominant framework in HRI research [56]. Through interviews with aging people and researchers they articulate how stereotyped perspectives of aging lead to ageism and unsuccessful robotic designs, instead of supporting aging people to be in control over their lives. They suggest how applying social models of aging and reflexivity in the design process could support researchers to understand biases and assumptions of aging people. Our work extends their work by supporting researchers to address bias and assumptions of assisted meals, through the lens of designerly framing.

In this article, we focus on *understanding meals as social, cultural, aesthetic bodily sensations*—seen through the lens of assisted feeding, where robotics are considered a promising area. As an analytical tool we have used the theoretical perspective given by Paulsson and Paulsson, which considers that all things are made to be used but that there are different types of use and that “to assess things we have to see them in the situations in which they are used.” [76] (p. 13). This leads to new starting points of a design situation; a “designerly framing”, supporting more experience oriented perspectives—also for practical tasks. The empirical material focuses on the experiences of having meal assistance and of using an eating aid that has a robotic arm that picks up food (see Figure 1(d)).



Fig. 1. a.b.c.d. (a) A designer discussing and sketching solutions at the workshop. (b) A sketch, and pictures of meals on the table to create associations. (c) A workshop participant and assistant testing the idea to tilt a cup with the lips. (d) An interview participant using a robotic eating aid at a meal.

## 2 BACKGROUND

In this section, we provide a background for why aesthetic, embodied, and social aspects of HRI are important to factor into the design space for assistive feeding technology. Even if a robotic device is essentially designed as an assistive tool to carry out the practical function of moving food from the plate, we will show how the meal as a use situation goes far beyond the merely practical, and the implications of this.

People’s needs and desires in meals are not a trivial thing to understand and design for. Meals are situated in diverse cultures, occasions and needs, going far beyond the myth that they are essentially only about nutrition [32]. Research in anthropology has shown how meals are intertwined in essential social human needs, such as participation, rituals, and identity [68]. Overall, social rules and norms in our society affect how, when, and what we eat. Not knowing about etiquette and how to behave in a meal situation is a universal sign of outsider status [32]. In addition to our sustenance, food is something that people enjoy and gather around [65]. Even if many pleasures of meals go beyond the taste and texture of the food, different food appears to trigger different emotions in our bodies. Desmet [23] conducted a study on food emotions, where for example sensory attributes, experienced consequences and personal meanings are part of food emotions. Macht et al. [65], conducted research on happiness, showing that the overall meal experience is affected by both external (environmental and social) and internal conditions (motivational, cognitive, and behavioral) and how hedonic eating increases feelings of happiness in one’s body. Research on health has shown the importance of treating meals as important and exciting events in healthcare, and emphasized the need to understand and approach the meal beyond its nutritional value [46].

We will now discuss how theoretical perspectives of the meal have been approached as a design space in HRI and **Human-Food Interaction (HFI)** in HCI, and describe relevant design theory for social aesthetic bodily interaction.

### 2.1 Robotic Research on Meals

Robotic assistance for meals is understood to have a desirable and important role for several stakeholders in healthcare, such as care recipients and caregivers [12, 13, 83]. Some robotic solutions have been investigated especially to prepare meals [11] and others to support people to feed themselves [35, 91]. However, these efforts have not been oriented towards aesthetic and social qualities and a holistic perspective of the meal. Other research in HRI have investigated socially assistive robots, conducting both social and physical assistance, where feeding is a relevant task but not investigated in depth from the users perspective (see e.g., [28, 51, 95]). McColl [67] conducted a study of a social robot used in meals at a healthcare setting to prompt users through the steps of eating, and to monitor food consumption and provide social stimulation. The robot would track the food on the plate and comment on the eating, and the user would feed him or herself. Other

HRI research has used cooking scenarios to investigate how adaptability affects the experience of a social robot [97]. Such scenarios can also be relevant for people with disabilities in their arms or hands, as they typically need assistants or other people to cook and serve their food.

There are several products on the market that already support people with limited ability in their arms and hands to feed themselves independently. These are typically referred to as meal-assist robots, eating aids, or robotic feeders. Examples of such eating aids include Neater Eater, My Spoon, Meal Buddy, Mealtime Partner Dining System (for an overview see [27]). These products are steered by a joystick (My Spoon), touch-push (Meal buddy), or by the user’s own movements (Neater Eater). The study reported in this article concerns Bestic; a commercially available eating aid that has a robotic arm with an attached spoon [59]. Bestic can be used with a joystick, STAR touch interface to steer, or touch button (for foot or hand) to initiate two different pre-programmed spoon behaviors supporting a more controlled mode or a semi-autonomous mode. According to the producer, it is designed to be safe, to keep the user in control, and to be small, quiet, and portable [59]. A study of Bestic has previously been conducted with two people with intellectual disabilities and four assistants [19]. This study found that a human assistant was still needed to be present during use, that the spoon got stuck in the mouth, and that the feeding was too slow and resulted in spilling. The study describes how this may affect self-esteem and associate meal situations with discomfort, and also sheds. This study also sheds light on a problematic power relationship between assistants and users with cognitive disabilities. Another study of Bestic conducted by Nickelsen [71] concluded that assistive feeding robotics are insufficient as intended advanced health technologies and argue for more engagement with involved groups such as care providers and users. A more recent study of this eating aid took an **actor network theory (ANT)** perspective and sorted out users, care providers, technology developers and governmental perspectives [72]. The study concluded that the developer’s overall goal for the eating aid was “usability”, whereas the users’ goals were more oriented towards “self reliance, control and agency”.

## 2.2 Human-Food Interaction (HFI)

In HCI, one strand of research has explored the relationship between people and technology in meals [14, 47]. Such research can provide relevant implications for robotic solutions, as it can widen our perspective of what meals are about, and how design solutions provide opportunities or research challenges related to meals in general. Grimes and Harper have argued that much research in HFI tends to involve a corrective perspective [36]: trying to help people cook, find recipes, choose healthier foods, or learn about nutrition. They have outlined a number of other areas to pursue, such as pleasure, nostalgia, relaxation, creativity, gifting, and family connectedness. We consider this to open more experience-oriented perspectives on meals. For example, Bell and Kaye describe how family connectedness, social activity, bonding, and enjoyment are intimately connected with how we seek to portray ourselves in everyday situations in relation to food [6]. Research on social aspects of food, eating, and cooking, such as how to support people in sharing recipes, is also related to social connectedness [94, 96]. Other investigations have focused on providing social awareness for people eating in different locations, such as CU-Later, which supports people eating in different time zones [98] and CoDine, which provides a video link and a multimodal sensory transfer to remotely create messages regarding food for people who are eating in different locations [104]. Because HCI as a research field often concerns communication technology, we find that HFI research issues related to meals tend to concern communication opportunities. Still, the HFI research field can provide useful perspectives on the meal for HRI, such as the importance of designing for meals beyond nutrition and corrective perspectives. We find that feeding experiences are more closely related to HRI, as feeding solutions concern physically

moving food for a person, more or less autonomously, where social capabilities or social perspectives on the assistive solution is relevant to reflect on.

### 2.3 Framing (and Reframing) Design

In professional design practice, a core and tacit design skill is to undertake activities that support framing (and reframing) a design situation. Essentially, framing is about the process of addressing the right problem and making sure that the overall question framing the design process is sound, in order to avoid developing unsuccessful solutions. In general, an initial framing of a design challenge is never fully correct but should be changed [16, 52]. In HRI, just as in any design oriented research field, there is a risk that previous types of robotic solutions or stereotyped views of people and their needs, are hindering a holistic understanding of needs related to existing and future solutions. Design fixation is a cognitive fixation, a mental blocking, where previous experiences and existing designs minimize the design space and hinder creative solutions [16, 48]. Crilly [16] argues how designers need to be aware of design fixations, and we believe that this is also the case for HRI research. Previous experiences and knowledge of existing HRI solutions for meal assistance will affect robot researchers' ability to come up with alternative perspectives of the meal as a design space.

The process of framing concerns getting insights about the design space, both what the problem is about and what possible solutions could be [26]. In this process, framing (and reframing) is about changing the initial assumptions about the problem and possible solutions in order to open up the design space. Kolko describes how "reframing is the act of purposefully shifting the normative frame" (p.5) [52]. Framing (and reframing) has been understood as a key characteristic of design thinking [17, 54, 75, 84]. Based on interviews with designers about framing design briefs with clients, Paton and Dorst describe how framing (and reframing) is related to the reflection-in-action [84] paradigm of design, rather than the paradigm of understanding design as a rational problem solving activity (i.e., [90]). They describe how projects that designers consider to be innovative, were essentially reframed in the design process. They also criticize Schön's [84] initial perspective of framing, and how he presented framing only as conducting alternative reasoning of possible actions in architecture, while neglecting how frames and framing are situated, practice-based and value-laden. Our work builds on the situated perspective, opening up for reframing situated values (such as usability) that are strong in HRI to foreground other perspectives relevant for design aesthetic and social qualities. Successful reframing can be understood as the opposite of design fixation. Framing can be supported by specific design activities, for example, creating several alternative sketches of possible solutions can support avoiding design fixation [48]. However, without a process that has zoomed out from the normative understanding of the initial problem (or existing solutions) in HRI, it will still be difficult to take a successful alternative understanding of the design space and the innovation space is reduced. Dorst [25] describes a specific type of abductive thinking that designers do and how this relates to framing. His perspective is that a frame is related to a specific perception of the design problem, building on a key thesis as an underlying principle: "IF we look at the problem situation from this viewpoint, and adopt the working principle associated with that position, THEN we will create the value we are striving for." [25] (p.525). This has also been described as designers' ability to create generators [54] and generative metaphors for the situation at hand, enabling a shift of concerns from margin to center [102]. This model of thinking suggests how designerly framing applied in HRI can challenge normative assumptions of robotic solutions, opening up the design space from an alternative angle starting from values. Starting from aesthetics and social values in assisted meals then means to both create the working principle and the design objects (e.g., robotic service or other solutions) to fit within the values found in the user research and other forms of data gathering. It also means that the

solution that matches the new framing may be a different type of robotic support, or not be a robot, even for something initially understood as a robotic problem.

Specific design methods can direct the focus in a design process. For example, in a Soma design process, methods such as bodymaps direct the focus on the researcher’s own bodily experience [44, 93] as a first person perspective. This can be difficult in situations with assisted feeding, since a disabled body is not the norm and simulation methods may lead to wrong conclusions. There is also the theory of embodied interaction, oriented towards understanding the contextual and situated nature of interaction, yet this theory in fact leaves out the bodily experience per se [93]. In user-centred design there is a risk that people are understood primarily as “users”, and that the process leads to an articulation of solutions developed with a preferred pattern of use and a limited perspective of users rather than opening for alternative interpretations and ambiguity [78]. The designerly framing in this article is not about applying a specific design method or theory to design an AT, but on the design skills needed to create the necessary materials and tools to result in an understanding of the situation at hand; here of assisted meals, and the essence of meals as a social aesthetic bodily experience. Here, the meal becomes the focal point. This is fundamentally different from aiming to understand the experience of a robotic eating aid from users’ perspectives, making the device the central focal point.

#### 2.4 Social, Aesthetic, and Practical Use

The designerly approach applied in this article focuses on how to understand experience in a holistic fashion, rather than from a usability perspective of a specific device. This is related to human-centered design processes, as well as theories of acceptance of both robotic products and AT. When investigating acceptance, the field of HRI has a tradition of lab experiments and quantitative approaches, where models such as **Technology Acceptance Model (TAM)** and UTAUT are relevant [5, 39, 105]. However, TAM has been criticized as lacking social variables and focusing overly on ease of use, which can be problematic in holistically understanding experiences in a domestic setting [105]. Although UTAUT brings forward several relevant considerations related to experience, such as performance expectancy, effort expectancy, social influence, and facilitating conditions and attitude, it has been critiqued to lack explanatory power [39]. Other relevant research conducted by Broadbent et al. on experiences with robots has focused on one of these considerations, such as how expectations may affect experiences with robots [12]. In turn, our approach is qualitative, design-oriented, and phenomenologically-based, as we try to understand a social phenomenon and an activity from the viewpoint of the person being interviewed. This is related to an experience-centered perspective and pragmatism, to understand meaning-making and bodily rich experiences [38, 43, 92]. Our work is also related to use qualities and experiential qualities, describing experiences of use [1, 3, 30, 61, 73] which are widely adopted concepts to articulate aspects of experience in design oriented research. Qualities have been understood as a design language that explains some aspects of experiences when interacting with artifacts. For example, Arvola analyzed practical, social, aesthetic, structural, and ethical dimensions as quality dimensions that designers were working with when developing a web portal [3] and Löwgren explored different types aesthetic qualities as theoretical concepts (e.g., pliability, rhythm, and fluency) for HCI [61]. A framework on qualities developed by Forlizzi and Ford has distinguished between context, users, and products [30]. Another related framework for the meal, created by Desmet and Schifferstein, categorizes aesthetic experience into different levels such as aesthetics, meaning, and emotions [22], but do not focus on social experience.

In 1956, Greger Paulsson and Nils Paulsson developed a design philosophy in the book “The artifacts’ use and imprints” (“Tingens bruk och prägel”, in Swedish) [76]. One of the authors, Nils Bernhard Greger Paulsson, was an art historian with a strong functionalist ideology, who had a

devoted mindset that any form of art is bound to specific sociological and psychological factors. One of his primary concerns was to make art and craft more accessible for the general society (not only for a privileged group of people) and connect artists and industry. In the book, Paulsson and Paulsson [76] reflect on three overall categories of use: social, aesthetic, and practical, to clarify experienced qualities of artifacts and the relation between these as a starting point for design. They argue that all things are made to be used but that there are different *types* of use [76] (p. 13). Overall, their design philosophy clarifies that “to assess things we have to see them in the situations in which they are used,” such as the following:

- Social use: To be with the things.
- Aesthetic use: To perceive the things.
- Practical use: To handle the things

According to Paulsson and Paulsson [76], social use is about *being* with things, and concerns status, acceptance, and our relationship to others. This is not only connected to our body; what we signal, what we do and wear but also what we use. Things we use send signals, which affect our relation to others. We take the stance that social use of things can be understood to concern extrinsic desires. According to Krippendorf [53], extrinsic desires are related to acceptance, family, honor, idealism, independence, social contact, and social status. Csikszentmihalyi [18] describes how things we use can represent our religions, interests, and relationships. Social qualities relate how individuals develop both a concept of self and identity through social interaction with others as expressed in symbolic interaction by Blumer [9], which is also the case for AT, as described by Shinohara et al. [88]. Shinohara and Wobbrock [86, 87] show how social factors affect how disabled people use AT, and how technology presentation, use, and others’ perception influence people’s perception of self-confidence and self-consciousness. Hinohara and Wobbrock [87], even defined social accessibility of AT, arguing how social norms and social interactions affect self-concept and identity, and how context frames social order. Meals have been described as a performance, and as a staged act [74].

Paulsson and Paulsson referred to aesthetic use as something that is observed and appreciated in an object. The Greek word aesthetic is related to “perceive” and “sensitivity” and how something “appeals to the senses”. To Paulsson and Paulsson, aesthetic use occurs when our feelings overrule our perception of the object and contemplation occurs. This suggests that aesthetic use is more related to intrinsic (internal) rather than external motivations. Shusterman writes of how we can increase enjoyment and get a more rich experience if we attend to how we eat food, its texture, taste, fragrance, the movement from the plate to our mouth, how we swallow, and finally the overall sensation when the food enters our body [89]. Dewey, taking a related pragmatic perspective, describes aesthetic journeying as being undertaken for “the delight of moving about and seeing what we see” [24]. This is compared to non-aesthetic journeying, which concerns reaching the destination in the most efficient way, not reaching a significant experience. Aesthetic qualities have been stated to describe engaging and seductive means in interaction [61]. We take the perspective that aesthetic qualities are related to our senses, our perception, and experience of pleasure—as well as feelings of displeasure, discomfort, or disgust related to things. Moreover, we find that psycho-pleasures, such as discovery, knowledge, and cognitive actions that can satisfy the intellect [49], are also related to aesthetic qualities.

Practical use concerns how things are physically handled in an activity, such as hitting with a hammer or making coffee, according to Paulsson and Paulsson [76]. Practical use is associated and understood through practical qualities, such as efficiency, time, and durability representing practical qualities—measurable by testing. Practical perspectives have also been discussed by the philosophers Verbeek and Borgman [101]. Verbeek describes how Borgman takes a practical

Table 1. Overview of Participants and Data Collection

Participant	Age	Sessions	Weeks of Bestic use
Carl	40	2	3
Eric	10	2	60
Oscar	20	2	3
Heidi	70	1	20
Elin	60	1	-

perspective of the meal when describing how microwave ovens simplify and reduce food-preparation time, and how such technologies change human eating and cooking habits.

The perspectives of social, aesthetic and practical use are still prominent in industrial and product design. Crilly [15] articulates how designers differentiate between social, practical, and aesthetic functions, and how “people use artifacts, while artifacts perform functions” (p. 2). This suggests that some functions may be better performed than others, but the research does not present empirical material that clarifies how this may affect users and their experience.

### 3 EMPIRICAL MATERIAL AND ANALYSIS

The empirical material for our project consists of home interviews and an experience workshop with a user, a personal assistant and a designer. While it would be possible to primarily focus on the usability aspects of the eating aid, this research was deliberately oriented towards understanding assisted meal experiences from another starting point or designerly framing, namely: *the meal as a cultural, aesthetic, and bodily sensation*. What are essential needs in different types of meals?

#### 3.1 Participants

For an overview of participants and sessions see Table 1. All of the participants had long experience of human assistance at meals, due to impairments in their arms or hands. None had cognitive disabilities or problems with swallowing. The interviewees were suggested by the company producing the eating aid Bestic. The experience workshop included one participant, the participant’s personal assistant, an expert designer and a researcher. This participant had not used any eating aid before. All participants had given their informed consent to take part in the study. The national ethical authority was informed about the data collection. Pictures of people have been made anonymous, and approved by them for use. Below we will discuss the background of each participant in more detail.

- **Carl** was interviewed twice. He had not used the eating aid before the study. The first interview was held at the introduction of the eating aid and the second after the three weeks. Carl is about 40 years old, and lives with his wife and child. His wife also has disabilities and cannot assist Carl with feeding. Carl was born with **cerebral palsy (CP)** causing spasticity movements. Assistants are present day and night. Carl is usually fed by an assistant but can drink on his own using a straw. At the introduction, the researcher and the technician brought their own food and shared a meal before the interview. Carl stopped using the eating aid after three weeks, mostly due to the unpleasant experience that the spoon was not flexible for spastic movement and would occasionally get stuck in his mouth.
- **Eric** was interviewed twice. On our first visit, he had already been using the eating aid for more than a year, and on our second interview about a month later, he still used it. He is about 10 years old and lives with his mother, father, and sibling. He was born with a muscle weakness in his arms but has no other disabilities. He can eat directly with his lips from the plate, but he has been told to avoid this in order to reduce the strain on his neck. He steered

the eating aid without any problem; only soup was considered impossible for him, due to spilling. When visiting restaurants or on vacation, his mother would feed him. During both interviews, his mother and sibling were present. Several times his mother would answer for Erik or question his answer, which possibly steered his answers. The study consent was signed by Erik's mother, but Erik was positive about participating in the interviews.

- **Oscar** was interviewed twice. The first interview was held at the introduction of the eating aid and the second after three weeks. Oscar is 20 years old and is living with his parents and siblings. He has CP, difficulties with feeding himself, and uses an electric wheelchair. His mother usually feeds him, and meals are an important gathering in his family. During the interviews, Oscar's mother interpreted what he said, and thus potentially also added her own perspective in the interpretation. Oscar stopped using the aid because it took him too long to feed himself. He found it more comfortable to be fed by a family member.
- **Heidi** was interviewed once. She had used two versions of the eating aid; the first for a month and the second for about four months. Heidi is about 70 years old and has an autoimmune disease. She has some function in her hands and uses an electric wheelchair. She can bend down and eat with her lips from the plate. She had had Bestic in her home for almost one year, until she got too annoyed with it when it spilled.
- **Elin** participated in the two hour long experience workshop, as she had a different situation than the other home interview participants. Whereas the other participants had already used the eating aid over a longer period, or had expressed a desire to use it, Elin had not used the eating aid and was not interested in using it. Elin is in her sixties and has had **multiple sclerosis (MS)** for about 20 years. At the workshop, Anna assisted her with food and drinks. Elin knew that the eating aid Bestic existed but was not interested in using it and had never tried it.

### 3.2 Home Interviews

All home interview sessions were focused on the robotic eating aid Bestic. The company producing the eating aid did not commission the research but provided contact with the interviewees. The company had several initial questions that they were interested in, and a product technician participated in several activities to learn more about the user's experience. This included the initial set-up and preparations of the interview study. Overall, the final interviews included an introduction followed by questions about its usability, the users experience with it and some social questions, which will be further explained below.

**3.2.1 The Robotic Eating Aid.** The product Bestic has a robotic arm with an attached spoon and can pick up food from the plate either semi-autonomously or controlled [59]. In the semi-autonomous mode, the user presses a button and the robot will make the decision on where to pick up food from the plate. In the controlled mode, the user can steer the arm with an operating device and decide from which area of the plate the food should be collected. The height and proximity of the spoon is adjustable to fit different users. For safety reasons, the spoon stops in front of the mouth, and the user needs to actively lean forward and take a bite. Several different operating devices can be used, depending on the user's mobility.

**3.2.2 Preparations.** The interview questions were developed in collaboration with the technician and an **occupational therapist (OT)**. The preparations also included a meeting with the inventor of the eating aid—who had permanent paralysis of the arms and hands after having had Polio as a child. The technician, who was technically responsible for the product, participated in the meeting and supported the arrangement of meeting with the founder of the company and with the OT.

The interviews were conducted in a semi-structured approach, following a qualitative research tradition where themes rather than exact questions steer the interviews. The interviewer (a researcher) was accompanied by a technician from the Bestic company. Whenever possible, the researcher and technician would bring their own food and also have a meal with the interviewee and some family member or assistant present. All interviews were recorded and transcribed.

Initially, the eating aid company had specific questions that they hoped the interviews would answer: What is it that makes the product valuable to use, i.e., not only possible to use, but adds value? What are the positive effects, and how strongly do participants value that feeling or its practical use? What are the negative effects and how strongly are these felt? What external circumstances, such as being at home, at a restaurant, alone, with friends, tired, alert, and so on affect the assessment of Bestic? These overall questions were taken into consideration when planning the final interview questions.

The interview questions were also developed together with an OT. The OT contributed with several important perspectives. For example, she stressed how people have to deal with limited physical energy in their body, affected by disabilities or age. This leads to having to budget their use of physical and mental energy throughout the day. Using AT may cost extra energy and reduce the ability to do other activities in life, which needs to be considered in the assessment.

**3.2.3 Final Interview Questions.** The final questions were organized into four different categories or themes—introduction, functional, experience, and social questions.

The *introduction questions* were about which meals the participants liked and disliked and why, and consisted of questions such as: What do you like the most—breakfast, lunch, or dinner? When does food taste the best; in which situation? What do you like to eat? What do you not like to eat? What do you prefer to spend your energy on in everyday life? What do you not like to spend your energy on? Why do you want to try Bestic and what are your expectations of this?

The *functional questions* concerned usability issues, such as: Can you steer what you want the spoon to pick up? Is it worth the trouble to be able to feed yourself? What do the family or assistants think of Bestic? Does it take a long time (to feed yourself) or is the time taken ok? Has Bestic caused any trouble or worked very well in some situations? Can you give examples? Is it easy or hard to learn how to use? Do you spill food when you use Bestic? Is it easy to clean? Have you tried different types of settings? What do you dream to be able to do that Bestic cannot do today?

The *experience questions* were oriented towards its role and the users’ feelings about the device: How would you describe Bestic: is it a companion, a tool, a robot or something else? Is it educational to use Bestic? In what way? Is it fun to use Bestic? Are some foods more fun to eat, or any situation where it is fun to use Bestic? Have you been frustrated or angry when using it? When and why? Does it use a lot of your energy to use Bestic? Are there other things that you have to neglect to have the energy to feed yourself independently?

The *social questions* concerned the participants’ experience of social relations and different social settings, when using Bestic. These included: What have friends said and commented about Bestic? Have you used it in different places? Why, why not? How did you solve the transportation of Bestic (e.g., in a wheelchair or assistant carrying it and setting it up). How is being fed by Bestic different to being fed by someone else? Is there something missing when using Bestic, or does Bestic add anything? Can you imagine using Bestic at a restaurant? Why or why not? Would you sometimes prefer to get fed rather than use Bestic? When and why?

### 3.3 Experience Workshop

In the home interviews, the use of the eating aid was clearly in focus. A professional designer at an independent design consultancy firm (not working with the Bestic company), raised the idea of

arranging a workshop to open up a holistic discussion of meal experiences and assisted meals. At this point in the process, the Bestic company was not involved in the set up of the research but still accepted the proposed designerly set up. This setup was done to avoid the eating aid dominating and coloring the overall discussion of meal experiences, which had become apparent in the interviews. Moreover, the workshop would then complement and extend the previous data collection. The attendees (see Figure 1 images (a), (b), (c)) were Elin, her assistant Anna, a professional product designer, and a researcher. Elin had experience of personal assistants for a few years but not of using Bestic. The lack of experience of a robotic eating aid was considered as an opportunity to get a greater understanding of the essential qualities of meals and assisted meals, and a possibility to avoid design fixation. It would have been possible to have one or two participants more with their assistants present at the workshop. Essentially, the limited number was due to challenges in recruiting people with disabilities. However, the set up was considered to be enough as the goal was to contrast and diversify the more device-oriented interviews from a qualitative perspective.

*3.3.1 Workshop Preparations.* To prepare for the workshop, a function analysis of the meal was conducted by the researcher. This approach was supported by a senior industrial design professional from the design consultancy firm, as a tool to go beyond only discussing practical issues of an eating aid, and instead open up the meal as a design space. Function analysis is a well-known design tool among industrial designers to specify requirements for a design solution [70]. Expert designers use function analysis to understand needs and which primary, secondary, and supportive functions could support those needs. A “practical” function analysis of an eating aid could include verbs such as “allow steering”, “allow stopping”, “be serviceable”, and the aesthetic function “feel smooth”. However, this function analysis focused on understanding needs related to the overall meal, not only the needs of a specific product. During the function analysis about 70 pictures were printed, showing different meal situations such as a picnic, a party, people using eating aids, a person wearing assistant protection, a wedding meal, soft drinks, and nutrition solution drinks. These were sorted on a wall under the categories of social, aesthetic or practical use situations, where the other types of use were considered as subcategories. This activity supported taking social, aesthetic, and practical perspectives of meal situations. For example, the primary social use of having a picnic with friends in nature, and of meals at weddings, and the primary aesthetic use of eating an ice cream alone in front of the television and the primary practical use of receiving nutrition intravenously at the hospital (where no visual experience, smell, taste or chewing or social meal situation etc is involved). The pictures were sorted on a wall under the overarching categories of social, aesthetic, or practical use.

*3.3.2 Workshop Set Up.* The set up aimed at supporting a discussion of different types of meal experiences and design solutions. First of all, images of meals and meal-related activities and products were put on the table to create associations with a wide range of meal situations. This included everything from chocolate fountains, picnics, dinner for two, people using assistive devices, festive meals, people eating outdoors and more. Bestic would not be physically present at the experience workshop, but one of the images showed Bestic in use by a person. With this set up the eating aid would be assigned a decreased role in the discussion, opening up for alternative perspectives and experiences of assisted and other types of meals. This would support more open reflection on the current challenges and design opportunities related to assisted feeding beyond a specific eating aid. Second, different types of nice tableware, such as Chinese bowls, and other products such as a round plate for mixing colors, tape, and papers would be set on the table. Third, different types and tastes of food and drinks, such as sushi and dumplings, Miso soup, Italian cheese, olives, fruits, and soft drinks were placed on the table. Finally, the set up included a professional designer to support the discussion with sketches of proposed ideas and follow up questions.

Table 2. Social and Aesthetic Qualities Related to Problematic Assisted Feeding Situations

Use situation	Social bodily qualities	Aesthetic bodily qualities
Causing spilling	Embarrassment	Discomfort
Lack of spoon flexibility	Awkwardness	Mouth discomfort
Slow feeding	Stress to be among others	Hunger, less taste
Can only feed mixed food	Undesirable special treatment	Missing textures and taste
Fixed rather than mobile	Avoidance of social environments	Reduced life quality
Dirty (difficult to clean)	Awkwardness	Bad taste, disgust
Wrong color, material or form	Identity clash, embarrassment	Reluctance
Undesired human assisted feeding	Forced social situation, privacy issues	Physical discomfort
Lack of proper feeding	Avoidance of social situations	Fatigue, irritation
Verbal command to assistant	Disrupted conversations	Fatigue in attention

When Elin and her assistant arrived for the workshop, a table had been set with food, nice tableware, a large variety of pictures of meals and other materials as described above to support the discussion. The researcher explained that the workshop intended to discuss meal experiences from different perspectives, such as meals as nutrition, meals as pleasure, and meals as social meetings. The researcher encouraged Elin to describe her own meal culture, what she found important during meals, challenges she had faced, solutions she had found, and solutions that she considered to be missing. The designer supported the discussion by clarifying Elin’s ideas with sketches.

### 3.4 Analysis

For an overview of the empirical material collection, see Table 1. The empirical material consisted of seven audio-recorded and transcribed interviews made in the participants’ homes, and one recorded and transcribed session from the experience workshop. The transcribed material from interviews and the workshop was treated in the same way. They were sorted into three different categories concerning primarily social qualities, aesthetic qualities or practical qualities. In the process it was found how practical functions gave rise to certain bodily experiences which could be primarily aesthetic or social depending on the situation. Thus, the theoretical framework of social, aesthetic and practical use [76] guided the analysis.

## 4 EXPERIENCES OF ASSISTIVE MEAL SITUATIONS

The results are a combination of interviews and the experience workshop, describing social and bodily aesthetic bodily qualities that are related to different types of situations. The framework exemplifies how such experienced qualities relate to the provided practical functions of an eating aid or an assistant. See also Table 2 for an overview of these.

### 4.1 Social Bodily Qualities

Social use becomes prominent when other people are present. Being social means to be aware of other people and oneself. When a person expresses what affects their presence among other people, these are prominent for social use of artifacts, objects, or devices. Stigma occurs when people feel that they might not be accepted, for example due to their appearance [34].

Eric expressed that being fed by someone else “is not so much fun”. He could handle the eating aid well but would also regularly eat directly from the plate with his lips (even if this strained his neck). He would use the robotic solution at home (with the family) but did not want to use it at a restaurant. He considered that being fed by his mother at a restaurant would attract less attention.

Heidi said that she would never use the eating aid in a restaurant. She felt like she looked like a baby after a meal with the eating aid: “It drops food so I feel like a two-year-old with food everywhere.. when I eat soup I need towels on the table and on myself”. When Bestic spilled, this not only led to discomfort for Oscar, but also for the other family members, according to his mother. If there was too much spilling Oscar’s brother would get nausea and also his mother would feel uncomfortable.

At the workshop, Elin reacted to a picture of a person using an assistant protection, which protects the person if the assistant spills. Elin did not use any assistant protection at the lunch workshop. She stressed that those things were not designed for attending social events and exemplified this by mentioning how this was out of the question at social events, such as parties.

Some meals are festive social events, where people want to show that they know the rules and rituals and fit in. The artifacts we use can support or hinder festive feelings. Elin could drink on her own using straws. However, she considered that straws were problematic because, to her, they would not fit in at all types of social events. The designer sketched a suggestion for bigger straws made of glass or other materials intended to fit with a champagne or another festive glass, and also to feel different against the lips; possibly being something that people without disabilities would like to try.

Being social means to pay attention to other people—which can be problematic in a feeding situation. Elin expressed that a downside of having an assistant at a meal with other people was that she had to direct her attention between several people—to be fed by the assistant and to socialize with others. Erik said, “It is awkward too when I’m being fed, because then I need to tell when I want more”. Thus, this would lead to disrupted conversations and attention, as well as overall annoyance.

Meals are a place where we can share thoughts and reflections with our loved ones. Both Elin and Carl had partners who could not support them with feeding due to their own disabilities. Elin would love to share a meal with her partner alone but her assistant needed to stay to feed her: “Now there are a lot of things that we don’t talk about while eating. Some things are secret”. Carl described his first experience with the eating aid: “It is directly more pleasant to feed yourself than to have an assistant”. His wife explained that “it’s much more private (with the eating aid); you can talk about whatever you want”. This suggests how privacy can be important in social meals. An example of desirable social qualities came up during the workshop with Elin. To Elin, eating crayfish had once been a special event at crayfish parties where people sit together and peel off the skins on the red crayfish, sing songs, and so on. To Elin, that was a shared and very social experience of smells, tastes, sounds, and visuals that enabled a rich meal experience.

#### 4.2 Aesthetic Bodily Qualities

Oscar said, “I think it is more pleasant to eat without Bestic” and that “it is more unnatural than when I get help”. He felt more calm when someone in the family would feed him. Similar to Carl, who also had CP, the spoon attached to Bestic was not flexible enough for the spasticity, and this gave rise to the feeling of being stuck. Moreover, Oscar preferred to eat with a fork, which was not possible with Bestic.

Straws, which were used by all participants, gave rise to a wide range of undesirable aesthetic qualities, several described by Elin. Elin did not like the thin plastic straws from the supermarket; those were difficult to take big sips with and she would get both annoyed and tired when she used them. Elin described how she finally found some useful straws in a store having things for children’s parties. They were thicker and in stronger plastic so she could take bigger sips. Still, she pointed out that the straws were not so nice to use. They were difficult to clean, resulting in a situation where “sometimes when I drink a nice drink there is a taste of old milk in one sip.

Awful!” Elin would sip coffee through a straw, but she did not find it as pleasurable as sipping directly from a cup as she used to before her illness. She found that the coffee was often too hot to sip. The designer sketched an alternative solution where a cup was placed in a high stand so it would be possible to tip the cup with the lips only. Elin and her assistant then used a small chinese bowl to physically test and imagine this type of solution.

Meals are part of traditions and culture, and certain dishes are associated with certain traditions or procedures where we eat food in a special way [68]. Elin very much enjoyed seafood. She now missed peeling and eating shrimps in front of the TV like she used to before she had the MS illness. Nowadays, she and her partner (who also needs assistance) had shrimps served ready on a sandwich in front of the TV. She described how this took away from the experience of eating shrimp, and how she did not really appreciate the meal of shrimp when served already peeled on a sandwich. To her, that could have been any other sandwich. Elin also longed to eat crab. Before she had MS, she enjoyed taking out the crab meat with a small fork. This illustrates how some aesthetic qualities that were part of her meal experiences before the illness (i.e., peeling the shrimps, feeling, and smelling them) was changed into a reduced meal experience even though the same food was served.

For someone with physical disabilities, physical strength and motivation may vary throughout the day. Elin’s strength would weaken during the day, but some mornings she could eat alone in bed, which for her was a moment of pleasure. This opened up the possibility of enjoying a meal without assistance, and avoiding the forced social situation that a human assistant can be.

### 4.3 Practical Functions

Several participants described how they tried to make it easier for the assistant or the eating aid to feed them successfully. Elin, for example, described how rice and minced meat are “good food to be fed”. She said that this was not because she especially liked the taste or the texture of rice or minced meat—but that it was easy food to feed for the assistant. The assistant could then take a little of everything for each bite. For a similar reason, Heidi would have an assistant mix her soups so they would function better with the eating aid and reduce spilling. This suggests how people adapt to the device but not necessarily matching their own food appreciation.

The eating aid required the user to either press one button to activate the spoon’s semi-autonomous movement, or several buttons to manually control the steering. Heidi expressed that “I would like to just look at the food and then it would come up to my mouth”. This suggests that the eating aid demanded physical and mental energy. It took Oscar about 40 minutes with the eating aid, instead of the 20 minutes it would take to finish a meal with an assistant. When Oscar could not get the food quickly enough, this would leave him hungry and eating cold food. This was also Oscar’s reason for not wanting to use the eating aid at a restaurant. “If I am really starving and have been out for several hours, I do not want to use it”. Moreover, he said that he would not use it at meals in school because lunch time was too short. This shows how limitations of practical functions can reduce enjoyable qualities of social and aesthetic use situations, reducing the overall pleasure of meals.

## 5 DISCUSSION

“Designerly framing” is about the process of addressing the right problem, making sure that the overall question framing the design process is sound in order to avoid unsuccessful solutions developing. Reflecting on situations where cultural, social, and aesthetic values in meals are primary contributes to understanding the stigma around and rejection of robotic devices. This extends previous research on abandonment in the field of HRI (see e.g., [12, 29]), becoming part of an emerging trend of design research in HRI that builds upon recent work on, for example, RtD [63] design epistemology [62], and designerly methods [41]. Designerly framing has previously been described in

related fields such as HCI and design (e.g., [17, 25, 26, 54]). Earlier work has pointed out the need to reframe researchers' understanding of aging in HRI, arguing that we need to address bias and assumptions around aging people [56]. Designerly framing has not previously been applied in the context of assisted meals in HRI. We thus extend existing research to show how designerly framing can support researchers to take a new perspective of assisted feeding in HRI, by foregrounding the aesthetics and social qualities of the meal. The goal is to explore the meal as a design space by more closely focusing on experiences and underlying values that may lead to the abandonment of robotic and other assistive devices.

Design fixation is a cognitive fixation on a specific type of solution, typically formed by previous experience and normative solutions, but that hinders novel perspectives being employed in the design (i.e., [16, 48]). In HRI, a possible design fixation could be that the solution should be a specific robotic device and not another type of solution. The first step in our process towards more "designerly framing" for assistive feeding was to hold interviews and assess an eating aid from several viewpoints, such as functional, experiential, and social perspectives. The home interviews investigated different types of social use situations for a specific robotic solution; using the device at home, in school or at a restaurant. Moreover, the interview questions were oriented towards the users' experiences of and feelings about both assisted feeding and use of the device. With the current set up of the interviews, the device was a central focus of the investigation and would thus color the interviewees' reflections on meals and assistance. When the eating aid was present and all questions focused on its use, the robotic device became the primary lens through which all meal situations were understood.

The second step towards "designerly framing" was therefore to zoom out from the design object (the eating aid) and take a new starting point. This step was done with a functional analysis of meals and a workshop focusing on assisted meal experiences, both suggested by industrial designers. Discussing experiences of various types of meals and assisted solutions with the end users opened up the possibilities to avoid design fixation and to get a more holistic understanding of important qualities in different use situations.

The "designerly framing" that is applied in this work is supported theoretically by functionalist ideas of use [76], and research on industrial design skills [15], to assess critical differences between aesthetic, social and practical use situations. This clarifies how social and aesthetic qualities are essential for people and are part of bodily experiences, which needs to be understood and applied in HRI. Overall, social, aesthetic, and practical qualities are always present in use, but one type of use can be more primary. In a situation where social use is considered primary by the user, a device that is useful but does not meet social requirements (e.g., an assistant protection) may be refused by users because they do not want to be associated with it. Applying "designerly framing" can thus be a design approach to actively engage in qualities of experience beyond usability of a device. This extends previous research describing possible frameworks of product experiences as storytelling [31], and of emotional and aesthetic product experience [22] and frameworks describing robot acceptance such as TAM [20] and UTAUT [40, 100]. A related perspective is introduced by Shinohara and Wobbrock [88], that stresses how "social accessibility" of assistant technology needs to be understood from holistic design stances, also strengthening the need for our work that provide insights into social as well as aesthetic aspects of assisted feeding.

## 5.1 Addressing Social Use

Specific rituals, and the feelings of connection to others and competence play a major role in meals [65]. A design solution with excellent practical functions (such as an assistant protection) may be useless at a meal that is primarily a social event. This exemplifies a situation where a solution is rejected, entirely based on its social qualities. Sometimes solutions need to have social

functions as the primary function, and the practical function is more secondary. An example of this is using a scarf as an assistant protection at a party, to create a successful association with adult clothing and fashion. This perspective is very much in line with how designing for social accessibility requires a holistic design stance, balancing users’ functional requirements with their socio-technical identity, as proposed by Shinohara [88], whose perspective is that something may be “socially usable” or not.

Because the appearance of AT and other products we use is intertwined with the user’s appearance and identity, we need a more holistic perspective in the design process. If a design creates embarrassment or stress and unwanted associations (see more examples in Table 2) it does not matter how useful it is, it may still not be used. Our findings indicate that several participants would not use the feeding robot at a restaurant as it attracted unwanted attention. This finding links to prior investigations of assistant technology use where people with disabilities abandoned the aid as they experienced it as not serving their function or too embarrassing to use [77]. Thus, even if the feeding robot would be perceived as a fairly good functioning tool to enhance independence, it is likely that people would still avoid using it. This suggests that social needs can prevail over both practical and aesthetic use.

Social use is not only about appearance but essentially concerns how well a design solution supports our relationships with people. Related research has shown how assisted feeding may be experienced as a situation that the person being fed cannot get away from [66] and that it involves a power relation with the risk of becoming power over, rather than power to someone [19]. Moreover, it can be a violation of privacy or integrity that a human assistant may cause when someone would like a social meal but not with his or her assistant. Robotic solutions are an opportunity to support independent meals in situations where human assistance is not desired. However, even if robotic solutions may enable more private meals and avoid forced social situations, there might be other privacy or independence challenges, such as if the solution is logging audio information or if it still requires a personal assistant to be present.

## 5.2 Addressing Aesthetic Use

Aesthetic qualities concern sensory input and perception, cognitive pleasure, and intrinsic motivation. Preferable people would get a rich experience of food, appreciating its texture, taste, fragrance, swallowing, and the overall sensation when the food enters the body [89]. Aesthetic qualities are difficult to measure, as they are subjective and highly individual preferences and experiences of sensory input and perception. It is however well known that the overall setting and environment strongly affect the meal experience and the possibility to get rich sensations from eating [46, 65].

Our preliminary results indicate the importance of considering different types of food in meals, and how they work with the proposed design solution. How different food, drinks and textures, sizes, forms and materials may feel different against the lips or to sip from, can be tested. For a robotic eating aid, not only the material and form but also how its movement is perceived, can be an important aesthetic quality.

## 5.3 Addressing Practical Functions

An extreme case of a meal where the practical function of being fed (nutrition) is central, is when receiving nutrition intravenously at a hospital. If we instead consider meals with AT, practical functions would rather concern measurable qualities of speed, efficiency, ease of cleaning, and the ability to handle different consistencies without spilling. We found that the participants in the study would sometimes try to simplify the situation for the human assistant or the eating aid by accepting mixed or minced food such as mince and rice that was easier to be fed. However, there is

a risk that such adaptations may decrease the overall pleasure of the meal, and thus affect aesthetic qualities. When some practical functions are missing or not functioning well, this typically also leads to undesirable social or aesthetic qualities.

It can be difficult to divide attention and to use verbal communication with a human assistant when having a shared meal. This suggests that using conversation as an interaction type may be problematic to assist in feeding. Even if voice commands can be practical in other situations, this appears to be a less desirable function in social meals.

#### 5.4 Applying “Designerly Framing” in HRI

Categorizing different use situations to primarily concern social, aesthetic, or practical use is an effort to investigate a pragmatic approach to address a more holistic perspective of design—beyond usability. Social use corresponds with Shinohara and Wobbrock’s definition of social accessibility, aiming to support assistant technology developers to be more aware of users’ visions of themselves [88]. However, whereas they only considered the social experience, we consider that either social or aesthetic bodily experiences can be primary at a given point. Whereas skilled professional designers can understand situations where social and aesthetic use is primary, this is less understood and applied in assisted robotics.

Below we extract implications for “designerly framing” in HRI design activities related to meals:

- **Creating or using design methods that reduce design fixation.** Co-designing activities and participatory design such as workshops of meals can be successfully conducted even when a robotic device is not present. In fact, the presence of a robot may result in it “stealing the show”, leading to merely a reactive response to the device and hindering users from reflecting on their own needs and experiences. For example, pictures of different types of meals (picnic, fast food, party, etc) and pictures of assistive meal solutions (robotic devices, products, assistants) can successfully trigger memories of meals and experienced qualities. Moreover, sketching several alternative and complementing solutions (beyond robots) for the meal can also support to open the design space and avoid design fixation.
- **Seeing through the eyes of others—preventing stigma and rejection.** Understanding needs in a variety of situations can decrease the risk that potential design solutions will be rejected. People with disabilities can successfully shed light on situations when social and aesthetic qualities are primary; something that people without disabilities may not be able to relate to, as such qualities may be taken for granted. We have exemplified how a robotic eating aid and other solutions (such as an assistant protection) can lead to undesirable aesthetic and social bodily qualities. User research with people can support reflection on situations where aesthetic and social qualities are primary and usability may be secondary.
- **Questioning the question and the initial idea—being norm-creative.** Data gathering and design activities can support questioning the initial assumptions of robotic support. User studies of existing meal experiences, rather than getting feedback on an existing prototype, can support re-formulating the initial question of needs. In this article, meals were understood from a holistic perspective beyond feeding oneself, even if the starting point was a robotic eating aid. This way, the solution that matches the new framing may be a different type of robotic support, or not even be a robot, even for something initially understood as a robotic problem. This opens up for norm-critical and norm-creative design perspectives in HRI, viewing the underlying design situation from a new angle.

#### 5.5 Methodological Considerations and Future Work

Designerly framing and reframing concerns to be reflective and avoid design fixation in HRI, also fixations on established user centered design methods. We have explored how a framework on

social, aesthetic and practical qualities could support reframing assisted meal experiences from a holistic perspective in HRI. Our approach extends other frameworks on qualities of experience related to the use of technology or products (e.g., [22, 31]). For a skilled designer, it is clear that qualities such as aesthetics and social qualities (or other underlying values) may override practical functions and guide the design to other types of solutions than initially considered. However, along with industrial designers’ work, this is not necessarily understood by clients who may fixate on the existing functionality and appearance of their current product. Similarly, we find that there is a risk that researchers intending to use a specific robotic platform, are fixated on a specific functionality or focus on usability in a situation where aesthetic or social needs are primary.

This research is socially engaged, embracing the diversity of bodies and experiences as matters of concern, thus contributing to the critical inquiry needed in HRI (e.g., pointed out by [8, 55, 60, 85]). The rich description of experiences and how they are connected to social, aesthetic and practical qualities of assisted meal experiences supports understanding users’ underlying values in meals and what may lead to rejection and abandonment. As previously described, this research extends and deepens existing research on the abandoning of AT (e.g., [77, 79]) and abandonment of assistive social robots [12, 29, 95]. The designerly framing of the meal clarifies how it can be problematic to study only one robotic device on a long term basis to understand abandonment to get implications for assisted feeding devices. This is contrary to some early work on abandonment (c.f [77]). As designerly framing becomes more understood in the field, similar approaches could be applied in other situations beyond the meal, supporting researchers to explore ways to open a design space rather than fixating early on a specific robotic platform. HRI researchers may have specific values and assumptions on robotic assistance which may not match existing needs and perspectives among users (e.g., [12, 29, 57]). Similarly to Lee et al. [57], we argue for engaging in diverse perspectives of users in order to prevent rejection and abandonment of robotic solutions, and our work contributes to a situated and detailed account of related experiences.

## 6 CONCLUSION

In this article, we have provided a new perspective of bodily experiences of assisted feeding. We have applied “designerly framing” in the context of meals and HRI. It is about the process of addressing the right problem and making sure that the overall question framing the design process is sound, in order to avoid unsuccessful solutions being developed and abandoned. The theoretical framework by Paulsson and Paulsson [76] has been used as a lens to make social and aesthetic qualities primary. The preliminary results presented findings from interviews as a first step towards “designerly framing”, with a functional analysis and an experience workshop as a second step. The second step opened up a more holistic perspective of the meal, triggering a greater variety of different associations and memories supported by the sketching of early ideas, without a design fixation on a specific robotic platform. This specific application of “designerly framing” has supported and extended knowledge on acceptance and abandonment of AT and assistive robotics, and articulated how such a framing is relevant for HRI in order to avoid design fixation when working with robotic solutions for assisted meals.

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