Foody Talk: Exploring Opportunities for Conversational Food Journaling

Lucas M. Silva
Computer Science
University of Iowa
Iowa City, Iowa, USA
lucas-silva@uiowa.edu

Xi Lu
Information Science & Computer Science
University at Buffalo, SUNY
Buffalo, New York, USA
xlu30@buffalo.edu

Emily X. Liang
Informatics Department
University of California Irvine
Irvine, California, USA
exliang@uci.edu

Daniel A. Epstein
Informatics
University of California Irvine
Irvine, California, USA
epstein@ics.uci.edu

Abstract

Digital food journaling can help support reflection and improvement of wellbeing relating to eating habits. However, it is often viewed as burdensome, and abandoned before gaining benefits. Advances in conversational user interfaces (CUIs) have the potential to support people journaling in a natural and interactive manner, but we lack understanding of how people would ideally prefer to use CUIs when journaling. We conducted 33 co-design sessions with 18 participants to ideate CUI interactions supportive of their health goals and in everyday situations. Our findings reveal that participants expect CUIs to be adaptive by learning goals and personal references, and support depth in detail and goal alignment while respecting situational constraints and intent. While participants expressed concern around navigating long-term data solely through conversations, they envisioned that CUIs could provide empathetic, non-judgmental feedback. We discuss opportunities for CUIs to support empathetic food journaling and accountability while following guardrails for delegated tasks.

CCS Concepts

• **Human-centered computing** → **Interaction techniques**; **User studies**; **User centered design**.

Keywords

Conversational User Interfaces, Personal Informatics, Food Tracking, Co-Design

1 Introduction

Digital food journaling can help people track their eating habits to support reflection and action to improve their wellbeing [29]. Such food tracking has been shown to support various health related goals, including better eating habits [4, 16, 24], weight loss or gain [29], collaborating with dietitians [52], diabetes management [18], and discovery and management of food intolerances or allergies [27, 34, 73]. People most often use technology to manually track what they eat, traditionally through database look-ups with food names for nutritional feedback or barcode scanning of packaged foods [74]. However, these methods are notoriously burdensome and barcode scanning may incentivize eating of packaged foods [17] instead of fresh foods like fruits and vegetables. While passive sensing for food tracking is still an ongoing research agenda, accuracy concerns and the burden of device wear still leave it as too impractical for everyday use [45, 59]. As a result, people often abandon digital food tracking shortly after starting and before reaping benefits [17].

Prior research in digital food logging has thus sought ways to facilitate effective journaling, most often focusing on improving the collection of data. Different strategies have included broadening data input modality options [68, 75], such as with photos [14, 16, 66] or voice memos [50, 57, 74] in addition to or as alternatives to the more nutrition-focused database search or barcode scanning. *Conversational User Interfaces* (CUIs) supporting journaling have been suggested as a potential way to lower barriers to burdensome tracking, such as describing foods consumed via voice interaction [55]. Describing one's food intake through conversations might offer flexibility and open-ended capture of one's eating events, which could be an easier and more natural way to journal when compared to other interactions [50, 51, 75].

Beyond simple voice memos, conversational journaling also has the potential to support logs more useful to one's goals and interactive, data-driven discussions about their eating habits. While prior work has begun to explore open-ended food descriptions in voice inputs through prototype deployments (e.g., [50, 55]), there is still a need for more formative work on how people would prefer to leverage CUIs to journal their foods in order to satisfy their personal goals and align with their lived circumstances. For example, prior work has suggested that conversational journaling could potentially go beyond simple description of foods in order to create logs

which are more closely relevant to one's goals [55]. In addition, conversation is a known technique to stimulate reflection [6], which could be mediated by CUIs regarding past eating behaviors. With advances in Large Language Models (LLM), CUIs evolving in multiple modalities (*e.g.*, voice assistants, chatbots), and the increased popularity of Artificial Intelligence (AI) support across devices and platforms (*e.g.*, phones, smartwatches, smart speakers, cars), people can now have pervasive access to conversational interaction across different contexts in their daily lives. Despite this potential for conversational food journaling, there is a need to understand how people wish to use dialogues for their self-tracking and self-reflection under different contexts, different foods and meals, and for different goals. Better understanding how people would ideally prefer to conduct such interactions given their needs, desires, and expectations can also help guide the design of CUIs in support of personal informatics beyond food journaling.

To investigate how CUIs might support people in conversational food journaling, we sought to answer the research questions:

- RQ1) How do people envision CUIs supporting *data collection* for food journaling?
- RQ2) How do people envision CUIs supporting *reflection* about eating behaviors?

To answer our RQs, we conducted 33 co-design sessions across 18 participants. During sessions we jointly constructed idealized conversational interactions for journal entries and reflecting on prior eating behaviors, varying the foods people journaled as well as the circumstances and environments for collection and reflection.

By thematically analyzing sessions and designed dialogues, we identify that participants envisioned CUIs as adaptive and personalized tools for food journaling, capable of understanding individual goals and terminology. For data collection, participants expect CUIs to offer opportunities for detailed logging through interactive dialogues and proactive CUIs towards goal adherence. For reflection, participants desire goal-oriented feedback and insights, delivered honestly but with empathy and without judgment, while acknowledging limitations in navigating long-term data through conversation alone. Our findings highlight the potential of conversational interfaces to enhance food journaling experiences in a flexible and natural manner. More specifically, we contribute:

- An understanding of how people envision CUIs to support journal entry building. Participants wished that CUIs could help them build logs relevant to their goals, learn personal terms and references around routines, and identify implied assumptions around foods often eaten together. While they expected CUIs to proactively help add detail and depth about eating experiences, they wished CUIs could pick up on tone and word choices to infer intention for shorter conversations.
- An understanding of how people envision CUIs supporting self-reflection on journaled food data. In addition to goal progression feedback, participants expected CUIs could provide reflective questions after journaling, support descriptive data queries, and help brainstorm about past foods triggering discomfort. They wished for CUIs to be supportive peers for empathetic accountability. While participants thought it would be impractical for CUIs to guide granular recollection on large amounts of journal entries, they suggested dialogues with summative comparisons and discussions about trends that would help reflect on lifestyle changes.
- A discussion on how CUIs can collaborate towards helping people reach their health goals. We discuss the need for CUIs to support communicating personal meanings, while following user-defined guardrails for delegated decisions to CUIs. We highlight balancing proactive support with user agency, and discuss how CUIs can provide empathetic accountability while avoiding typical pitfalls associated with peer influence in food journaling.

2 Background and Related Work

Our work builds on prior personal informatics research in digital food tracking and HCI studies with conversational agents. In this section we review prior work in digital food tracking, CUIs for health and wellbeing, and recent efforts that start to investigate CUIs for personal informatics practices.

2.1 Digital Food Tracking for Personal Informatics

Digital food journaling technology has become a popular practice in people's everyday lives, with about 42% of U.S. adults having tried an app for diet or nutrition tracking [33] and many of these apps reaching millions of downloads globally, collectively surpassing a billion users [19, 85]. Tracking food intake allows individuals to reflect on their eating behaviors and food choices, which is helpful for long-term behavioral change [20, 24, 25]. Reflection can occur during the tracking activity itself (*i.e.*, reflection-in-action [11, 72]), such as when someone immediately considers nutritional choices and portion sizes while logging a meal. Food journaling apps' visualizations and feedback can also help post-hoc reflection (*i.e.*, reflection-on-action [11, 72]) by highlighting diet over timelines, potentially enabling individuals to make adjustments to their eating habits [25]. Such apps often utilize many behavior change techniques to promote moving from reflection to action (*e.g.*, reminders, rewards, social features) and to motivate journaling since the effort required is a major barrier for persistent use [17, 46].

Food journaling systems can largely be classified into manual and automated methods, each with distinct advantages and drawbacks. While automatically detecting eating moments and classifying foods can potentially reduce the manual effort of journaling foods, these approaches remain impractical due to accuracy limitations [45, 59]. Further, full automation might diminish active user engagement and awareness of eating behaviors [12]. Manual food journaling, which is commonly supported by commercial apps like MyFitnessPal, Ate, and WeightWatchers, requires users to input records [12, 17]. Entry is typically supported by food database lookup [59] to record food names and nutritional values. However, these databases for manual journaling require effort to search for the most descriptive foods, and often are limited in the food cultures they contain [17]. Research and commercial systems have also supported other manual methods, such as barcode scanning [64, 74, 79], or open-ended descriptions and photos [4, 16, 49, 55, 57] as techniques to lower capture burden. Food description or photo modalities for manual journaling can help shift focus from collecting and reflecting calories and nutrients to a more holistic sense of

eating habits [14, 16, 24, 75] and celebratory moments [13, 16, 26]. These processes of manually entering foods help raise individuals' self-awareness about their eating behaviors but require significant effort to sustain as people need to remember to log every meal and input food details [17, 74].

While food journaling has the potential to promote better health, it can be surrounded by stigma and hidden prejudice. Studies indicate that many people view it as a sensitive activity, often associating it with body image concerns [23, 46]. Ethnic and home-cooked meals are often harder to journal with database lookup apps [17]. Studies show that people sometimes avoid journaling food in public or in situations where they may be judged for their eating habits [17, 75], which negatively impacts the data collection [47, 75]. Researchers have also expressed concerns about food journaling encouraging unhealthy or problematic behaviors, such as promoting disordered eating behaviors through setting low consumption goals, or promoting pro-eating disorders [10, 17, 23, 46]. Overall, this literature points out that self-tracking technology, particularly of metric-based goals like calorie counting, can make people feel judged for their food choices.

2.2 Conversational User Interfaces for Health and Wellbeing

Much work in HCI, CSCW, and Computer Science has sought to develop and investigate uses and user interactions for CUIs and AI in general. From Voice Assistants (VA), rule-based chatbots, and more recently LLMs like ChatGPT, research and commercial systems continue to explore use cases for CUIs and how to improve the design of conversational agents [48, 60]. However, the conversational nature of CUIs also introduce challenges, such as managing user expectations, handling breakdowns in understanding, addressing privacy and trust concerns, among others [3, 5, 30, 43, 60, 84].

Recently, CUIs have being investigated to promote health care across domains, focused on both individuals and populations at scale [31, 38, 42]. Recent systematic reviews in this space [42, 63] suggest that advances in conversational agents for health fall under various categories of support ranging from training, education, and assistance to prevention, diagnosis, and patient monitoring. Among areas, health screening, information seeking, and personal health care interventions are prominent focus of CUI applications, indicating its potential to support wellbeing [37, 38, 41, 54, 65].

Some work has evaluated the use of CUIs for health data collection, often comparing with traditional apps and paper or digital forms [21, 39, 48]. For example, Kocielnik et al., [39] identified that CUIs can be a more interactive health screening alternative than survey forms and have increased engagement. In another example, the deployment of CareJournal [71], a voice-based agent, demonstrated the potential for CUIs to support data collection and scaffold information disclosure between older adults and caregivers, stimulating and mediating communication towards better care-partner experiences. In fact, CUIs have the potential to support rich health data disclosure via stimulating prompts [82] and a familiar dialogue-driven nature [32]. However, open-ended conversations might produce rich but "noisy" data, being potentially difficult to parse later (*e.g.*, during medical appointments) [15].

Overall, CUIs show promise in various health applications as an engaging interaction modality that offers benefits around accessibility and open-ended data collection. Our study contributes to the space by exploring nuanced dialogue interactions to support people's personal health management via tracking and reflecting, particularly in the context of food.

2.3 Conversational Support for Personal Informatics

More closely related to our work, some studies have sought to leverage CUIs for collection of or reflection on personal data, e.g., personal informatics [44]. To support data collection with CUIs, studies have largely supported capture by enabling people to track open-ended descriptions of their activities. For example, Silva et al.'s ModEat system [55, 75] included the ability to journal open-ended food descriptions via simple voice-based dialogue with CUIs in smart-speakers, but included no further prompting. FoodScrap [50] required spoken responses to scripted questions about eating moments such as why people made food choices and their food's preparation methods, demonstrating how question-answer iteration for food inputs can promote capture of data details. Users of both ModEat and FoodScrap found the entries created through these open-ended and iterative modes of input useful for later self-reflection. Systems have begun to explore logging via more conversational agents, such as MindfulDiary, an LLM-based chatbot that supported data collection and summarizing of mental health experiences [35]. This more interactive approach led to logs with greater topical diversity, encouraging logging of more varied and detailed aspects of their mental wellbeing.

For self-reflection, some research has examined opportunities for CUIs to retrospectively review logs and often alongside visualizations to help people make sense of data [36, 69]. For example, in designing and evaluating TandemTrack, Luo et al. [51] argue that combining voice interaction with graphical summaries for exercise data review can be enriching, supporting asking questions while looking at visuals. In deploying a mobile CUI that delivers daily mini-dialogues and graphs related to user's physical activity, Kocielnik et al. [40] found that the dialogues promoted reflection that resulted in increased motivation and new health behaviors. Similarly, Strömel et al., [77] identified that LLM-generated descriptions of step count data could foster more reflection than graphs alone. CUIs have the potential of going beyond helping people review their data, supporting introspection around habits and choices [83].

Towards this end, research has sought to support moving from reflection-on-action [11] to behavior change via CUIs that provide recommendations commensurate with one's personal informatics data. For example, in WorkFit, Ahire et al. [2] indicated that CUI-based interventions could help instill healthy behaviors in the workplace, like reducing sedentary behaviors, but risk being inopportune during some work situations. Closer to our work, Mitchell et al. [62] has investigated the use of CUIs as virtual nutritional coaches, identifying that they could function similarly as human coaches but with increased consistency in following protocols and "patience". In a following study [61] they compared AI-based chatbots with rule-based ones, finding that while AI chatbots promoted shorter

conversations, participants often rated scripted or rule-based chat-bots as having better question-asking strategies, highlighting a disconnect between speed of interaction and user preferences in health-related CUIs. Their results further highlight the need for formative approaches to understanding user's needs around conversational food journaling, which in part motivates our RQs.

Overall, prior studies indicated that CUIs can support some data collection, and discuss conversational mechanisms that could lead to entries that people value later. However, these examinations stop short of exploring ways people might wish to ideally interact to conversationally construct their logs. We contribute formative understanding of how people envision CUI interactions for their personal goals and everyday situations, adding nuance about user preferences and needs for food logging and reflection.

3 Methods

In order to understand how people envision using CUIs to support data collection and reflection in food journaling, we conducted two remote co-design sessions with each of eighteen participants using a digital whiteboard. Our study was approved by the university's Institutional Review Board (IRB).

3.1 Participants

We advertised our study through a screening survey sent to local mailing lists as well as subreddits related to food tracking or cities close to our university, a metropolitan area in the US. We sought to recruit participants with diverse food-related goals and experiences, including those seeking to manage their weight, chronic conditions related to diet, and those seeking a general awareness of health and eating habits. We also sought to recruit people at different life stages and with different levels of journaling experience. As a result, some participants have journaled previously on apps (e.g., MyFitnessPal, Ate), paper, or not at all. All participants had some interest in health goals related to their eating habits and were living in the U.S. They described having varied food cultures, including American, Japanese, East African, Italian, and Middle Eastern.

Participants were compensated $25 per co-design session (up to $50 total). We use P# to reference each participant (Table 1).

3.2 Study Procedures

Our study involved multiple phases of engagement with each participant that we detail below: an initial survey about prior experiences and motivations, pre-session photo-journaling "homework", and two co-design sessions.

Initial survey: In an initial survey, participants described cultural backgrounds which influence eating habits, if they had any previous journaling experience, food related goals, any related health complications, confidence with using conversational voice assistants, and basic demographic information.

Photo-journaling "homework": Prior to the first session, we asked participants to take pictures of their meals and snacks for one day and share the pictures with the research team via email. We incorporated these photos into the co-design sessions.

Co-design sessions: We conducted two co-design sessions with each participant via video conferencing and Miro [1], a digital

whiteboard tool that enables creative collaboration. Our co-design method was inspired by previous participatory research and more specifically by the work of Wirfs-Brock et al. [83] that used cards to co-design dialogues related to personal history of music listening. Supplementary materials contain a blank Miro board template we built to use during sessions. We kept sessions to a 1 hour limit, averaging 55 minutes per session. Participants P08, P09, and P14 were not available for a second co-design session. In total, we conducted 33 co-design sessions.

During the first co-design session, we first went over the participant's previous journaling experiences in detail and filled in sticky notes about their goals, prior journaling, if any, and general perspectives about tracking food. We then explained the co-design process and the cards we could use for mapping dialogues (Figure 1), explaining that they would be used to help create *"ideal"* conversations related to eating events.

To stimulate ideation about everyday life situations and participant's unique experiences, we guided design activities for seven scenarios and events (Figure 1-middle). For each scenario, we would first select an event card, followed by adding one of the food pictures the participants took which fit the scenario (*e.g.*, a snack if in the snack-eating scenario), before filling a context card based on the context from the selected picture (*e.g.*, what the participant was doing before, during, and after the meal). If participants had no pictures relevant for a given scenario (*e.g.*, takeout food), we asked about a recent corresponding meal and used a picture found online. After setting up the scenario and context, we role-played the same situation while imagining the availability of a CUI agent for food-related dialogue (*e.g.*, a smart-speaker or on the phone while in the kitchen, a smartwatch while at a park). We also included a scenario on logging unfamiliar foods to explore dialogues for journaling meals with uncertain compositions (Figure 1-right). To map dialogue, we explained the use of conversation cards and asked participants to iteratively use them to map dialogue of what a CUI could say and what they would say (Figure 1-left), reinforcing the flexible and "ideal" approach to the co-design activity.

The goal of the second co-design session was to explore conversations about previously logged foods. First, we started with a broad prompt to design conversations related to previous meals and data exploration. We then iteratively asked participants to be more specific around what they would discuss, if anything, about their eating habits such as involving insights, if involving comparison, about information CUIs could provide in response or proactively, timeline, data granularity, and if discussing about shared data with others (*e.g.*, multiple people tracking together).

We co-designed dialogues for different scenarios and events, initially, but participants often duplicated a scenario when ideating other nuanced condition (*e.g.*, home-cooked meal: during cooking, eating leftovers, or when preparing with a partner or child). It was also often the case where some scenarios were gone over more quickly (*e.g.,* for a scenario of journaling around other people P15 said *"I would journal the same way [as previous activity] if its just my family around"*). Participants could also go back and change the dialogue from a previous activity after having a new idea. Overall, we approached activities from an imaginative perspective and with flexibility of what participants wished to focus more or less on,

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[1]https://miro.com/app/
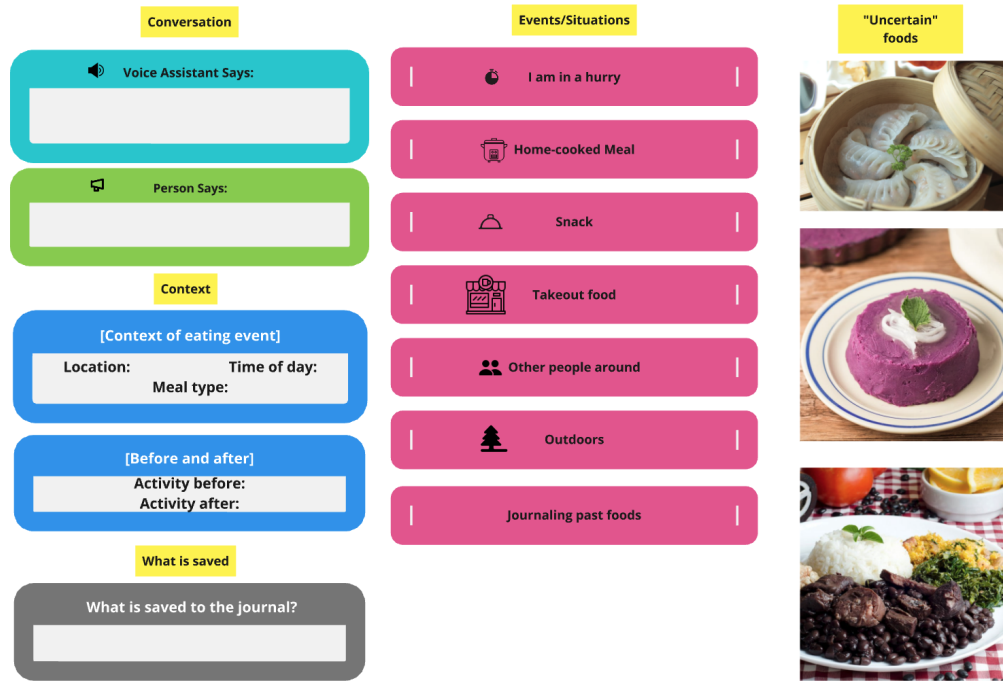
Figure 1: Co-design sessions made use of several types of cards. During sessions, we role-played conversations under different situations and events (middle cards), making use of pictures of foods participants had previously sent us. For each activity, we used contextual cards to highlight circumstances, and conversational cards to map explicitly what a CUI and a user would say. To explore conversations around unfamiliar foods, one co-design activity involved building dialogues around a food selected among the three food pictures on the right.

which led to multiple conversational paths for some scenarios and simple or no dialogue for other scenarios.

At the time of the sessions, voice assistants were the most popular medium for CUIs, *e.g.*, the sessions were done prior to the widespread attention placed on primarily text-based chatbots driven by LLMs like ChatGPT. We therefore situated participants in roleplaying and ideating everyday voice-based interactions with smartspeakers, phones, watches, etc., that could offer conversational interactions, but were clear in explaining that the co-design could be imaginative and go beyond any current technology limits. This helped participants consider the conversational aspect of journaling in addition to the modality (*e.g.*, P16 said "*[outdoor] if it's too loud, I would type it [dialogue] in*"). In the initial survey, 12 participants reported being very confident in using voice assistants, 4 said they were somewhat confident, and 2 were less confident.

3.3 Data Analysis

Our analysis of the co-design sessions drew inspiration from reflexive thematic analysis process [7, 8]. The first two authors first familiarized themselves with the data by reviewing the recordings of two participants and their design artifacts and open-coding transcripts. Researchers met to discuss the open coding and started an affinity diagram with excerpts. We then individually open-coded six more participant recordings and iterated over the affinity diagram, which resulted in an initial codebook. Researchers then met regularly to code the remaining co-design sessions and refine the

codebook. The final codebook had 9 higher-level codes and 34 subcodes. For example, a higher-level code "Conversational Reflection", had sub-codes like "Positive and empathetic feedback", "Suggest Actions", and "Short/quick insights". We used coded data and the codebook to inform themes of opportunities for conversational journaling and reflective dialogues. We also analyzed co-designed artifacts to identify conversational strategies related to our research questions and in support of the themes created via the affinity diagramming and codebook, using collages of designs to support findings. Themes were refined during the paper writing process and in regular research team meetings.

4 Findings

4.1 RQ1: Supporting Data Collection for Food Journaling

Our analysis of the co-design sessions identified that personalized and adaptive interactions are needed to support effective conversational food journaling. Participants generally had an assumption that current conversational assistants are *"trained on general data"* (P01), limiting appropriate and useful conversations relevant to food journaling and individuals' eating and reporting practices for data collection. To address this, we observed that participants expect that future CUI systems should 1) learn goals and build relevant journal entries; 2) learn and understand personal terms and assumptions related to their eating practices; 3) offer opportunity

Table 1: Participant demographics and details. We recruited participants at different life stages and with a mix of different food-related goals and prior experiences with journaling.

ID	Age, Gender, Occupation	Food complications	Experience with journaling	Food-related goals
P01	M, 21, Student	Lactose intolerant	On paper	"Mindfulness and nutrient tracking"
P02	M, 33, Engineer	Food intolerances and allergies	None	"Low sugar, calorie intake, and nutritional facts"
P03	F, 25, Student	None	Bullet journal	"Eat better and more vegetables and fruit"
P04	F, 25, Substance use counselor	IBS	Mobile app	"Eat less meat, eat more vegetables/fruit"
P05	NB, 19, Student	Lactose intolerant	On paper	"Count calories"
P06	F, 42, Professor	Gestational diabetes	Mobile app	"Losing weight and getting off diabetes medication"
P07	F, 60, Estate manager	Wheat intolerance	On paper	"My stomach started hurting, I wanted to figure out why"
P08	F, 44, Physician scientist	Exercise-induced anaphylaxis	None	"Be healthy"
P09	F, 40, Office manager	Anxiety disorder	Mobile app & Paper journal	"Meal planning and tracking nutrients"
P10	F, 28 eLearning specialist	None	Notes app	"Count calories, how much and when I eat"
P11	F, 30, Writer	Lactose intolerant	Notes app	"Eating healthier"
P12	M, 32, Analyst	None	None	"Eat healthier and eat sustainably"
P13	F, 32, Engineer	None	Calendar & Mobile app	"Make sure I have the right amount of fruit and vegetables"
P14	F, 70, Retired attorney	None	Mobile app & Paper journal	"Recall what I ate and learn about nutrition"
P15	F, 31, Administrator	None	Mobile app	"Weight loss and a balanced diet"
P16	F, 24, Student	None	None	"Weight loss: Caloric and nutritional value"
P17	F, 24, Lab manager	None	Mobile app & Paper journal	"Maintaining a healthy lifestyle"
P18	F, 24, Student	Lactose intolerant	Calendar & Notes app	"Make sure I am eating regularly and consistently"

for deep detailed reporting through interactive dialogue; and 4) adapt to time and situational constraints. By tailoring conversations to people's particular objectives, terminology, and routines, CUIs could facilitate more natural and supportive conversational food journaling data collection.

4.1.1 Learn Goals and Preferences for Creating Journal Entries. In order for conversational assistance to co-construct journal entries, participants envisioned the need for CUIs to understand their varied food journaling goals and what information from dialogues is relevant to be recorded to support later reflection (see Section 4.2.1). Participants with specific nutritional goals reported that a CUI should be aware of their targeted elements and values. P08 explained she wished to *"preconfigure requirements, like X percent of calories, protein, servings"* to enable progress monitoring aligned to her nutrient targets. P10 similarly wished a CUI would know her goals: *"ultimately I want to be able to ask information about my*

snacks and my meals, but also keep it together in terms of like, how many calories did I eat today."

In addition to the more traditional nutritional and quantitative goals, some participants also wished to inform qualitative goals related to their health and tied with eating practices. Several mentioned assistants should learn their goals related to frequency of eating events in order to inform conversations around fasting periods or monitoring of consistent eating. For example, P18 expressed wishing that CUIs be aware of one of her goals *"of not skipping meals"* and P04 said *"it should save the time of the meal, so if I am tracking intermittent fasting it is something we can talk about [later]"*. Participants with specific dietary restrictions or health conditions emphasized the importance of the CUI understanding their personal health challenges in order to save in entries about foods that could be a risk to them. For example, P04, who has IBS, wanted a

CUI to save and flag food items (*e.g.*, Figure 2a) that could trigger discomfort levels (*e.g.*, FODMAP foods [56]):

> P04: *"When you sign up you can kind of say, like, your background information about IBS and these are the foods that trigger my IBS... when I eat certain things, it can save that what you ate is a high FODMAP food."*

Overall, participants considered that awareness of their specific health goals is important for directing CUI's focus towards information relevant to user's health objectives and determining what parts of the dialogue can inform journal entries.

Record relevant data: Given an initial awareness of personal goals, participants desired CUIs to support monitoring the kinds of data which were relevant to their health objectives. Participants with quantified goals expected CUIs to automatically retrieve nutritional information from official sources. P09 felt comfortable having the CUI automatically record details for fast food, stating *"If I say Chick-fil-A with no cheese, it will just confirm 'logging' it. All food major chains have their nutrition data on the internet, so it would be easy for [the CUI] to pull the nutrition information."* For more qualitative goals, participants indicated that CUIs could help keep track of their behaviors, such as helping to *"keep track of my frequency [of meals]"* (P18), *"frequency of eating snacks"* (P01), etc. As for goals related to health complications, CUIs were envisioned as supporting entry building alongside managing their conditions. P01 and P05, who are lactose intolerant, suggested the assistant should save in entries if their foods contained dairy and *"mention that there's dairy in it [food description]"* (P01) or alert *"to take lactate if his food description contains dairy items"* (P05). Similarly, P11 suggested that CUIs could *"ask me 'do you have any allergies?' or 'are you strong with worship [religion] restrictions?' [...] It can use this to warn me in case I eat something with it [ingredient] by mistake."* These varied expectations demonstrate how goal-awareness is necessary for CUIs to use interactions in building relevant journal entries.

Follow user-defined rules and support agency: Alongside understanding personal goals, participants expect CUIs to follow rules on how to create entries based on personal preferences, effectively following user-informed guidelines in order to share responsibility in carrying out journaling tasks. Some preferences for rules were grounded on experiences with the underlying mechanisms of database searches for nutritional information. For example, P6 and P15 wanted to establish a rule that the CUI should select the highest calorie option when there are multiple database entries for a food item (Figure 2b). P6 said *"there's usually like a ton of options on a [food] database for something like pork dumplings. Some might be too fatty, you know, but the carbs or calorie estimates are going to be very low on some options. So I would pick the one that has a higher caloric estimate."* Similarly, P15 wanted to *"err on the side of caution and go for the one that has the most amount of calories"* and envisioned instructing the CUI like informing: *"CUI, I had two servings of tangerines today. Add it to my snack and make sure to also get the one with the most calories in the database."* P10 wished to inform the idiosyncratic rule of *"not count sugar from fruit, so it would be great if it could like, not include fructose... so I can know, like, what percent of the time am I below the processed sugar goal."* These examples demonstrate that through the utterance of rules, some participants felt comfortable to delegate strategies over automated

entry building. Ultimately, participants with desires for more control envisioned such rule setting as a way to delegate quantification for the CUI to do *"the guessing for you"* (P15).

In contrast, some participants wished for the possibility of more direct control over journaled data by being able to specify or adjust themselves when data mattered towards monitoring their goals. Retaining the ability to provide detailed food descriptions and relying on one's own experience, knowledge of nutritional calculations, or searching abilities can provide a sense of ownership and increased accuracy rather than fully delegating automation tasks to CUIs. For example, P2 said *"I think we can do direct or indirect input. Directly would be for something provided with calorie and nutrition facts, so we can just say 'okay add 400 calories to my daily journal.' Indirectly, the personal assistant could fetch some [nutritional] information from the internet, like calories."* P03 explained she often would like to do the estimation and searching herself and inform the assistant, *"I might guess [the amount of sugar] when talking with the CUI, but then I could go on my phone and edit, like, after searching online if I want to actually track it well. I guess the CUI could search it and automatically, put in a value, but I kinda want to Google it myself. I feel that would be more accurate than if the CUI did it."* Similarly, for complex dishes P15 might rather *"rely on just my general awareness of what foods tend to be calorie wise"* than trusting a CUI's estimation process. Overall, some participants preferred to keep more control of journaling due to a higher sense of agency and confidence in their own experience and capabilities.

4.1.2 Learn and Understand Unique Personal Meanings and Assumptions. Our analysis found that participants expect CUIs to learn their personal terminology, assumptions, and references over time. Conversational utterances can have personal and subjective connotations and carry important food and eating behavior references that people deem important for their logging practices. Understanding personal meaning around conversation in food journaling dialogues could make building entries more natural.

Understand terms and references: Participants emphasized the importance of CUIs recognizing subjective connotations and understanding their personal use in conversational utterances. For example, P03 emphasized the importance of understanding references to personal portion sizes: *"if I don't share what I consider a portion, then the assistant won't know and it'll be inaccurate when it goes into the diary."* Participants also explained the subjective nature of some terms people might use to classify their meals. For example, P17 wished to inform the CUI a subjective classification of what is healthy in his perspective for later inquiries about his *"healthy eating"* goal. He said *"first of all it's like I think 'healthy' is kind of subjective, like a salad can be seen as healthy, but actually full of toppings, so it might not be helping towards your healthy goals. So, better for you to tell the CUI [yourself] when something is healthy."* Likewise, P01 said that *"When I say 'snack', my version of snack is very different from other people. My definition of snack can vary the quantity of food and be very different from someone else, so it'd be relative to how I define snack. Then the assistant could classify and learn my eating habits."* These examples illustrate a need for CUIs to understand personal meanings in order to support journaling and reduce errors and ambiguity. Moreover, people expect systems to learn their intentions via conversations and for future interactions.
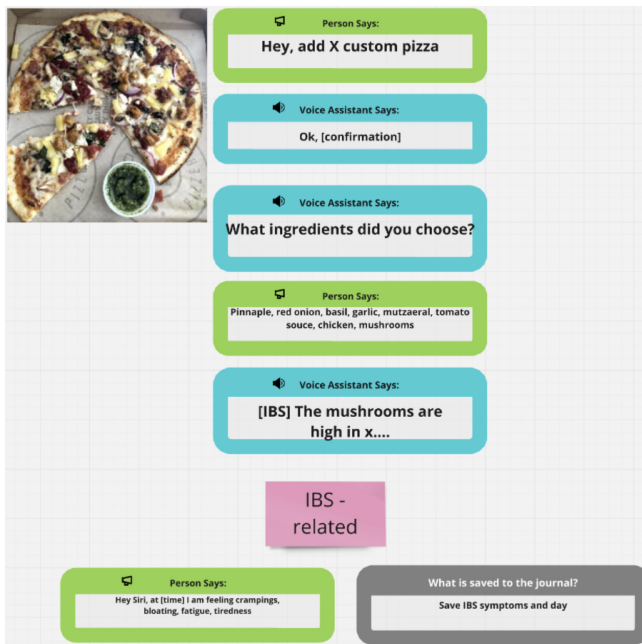
(a) P04 envisioned CUIs providing IBS-related food ingredient information and recording discomfort levels, supporting her condition management goal.
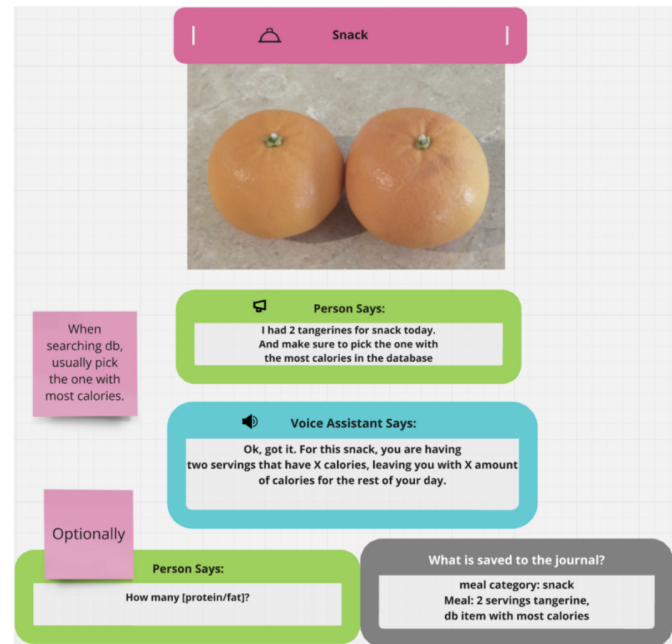
(b) P15 envisioned delegating nutritional database searches to CUIs while specifying a rule to select the one with highest calorie count, illustrating a desire for automation guided by preferences.

Figure 2: Participants expected CUIs to learn their goals and rules around journal entry building in order to create logs relevant to them and useful for later self-reflection.

Participants expressed that they wished conversational agents could understand and remember personal references to routine meals and recipes, which could lower the need for extensive dialogue. Some participants framed this in terms of using named references to specific recipes or routine meals. For instance, P15 suggested referring to *"Rachel's pasta"* when describing the meal, while P10 envisioned programming standard drinks: *"My standard coffee contains like coffee plus a quarter cup of soy milk and a spoon of sugar... then if I say I am having coffee and don't specify anything else, the assistant knows it's the default coffee... the goal is to make it as easy as possible."* P09 illustrated how this could extend to multi-serving meals and future logging: *"There's four of us [in our household] and this recipe has six servings. Which means there's two more servings to have for lunch later in the week, so I can tell it [CUI] to log it again later like 'Hey, log one serving of that pork chops with gravy carrot and potatoes'."* P17 further emphasized the potential for the agent to recognize regularly consumed meals: *"[CUI] they'll just be like 'okay, what are you eating?' So, if it's something that I eat very often, it can be a regular meal. And I could just say 'this is my granola bowl,' and it would just have that already. But if it's something that I don't eat regularly, I'll list everything."* These examples highlight participants' expectation for CUIs to recall meal information and references to facilitate conversations in each logging session.

Understand and act on assumptions: Participants also envisioned CUIs should make informed assumptions when constructing entries, which could lower the requirement for detailed dialogue to explain or describe eating events. In contrast with the previous point around personal terms and references, this finding relates to unsaid but implied personal meanings. P02 explained that *"the assistant needs to be familiar with the habits and likes and dislikes of the person it is providing assistance to"* in order to *"not necessarily need to provide full sentences... like, if I always eat bread with butter and so I don't need to say the butter, it will learn. the assistant can distinguish and determine what specific things go together."* Similarly, P01 explained that *"my cereal is always with milk"* and P02 said *"marinara is always with spaghetti, not rice."* Participants generally envisioned conversationally teaching CUIs about such assumed pairings, such as P18 that said *"the more details it [CUI] gets, it gets to know my patterns and maybe eventually it will be able to infer what I am saying."* Participants also wished that learned personal assumptions could impact details in logs, like type of meal based on routine. For example, P09 wished *"It [CUI] would be confirming the meal is lunch because it will know 11 o'clock is my lunch. It's assuming it and saving it,"* while P5 wished that a meal should still be saved as breakfast even if close to noon, as long as it was the first meal of the day and she had just woken up.

In summary, tailoring conversations requires understanding and learning people's journaling related language, such as specific terms and personal references. To enable this level of personalization, conversational assistants could progressively learn about users through interactive journaling. Our findings highlight participants' expectations that CUIs should maintain natural food journaling conversations while recognizing terms with underlying unique

intentions. This recognition is crucial for recording information that is personally relevant to support goals and later reflection.

4.1.3 Offer Opportunity for Depth Through Interactive Dialogue. Our analysis revealed that participants envisioned CUIs engaging in prolonged, iterative, and proactive conversations to support richer and more detailed food logging, such as for more descriptions of food components and precision in nutritional information. This interactive approach could make data more reliable for self-assessment and capture details that might otherwise be overlooked.

Following iterative and collaborative building of entry details: Participants often designed iterative conversations that leveraged turn-taking to gradually add details about the meals they had. They envisioned that CUIs could stimulate better journaling by asking questions and following along or guiding detailed descriptions. P13 explained that a CUI should *"be more like a person like me, sort of a conversation"* and after an initial food description it could ask *"do you want to take notes or something else? ... And I might say 'Please note that I used 10 grams of Parmesan, instead of butter, for 50 grams of rice'."* P06 exemplified that such types of questions could stimulate her to provide nuanced information about what she ate, like *"this recipe used fresh bean sprouts instead of canned."* Others considered that a similar iterative process could provide steps for granularly food description. P09 explained: *"I weigh everything as I am prepping. So while I am cooking, I would tell it the ingredients, weight, and 'next' one by one receiving acknowledgement [from the CUI]."* This collaborative approach to building entry details indicates that CUIs could potentially act as partners in the food journaling process, following along and stimulating users as they think about and describe their meals.

Participants also viewed interactive dialogues as a way to follow up with personal classifications around enjoyment and the *"impact to the body"* (P08) of what they ate. P17 suggested he would want to say *"'make a 'star' by this food or 'I would want to eat this again,' so that it knows that this is something you really enjoy eating"* and P13 said she would *"like to say a rating, like saying 'this was tasty' or something that would express what I felt."* Such expectations were fueled by a hope of later being able to ask about patterns around foods that can lead to a sense of satisfaction. P10 envisioned that the CUI could stimulate such recordkeeping by providing questions around *"feeling about the meal"*. Similarly, P08 wished that the CUI *"would record the nutrients"* and follow up with a question about *"if I got full or heartburn after eating something. So, like, there's documentation about the immediate feedback on your body."* She explained that this was *"so it [CUI] can anticipate trends and if there's a pattern that you don't like, and figure out ways to change that pattern."* P07 similarly designed long conversations where she partnered with a CUI to discuss levels of discomfort, register how foods might be impacting her, and explore what foods might be triggering. She exemplified CUIs role as asking questions (e.g., *"from one to ten, what was your discomfortable level?"*), providing suggestions (e.g., *"Was it the Banza pasta, tofu, or onion ingredient?"*), or following instructions (e.g., *"Please, add this to [P07]'s discomfort list."*). Overall, participants viewed conversational journaling as a potential prolonged process that could use multiple dialogues to build depth in detail and range of data categories, both about the food itself and other personal perspectives around the eating experience.

Proactive questioning to resolve ambiguities, improve accuracy, and drive towards goal compliance: For participants with goals of tracking nutrition precisely, follow up questions were seen as valuable for constructing comprehensive and accurate entries. P09 emphasized, *"to get accurate nutrition info it's important to be specific, so it would ask me, like, how many servings I am cooking."* P17 similarly explained that CUI asking *"how much did you put in for each ingredient?"* would be important *"If people are curious about calories."* Participants agreed that conversations with multiple questions might enhance journal reliability. P15 illustrated how co-construction of entries could jog memory and disambiguate utterances:

> *"If something that I say for the assistant to add is too ambiguous, it would be a great idea to have it prompt me for more information... it's really common to forget things, like the sauces, like ketchup which does have some calories. And like toast, you might just say 'toast' but maybe you had butter or jam with it. So, asking 'did you have anything with that?' would be helpful."*

In general, participants expressed that proactive CUIs for food journaling could take on a *shared responsibility* in making sure logs could appropriately support their goals. P02 explained that *"if it [CUI] needs missing information, It should be responsible to ask for more details and for you to elaborate. Hopefully it knows what missing information it needs to do a [database] search."* P03 suggested that an assistant should help her think more about food components that could affect nutritional values by *"asking if there's like extra stuff on it. If it would change the results, change the nutritional value quite a bit, it would be important for the accuracy when I look back at the data."* In addition, participants emphasized that proactive CUI's responsibility towards data completeness needs to be tied with individual goals. P13 explained that *"some details are more relevant, but others are too much and not too important for my goal of checking if I had enough or the right amount of food and vegetables."* Similarly, P03 added, *"If the [CUI] asked what type of vegetables, it would be too much. I don't care about each type, just that I am eating vegetables."* These findings highlight participant's expectations for CUIs to actively help them in the food journaling process to enhance accuracy, completeness, and relevance to quantitative food goals. By prompting for additional information, CUIs could help users overcome common challenges in food logging such as forgetfulness, ambiguity, and oversimplification, potentially leading to more precise and useful nutritional tracking.

4.1.4 Adapt Conversations to Time Constraints and Intention In-the-Moment. While participants recognized the potential benefits of detailed conversational interactions for improving food journal entries, they also emphasized the need for CUIs to adapt to time constraints and situational factors. While location could be a factor, participants reported reluctance to journal depending more on locations' social contexts. Participant's perspectives were similar to concerns expressed in previous works in food journaling [16, 47], such as being more or less comfortable with journaling via CUIs around other people depending on relationship [76]. For example, P3 stated that they would use a CUI for food journaling *"around close people but not in public. It can be weird"*. P15 similarly stated that they would journal with a CUI around *"Friends or guests, depends*

upon the friend if it's really the kind of a close friend I'm totally fine with doing that.'' However, even when alone, participants expressed expectations for CUIs to respond according to their cognition and intents in the moment. Overall, excessive probing could become annoying or inconvenient if not contextually appropriate.

Respect time constraints: While participants often sought out comprehensive detailing of foods they also acknowledged that it may not always be possible to have multiple dialogues in the moment. When pressed for time, participants concerned with precise descriptions expressed preferring short and more direct instruction. For some participants interested in quantified goals, the urgency could mean taking on direct control over recording core data points. For example, P09 considered dictating *"record lunch, 400 calories"* if she did not have time for a detailed conversation, P15 said *"if there are too many ingredients, I might just say 'Quick add 500 calories to dinner'",* and P06 said that *"If I am in a hurry I wouldn't go through the long process, if it is stuff I love to eat, I think I can estimate myself."* These examples illustrate how time constraints can shift users' priorities from detailed accuracy to efficient core data capture.

Participants also proposed strategies for time-pressured situations while maintaining journaling consistency. P01 expressed that with limited time, he would not bother to *"go through the trouble of trying to get the CUI to really figure it out. I would just tell it to track an eating event and go back into an [phone] app later and manually input it."* P16 suggested a similar two-step approach: *"I would just ask the CUI to quickly log whatever I eat. And then maybe later on, if I have a set time it can ask me to recap everything I ate and I could clarify further on those things."* P18 proposed using time-based commands like *"ask me again in an hour."* Participants considered that retrospective logging could then mitigate such circumstances by incorporating temporal cues (e.g., *"Yesterday at 7pm, I ate quesadilla"*, P07; *"Hey CUI, please add a meal for yesterday at 5pm,"* P04). These varied approaches highlight the need for CUIs to adapt to flexible, time-sensitive journaling. By recognizing and adapting to users' time constraints, CUIs can facilitate continued engagement with food journaling even in hectic situations by allowing for brief and instructional inputs with the option for later elaboration.

Respect cognition and intention in the moment: Participants considered that CUIs could infer or probe carefully if they were available or willing to follow further conversations. They proposed that CUIs could interpret certain phrase choices and dismissive connotations as cues to adjust interaction style to user intents. P13 considered that an *"advanced assistant would recognize when I am more conversational versus giving orders"* and adapt conversation flow accordingly. Many participants viewed saying *"thank you"* as an implicit conversation closer, with P09 stating (Figure 3b), *"It would know that we are done [conversing] when I say 'thank you'."* More direct approaches were also suggested, such as P10's use of *"done!"* or P01's explicit instruction (Figure 3a), *"'assistant, I'm in a hurry, record whatever meal'. The assistant would parse that I'm in a hurry and not ask any more questions."* Some participants favored a proactive but cautious approach from CUIs. P18 suggested CUIs could *"start off with 'hey do you have time to give me more detail?' Or maybe it should know my schedule, like my calendar."* P07 suggested that the CUI *"would ask 'do you want to dive more?' and if no, the conversation ends"* after an initial set of interactions to describe foods eaten. These diverse suggestions highlight the importance

of CUIs being able to recognize and respond to various verbal and contextual cues, allowing for nuanced interactions in journaling.

Overall, cognitive and situational factors can influence whether participants consider the effort of a prolonged conversation is a worthwhile tradeoff. P13 said it would be beneficial if it asked questions (e.g., *"how I cooked, like if cooked or fried"*) but only *"when I am in a relaxed context. The [CUI] should realize when I don't want to be bothered."* P02 said *"Maybe at some point you are not in a good mood, so you don't want to hear the system talk, so I think it should be possible to optimize it based on your needs."* P3 added, *"If the [CUI] is asking too many questions and I don't feel like answering more, I would just end the conversation."* These examples indicate the need for CUIs to be perceptive of users' internal states to provide appropriate levels of interaction.

4.2 RQ2: Interactions for recollection and reflection on eating behaviors

Our analysis of the co-design sessions identified that participants anticipated that conversational interactions could help them reflect on goal progress and eating behaviors in ways both similar and unique to traditional food journaling systems. Participants generally expected CUIs to provide feedback and insights comparable to the goal progress visualizations offered by current food tracking apps. More unique to conversational interaction, participants designed CUIs that could help them by immediately asking reflective questions after journaling, supporting data queries in a flexible manner, and helping brainstorm previous eating events that could have led to feeling discomfort. At the same time, they expressed concerns about the ability of CUIs to support granular recollection and navigation of large amounts of journal entries with the same ease as visual representations. Overall, our findings reveal opportunities for CUIs to support reflection through goal-oriented feedback, empathetic accountability, and collaborative exploration of eating patterns, while also highlighting perceived limitations in navigation large amounts of past logs.

4.2.1 Provide Goal Oriented Feedback and Insights. Similar to other food journaling systems, participants envisioned that conversational interactions could help them reflect on goal progress, and expected CUIs to provide feedback and insights comparable to the goal progress visualizations offered by current food tracking apps. Participants reported that this feedback would remind them about their goals and help make choices about their meals later that day, especially for those that set goals related to a specific minimum or maximum nutritional value. P10 exemplified this by suggesting the ability to request *"remind me of my goals"* and receiving responses like *"you've had 50% of your daily allotted amount of sugar, and 40% of your recommended daily calories."* P13 similarly said that *"when asking about if goals were met, assistants would explain, like 'you are off by 20%'."* Others considered that such progress feedback could be following a food description conversation, such as P15 that envisioned the followup: *"For this meal, you are having two servings that have X calories, leaving you with X amount of calories for the rest of your day."* Similarly, P11 designed the CUI saying, *"You are not on track to eating enough vegetables. You should eat two more servings of vegetables;"* P06 said *"After journaling, I would prefer to hear what I have left [available towards my goal] for the day;"* and
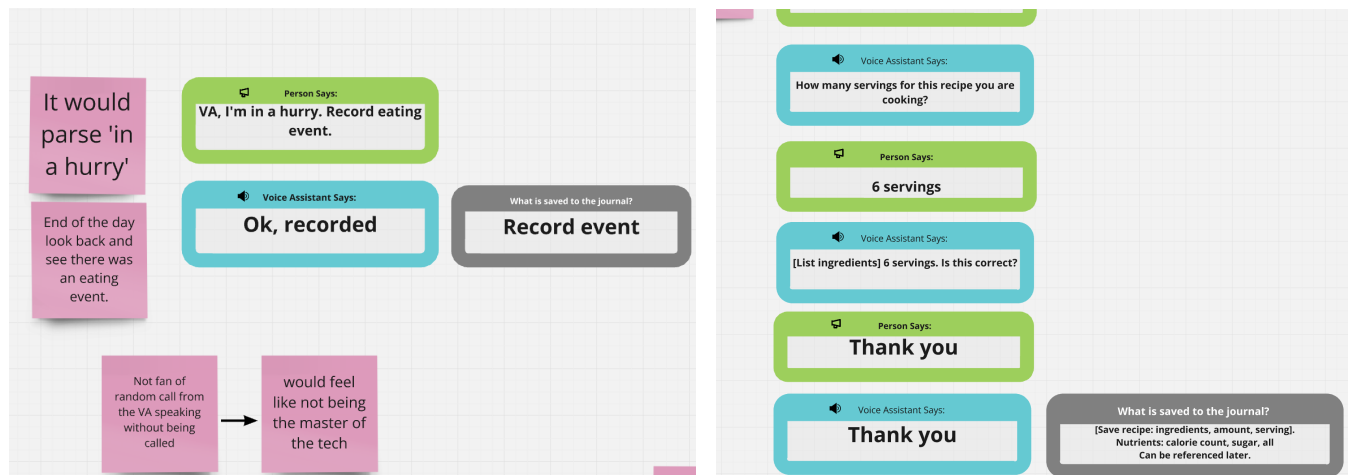
(a) P01 considered that when in a hurry, he would explicitly inform a CUI that he did not have enough time for extended dialogues.

(b) P09 considered that CUIs should understand implied dismissive wording choice and used "thank you" as an example.

Figure 3: Participants considered that CUIs should interpret direct language and interpret word choice and implied tone in order to decide if further conversation prompt is opportune.

P03 said that CUI could respond with *"You have exceeded your daily sugar intake. This Item has X many grams of sugar."*

Beyond uses which were similar to traditional food journals, participants designed their ideal CUIs for reflection in ways more unique to conversational interaction. When participants designed journaling dialogues, they wished that CUIs could immediately ask questions to help them reflect on their eating choices in addition to information or goal feedback. Participants saw value in CUIs providing immediate feedback helping them *"be a little bit more informed"* (P08) and *"be aware of the meal's nutrients"* (P04), but also reflect on how sated they felt or how they enjoyed their meal. P18 proposed that the CUI could ask, *"Did you enjoy your meal? How full are you? Are you still hungry?"* with potential responses like *"Yes, it was great/delicious. I really liked it. It was ok. I didn't like X, we can change it for the next time."* P07 suggested post-entry conversations led by reflective questions like *"Was it healthy? How fast did you eat? Did you add sugar? How much did you eat?"* P02 imagined the CUI asking, *"Are you going to have the 16oz chip?"*, helping reflect on portion sizes and potentially influencing the decision to eat it. Providing immediate reflective questions paired with information feedback could help people become more mindful, better understanding the foods they chose and the act of eating.

Participants also considered that CUIs could assist with explicit data queries about eating habits. P17 considered asking questions like *"What was the meal I ate the most? What time did I usually eat breakfast/dinner/snack? How many times did I cook at home last month versus this month?"* P10 was interested in asking about food categories: *"How many servings of vegetables or fruits did I eat on average?"* and *"How often am I below my processed sugar goal? (Optionally I can specify a time frame),"* while P04 was curious about his earliest eating events (e.g., *"You have been starting to eat at about 9am each day"*). P01 wanted to check if his personal definition of *"small snack"* was actually small and he could ask *"'give me a number [for amount] of what my small is' and check if it isn't just something*

for me to feel less guilty if I am overeating". P05 explained CUIs should be able to follow and respond to specific data requests, such as *"How much protein did I eat in total? List chronologically today (or another day)"* with a potential response of *"For breakfast you ate X, snack X amount, lunch Y, Dinner Z... In total you had E amount of protein."* Such flexibility in querying about their data could allow users to explore curiosities and aspects of their eating habits.

Some participants with goals of managing discomfort or intolerances expressed interest in CUIs helping them recall foods and brainstorm potential triggers. P07, who was exploring potential food sensitivities, envisioned a collaborative process with the CUI (Figure 4): *"It could help me with a possible list so we can think which ingredient might be bothering me. And I can add details, like 'didn't have fresh carrots so used canned instead' and that might be the problem. It could ask me 'do you think it is ingredient x?' and we keep going like that."* P04, who has IBS, wished to be able to inquire:

> *"If I feel really bad on one day, I can ask about my food triggers. Because everybody's IBS triggers are different. So, [asking] 'What did I eat differently that day that may have made me feel bad?'. Maybe it will say 'You had cramping/bloating after eating garlic or dairy'."*

P01 similarly highlighted how CUIs could help reflect on reasons for unexpected reactions:

> *"Everyone's lactose intolerance affects them differently... Usually I just get an upset stomach. I have friends who get headaches from dairy. In the event that I get a terrible migraine and can't figure out why, I can ask the assistant and it says 'you consumed dairy about two hours ago.' I'll be like, this might be a lactose reaction."*

This approach to self-experimentation and exploration of past meals highlights the potential for CUIs to be speculative when helping people understand the impacts of their diet.

Overall, participants imagined that CUIs could help them by immediately asking reflective questions after journaling, supporting data queries in a flexible manner, and helping brainstorm previous eating events that could have led to feeling discomfort.

4.2.2 Provide Empathetic and Non-Judgmental Accountability and Support. When reflecting on their experiences with traditional journaling, participants often felt that the technology could cast judgment if goals are not being met. For example, P01 said that goal feedback often doesn't *"feel good, it is judging me, now it's made me feel bad."* Conversely, participants thought that reflective conversations could be more supportive if they used a positive and encouraging tone. While participants felt that the feedback should be honest and evaluative of their habits, an encouraging and optimistic tone could be more helpful for them when making future decisions about their diet even if goals are not being met. For example, P3 said *"it would motivate me more if it was positive, even if the data isn't positive. It can motivate me more towards my goals. Like 'Good Job!' or 'You ate less vegetables, but keep trying!'"* This was echoed by P11 who said *"Tell me something encouraging. It would tell me whether or not I'm on track, like 'you are on track to eating your goal' or 'you're not on track, but you can do it!'"* Similarly, P7 said *"If it was a good week nutritional-wise, 'congratulations, you did good' versus if it was a bad week, would say encouraging things like 'you can do better'."* Given the more personal interaction, participant's suggestions indicate that CUIs should prioritize motivation and encouragement over criticism to maintain user engagement and promote positive behavior change.

Participants indicated that CUIs could offer specific suggestions of potentially actionable changes without sounding imposing or judgemental. P01 explained that *"It would feel a little weird and uncanny to me if it is telling me what to do. So, let's say after saying the weekly summary it [CUI] could give me suggestions. It's like 'you've been eating more of this type of food, like can we recommend you eat more of this [other] instead? Like a sugar diet, and from eating out to homemade meals.' … I want to feel like I am still the master over the technology."* This preference reflects a desire for a supportive, collaborative connotation with CUIs rather than a directive one, maintaining user's sense of control and decision-making power. Similarly, P08 said:

> *"Even if you're eating something bad, it can give some sort of constructive feedback. Nobody wants to hear negative comments, like 'you're eating horribly, you did a bad job today.' It is identifying ways that you could do better, and suggestions for how to do better. Like, suggest 'have you ever considered instead making fish at home?' or 'This has a lot of carbs, might I suggest X instead?' Have some supportive recommendation on how to change the diet. Suggest things to slowly move a person towards the desired outcome."*

Given the conversational nature of the reflective support, participants considered the need for CUIs to balance honesty with tact (*e.g.*, Figure 5), offering constructive suggestions versus imposing language that is more accepting and more likely to act upon.

In addition to suggesting that CUIs express empathy and tact, participants suggested CUIs could use accountability and collaboration strategies, calling attention to behaviors in need of improvement

and acting like a peer to support healthy eating. This role was often imagined as offering timely feedback, gentle reminders, and advice in line with their personal goals. For example, some participants drew parallel to how they had received support from peers, like mothers and husbands. P18 illustrated this collaborative aspect, suggesting the CUI could say, *"'You haven't eaten, go eat!' Like, I was talking with my mom on the phone, and she told me to go make something because I was still hungry and didn't think about it. So it [the CUI] could give me insights, like 'oh you're not giving yourself enough meals that actually make you full.'"* Similarly, P14 said, *"similar to my husband, if I was deciding on what to eat, the assistant could give me feedback, something that would be useful like 'it's late at night, better not eat something salty'."*

Participants also envisioned CUIs providing more direct accountability through warnings and flags. For instance, P11 suggested the CUI feedback, *"Pay attention to your candy intake!"* while P2 imagined alerts like, *"Please be advised you have now consumed 20% more sugar than other people on average."* P07 proposed that the CUI could provide subtle warnings paired with alternative suggestions: *"Can I recommend that you eat less sodium?... Here are suggestions of recipes to lower your sodium."* P05 suggested CUIs could warn about not eating enough: *"I noticed you did not eat X amount of servings, which is the recommended for someone your size."* This collaborative, accountable approach was seen as a way for CUIs to provide personalized support that goes beyond simple tracking, actively engaging users in their behaviors and helping them make more informed decisions about their eating habits.

4.2.3 Perceived Limitations on Conversational Navigation of Long-Term Data. Despite being optimistic about journaling via conversational support, participants generally expressed concerns about the ability of CUIs to support recollection and navigation of large amounts of journal entries with the same ease as other interaction modalities common in traditional food journals, particularly visual representations. Participants, especially those with a more data-oriented mindset (*e.g.*, having quantitative goals related to calories or nutrients), were unsure about being able to access their data granularly through conversational interactions with CUIs.

Participants generally felt that discussing large quantities of data, such as extensive food entries over time, would be time-consuming, tedious, and ineffective for reviewing with dialogues. P16 articulated this concern, stating that *"for data analysis, I feel like it's too much to ask for an assistant to tell me all the information... It might be easier to look at past data through an app because I would be able to see everything at once, while the assistant can give information one at a time."* Similarly, P03 expressed a preference for visual representations: *"I remember things better if I see it. Assistants could say numbers, but I would forget them. So, I would rather go in the app and look at graphs."* P15 also was concerned with navigating large data descriptions through conversations, saying:

> *"When I'm looking at a lot of data or I'm getting kind of a big picture view of my journaling and my progression and weight loss and whatever, I tend to need a visual reference, because otherwise, if I'm just told this information, which can be quite dense, if it's just told to me I have not visual reference... It will just kind of go in one ear and out the other."*
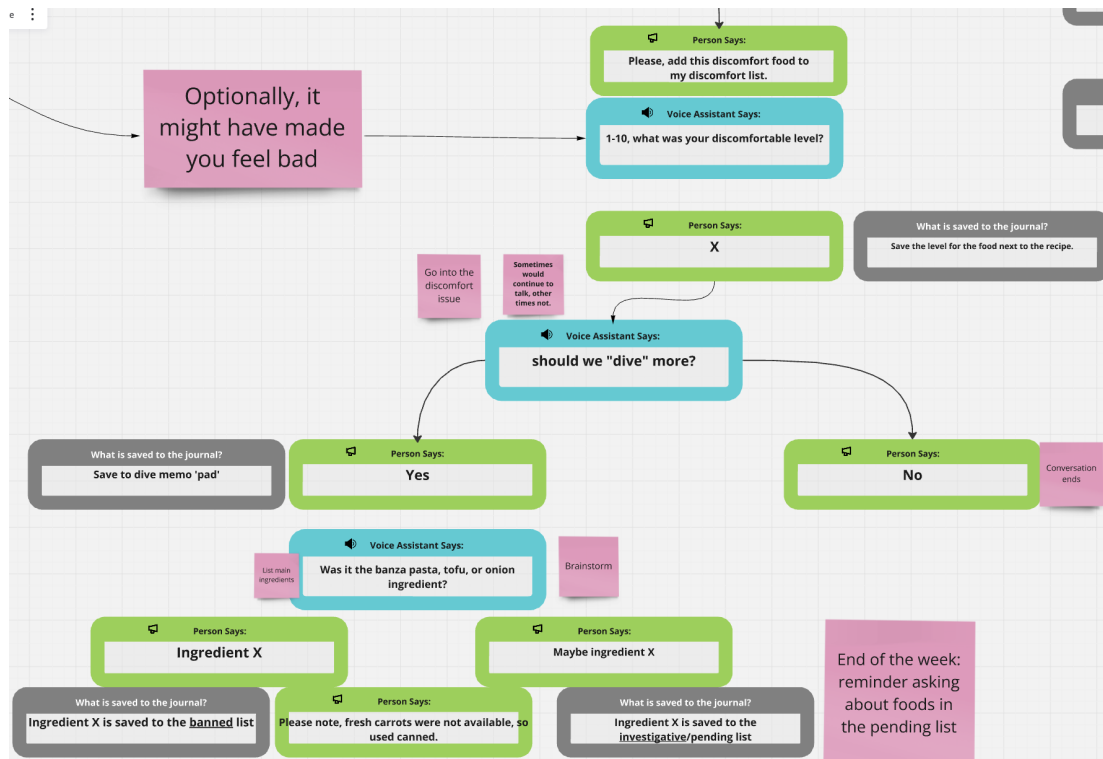
Figure 4: To support collaborative exploration of food discomforts, P07 designed a long dialogue where the CUI would proactively help her classify foods during data collection and brainstorm potential discomfort triggers. Here we depict a small part, focusing on the brainstorming turn-taking strategy P07 designed.

Figure 5: P08's CUI included constructive and positive language, nudging towards healthier choices. Participants emphasized the importance of empathetic and accountable feedback even in the presence of unhealthy choices or unmet goals.

These concerns highlight a significant challenge for CUIs in food journaling: balancing the convenience and immediacy of conversational interactions with the difficulty of going over large quantities of granular data collected continuously.

However, participants envisioned strategies to mitigate these limitations, particularly when considering conversations around long-term data. Suggested strategies primarily involved time-frame comparisons and discussions about trends to help reflect on lifestyle changes. For example, P01 expected to be able to discuss *"super simple stats for comparing progress, like 'your caloric intake and eating events increased between this week and last week'."* P02 suggested asking for comparisons like *"Compare my May summary to April"* and others speculated feedback could be like *"for this week, you consumed 10% less calories and 20% more sugar"* (P16) and *"you have consumed 10 grams more vegetables this week than last week"* (P13). Similarly, participants considered that discussing *"the overall trend more than just specific numbers"* (P15) could identify patterns and insights useful for reflecting on healthier choices. They imagined CUIs identifying and communicating various types of trends, such as P3's suggestion of *"you are eating on average 500 more calories on the weekend than weekdays."* Likewise, P08 noted how discussing logs could be *"useful to hear about trends, like, '3pm you usually want sweets'."* Additionally, some participants suggested combining conversational and more visual modalities, similar to prior work in supporting reflection with self-tracking data [40, 51, 76, 77].

In summary, while participants saw value in conversational journaling for logging and insights, they perceived limitations in using CUIs for navigating and comprehending long-term data. However, comparisons and trend-focused conversations were seen as a way for CUIs to engage about large log data sets with succinct insights that are easier to digest conversationally.

5 Discussion

Our study explored ways that CUIs might ideally support food journaling, focusing on two key aspects: data collection and reflection on eating behaviors. Regarding data collection (RQ1), our findings reveal that participants envisioned that CUIs could help with building goal-relevant logs if CUIs can learn and understand personal goals and terminology. Participants proposed that CUIs could engage in interactive dialogues to capture richer, more nuanced data about eating habits as long as responsive to situational intents and constraints, like available time. For reflection on eating behaviors (RQ2), participants proposed that CUIs could provide short and comparative goal-oriented feedback and insights, supporting self-reflection through accountability and help brainstorm discovery of food discomfort triggers. They envisioned CUIs as collaborators in their health journey, capable of offering encouragement even when goals were not met, while still discussing logs transparently. While participants saw great potential in CUIs for immediate feedback and discussing trends, they expressed limitations in using them for navigating long-term data. A summary of key recommendations for CUIs supporting data collection and reflection based on our findings is available in Table 2.

We now discuss our findings while highlighting opportunities for designing CUIs for food journaling, pointing towards a future where these systems could serve as companions in personal informatics.

5.1 Communicating Personal Meanings and Implementing Guardrails

Our findings suggest that in order for CUIs to support people in collecting the kind of information they desire about their foods, CUIs need to follow both explicit and implicit guidance from users. Prior work involving CUIs for health data collection typically follow explicit scripts or protocols for what information is prompted, which is relevant for applications like health screening or to direct specific data, but might become less conversational [39, 50, 62]. For conversational food journaling, while participants appreciated the flexibility of more open-ended conversations, they also had particularities for how they wished CUIs to track foods and contextual information important for their personal goals. When designing their own dialogues, they created personalized *guardrails* for how they wanted to delegate choices around how CUIs should journal their food, effectively structuring conversation-driven data collection in ways which would be useful for goal assessment and later reflection. For example, guardrails could establish explicit rules around estimating nutrients (*e.g.*, always overestimate, do not count natural sugars) and formatting data in logs. Participants also emphasized that in situations where they feel confident in their own expertise and experience, CUIs should switch from delegated assistance to following direct commands - such as when experienced users prefer to input their own calorie estimates rather than using delegated searches or calculations. By adapting to users' guidelines for conversational journaling, CUIs have the potential to collaborate and can share the journaling responsibility.

Prior work has indicated that open-ended conversations can be easier interactions to produce health data, but may be considered "noisy" for review [15, 75]. Our participants reinforced this and emphasized the need for structured logs that support both quantitative analysis (*e.g.*, nutritional data, aggregation) and qualitative understanding (*e.g.*, subjective meanings, feelings around eating events, discomfort sensations). In addition to explicit guidance on log structuring, participants wished that CUIs could follow implicit cues for creating logs. For example, conversations could involve subjective meanings related to food experiences and unique references to routines and foods, which are implicit meanings that are still relevant to building logs. Our findings highlight the need to transform open-ended descriptions into structured logs containing the complex variety of food-related information relevant to personal interests and that are embedded in conversational iterations.

In traditional food journaling, structured versus unstructured logs have often been divided between technologies which target different goals, such as apps supporting hedonistic and mindful food experiences using unstructured logs, and apps supporting a more quantitative nutritional focus using structured logs [17, 75]. However, in conversational food journaling, our findings indicate that both qualitative and quantitative goals would benefit from structuring the kinds of data which are collected to support these goals. Still, it can be challenging for systems to interpret subjective meanings and learn personal guardrails, requiring sophisticated processing, adaptive learning capabilities, and potentially explicit configuration. However, this is necessary given the conversational form of interactions and the intimate relationship people have with

Table 2: Summary table of key recommendations for CUIs based on our findings

How CUIs Can Support Food Data Collection (RQ1)

Learn Goals & Personal Meanings	• Support recording data most relevant to individual's goals
	• Follow user-defined rules for delegated entry building
	• Support agency in specifying entry details
	• Understand personal terms and references
	• Leverage assumptions for entry building (e.g., habits, food pairings)
Support Depth Through Interactive Dialogue	• Follow iterative, collaborative dialogue for detailed entry construction
	• Resolve ambiguities through proactive questioning
	• Prompt for missing goal-relevant information
Adapt to Constraints & Intent	• Support quick logging with later elaboration
	• Interpret implied dismissive tones and conversation closers
	• Adapt to user's cognition and intent in the moment

How CUIs Can Support Reflection About Eating Behaviors (RQ2)

Provide Goal-Oriented Feedback	• Provide goal progression updates and eating patterns
	• Offer immediate post-meal reflective questions
	• Support flexible data queries
	• Help identify trigger foods and discomfort symptoms
Provide Empathetic Accountability	• Use positive and encouraging language
	• Provide constructive, non-judgmental feedback
	• Offer gentle reminders, warnings, and alternative foods
Recognize Data Navigation Limitations	• Acknowledge difficulty with granular data review via CUIs alone
	• Use time-frame comparisons
	• Focus on summative insights and trends

food and related contexts, opening possibilities for more personalized and meaningful food journaling experiences. Future research could explore intuitive ways for people to communicate preferences and establish guardrails for delegated log building, potentially through interactive onboarding processes or learning over time through prompts as people journal in different everyday circumstances, offering suggestions for clarifying personal terms and references when ambiguous and refining journaling parameters based on observed patterns in dialogues.

5.2 Supporting Proactive Journaling while Understanding Situational Constraints

While our participants appreciated the ability to describe foods in an open-ended manner, they often designed dialogues with multiple rounds of turn-taking instead of a monologue. This highlighted expectations that food journaling would be iterative and partnered conversations rather than one-directional, descriptive and commanding utterances. Prior work in food tracking has indicated that open-endedness is a key opportunity in CUIs for adding details more flexibly [50], but risk creating incomplete or not useful logs for later self-reflection related to personal goals [55]. Our findings suggest that through conversational turn-taking, CUIs can help guide dialogues towards relevant, unambiguous, and detailed goal-oriented information about eating events. Our findings suggest

people might desire to be expressive and encouraged via more opinionated CUIs as long as directing towards goals and adaptive to contextual availability. Such nudges from CUIs might encourage users to consider adding missing details or engage in introspection about their short and long-term goals.

A challenge remains in how to balance CUIs being proactive in supporting journaling with situational constraints. Prior work on general-purpose voice assistants has indicated that when proactive smart speakers start conversations spontaneously, people's response varies based on availability patterns, mood, busyness, and other contextual factors [9, 81]. Our work extends such findings to indicate that to support personal informatics, CUIs can be opinionated and proactive in ways beyond starting conversations. Instead, CUIs can aim to maintain and stimulate prolonged dialogues with the objective of improving journaling depth and quality. Our findings further indicate that tone interpretation and direct choice of words can be representative of context and intent in the moment, which could be used to guide CUIs in deciding if probing further conversations is appropriate. Future work could further investigate how CUIs can infer situational appropriateness from dialogues and become adaptive to context as conversations flow.

Our findings suggest that proactive and reactive CUIs can support both reflection-in-action and reflection-on-action around eating behaviors, though each faces distinct situational and modality

constraints. For reflection-in-action during food logging, while participants valued the possibility of immediate feedback and prompts after describing food components, time pressure and contextual constraints could limit engagement depth. For reflection-on-action, while conversational interactions could enable rich retrospective analysis, a conversational format could pose challenges for granular, long-term data navigation compared to visual representations. This aligns with prior work showing the complementary roles of different modalities in supporting reflection [40, 51, 76, 77]. However, our findings suggest that collaborative conversational reflection offers unique advantages that complement traditional visual interfaces. The interactive, turn-taking nature of CUI dialogues might promote more intimate and collaborative engagement. This iterative process of describing, questioning, and discussing eating behaviors could lead to deeper insights than purely visual analysis, particularly for supporting more introspective aspects of food journaling.

5.3 Being Empathetic and Accountable Journaling Partners

Previous research has shown that self-tracking can negatively impact personal health, leading to rumination on negative thoughts [22] and feelings when not achieving an unreachable idealized health state or body shape [53, 67], or guilt when consuming non-healthy foods [17, 78]. Our findings highlight CUIs can potentially mitigate these judgmental and negative feelings often associated with traditional food tracking. Our participants expressed that CUIs could offer positive and encouraging feedback, as opposed to indirect or direct criticism about failures to reach goals, which can reinforce negative feelings and self-doubt. Conversation is a known technique for fostering reflection [6], and we argue that CUIs pose great potential to foster reflection in ways which are motivating and considerate of user's self-esteem.

Prior work around voice assistants for general-purpose interaction has indicated some preferences for smart and proactive CUIs, but divergence about using humor, social, and personification conversation styles [70, 80]. Our findings extend this by demonstrating that for food tracking, and perhaps other personal informatics domains, there is a strong preference for positive and encouraging feedback, even when confronted with lack of progress towards health-related goals. Such preferences align with the need to avoid triggering negative feelings that could lead to disengagement from the journaling process. However, challenges remain in striking a balance between being supportive, motivational, and encouraging while still providing honest feedback and stimulating accountability. Even in the face of unmet goals and reviewing bad habits, participants considered that uplifting, but still truthful feedback could help reflect on better choices and gain motivation to continue journaling.

One potential approach to achieving balance between supportive and truthful feedback is by mirroring positive peer support that sometimes occurs between people in social groups. For example, people frequently adapt the health-related advice they give to their close friends [1] and how they go about providing social support [13, 26] in order to encourage healthy behaviors. Our findings extend these mechanisms by suggesting that people can similarly wish CUIs to behave like peers in journaling by offering forgiving, yet accountable support. These interactions often involve motivational

and encouraging conversations about habits, honest suggestions for better choices, and specific recommendations (e.g., not skipping meals or substituting meals for healthier new recipes). CUIs also have the added benefit of being persistent and patient during dialogues, which is not always possible with human peer support[62]. By embedding these overarching behaviors in CUIs for journaling, the process could become more encouraging and supportive in every aspect, from data collection to review and recommendations for action, addressing a current gap in app-based approaches.

However, it is crucial to note that not all peer interactions are positively associated with food journaling, and care is needed to achieve a balanced, positive peer CUI design. Past work has identified that some peer influences can steer individuals further towards eating disorders [10, 23, 46], create stigma and feelings of embarrassment [17, 75], and impose potentially unhealthy social norms [46, 67]. As CUIs increasingly make use of LLMs that are trained on data situated within these complex social influences, there is a risk of CUIs replicating such negative biases related with food. For example, since LLMs are often trained with data from online spaces, conversational assistants could directly replicate negative behaviors and discourses related to food, such as shaming and insensitive language around body shaming [28, 58], or implicitly replicating cultural expectations and unrealistic standards [10, 46]. While CUIs have the potential to enact social support and accountability, care is needed to design with appropriate tone and encouragement, even in the face of unmet goals and lack of progress.

5.4 Limitations & Future Work

Our study provides valuable insights into the potential of CUIs for food journaling but has some limitations. While co-design sessions are an effective method for understanding people's visions for what technology could support, the open-ended exploration of the space may limit the practical implementation of some dialogue strategies. For example, it may prove more challenging than participants anticipated for CUIs to detect contextual intent, such as being pressed for time. Future work which aims to implement some of these CUI-based journaling systems can help validate the feasibility and effectiveness of these approaches.

Additionally, our study focused on individual use of CUIs, although it has been widely suggested that eating habits and food journaling practices are socially influenced [26, 49, 75]. Future research could explore perspectives of ideal CUIs to support food journaling within settings like families, peer support groups, or healthcare providers to better fit with people's everyday use of food journaling and to provide more comprehensive health management. Such understanding is particularly important in extending our findings beyond the context of the United States, as cultures and other contexts may have different eating practices.

6 Conclusion

Our co-design study of conversational food journaling revealed insights into how people envision using CUIs for data collection and reflection on foods and eating behaviors. We found that participants expected CUIs to be highly adaptive, learning individual goals and personal references to support detailed logging while respecting situational constraints. For data collection, participants envisioned

CUIs offering opportunities for in-depth reporting through interactive dialogues, while also adapting to time and intention. Regarding reflection, participants desired goal-oriented feedback and insights delivered with empathy and without judgment, similar to supportive peer interactions. However, they expressed concerns in using CUIs for granular navigation of long-term data, expecting feedback to focus on short comparative and trend insights. Our findings suggest that CUIs have the potential to mitigate challenges associated with traditional food journaling by facilitating the delegation of journaling and fostering accountable, yet empathetic conversations for motivation and reflection.

Acknowledgments

References

[1] Elena Agapie, Lucas Colusso, Sean A. Munson, and Gary Hsieh. 2016. PlanSourcing: Generating Behavior Change Plans with Friends and Crowds. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW 2016)*. 119–133. doi:10.1145/2818048.2819943

[2] Shashank Ahire, Benjamin Simon, and Michael Rohs. 2024. WorkFit: Designing Proactive Voice Assistance for the Health and Well-Being of Knowledge Workers. In *Proceedings of the 6th ACM Conference on Conversational User Interfaces (CUI 2024)*. Article 5, 14 pages. doi:10.1145/3640794.3665561

[3] Tawfiq Ammari, Jofish Kaye, Janice Y. Tsai, and Frank Bentley. 2019. Music, Search, and IoT. *ACM Transactions on Computer-Human Interaction* 26, 3 (jun 2019), 1–28. doi:10.1145/3311956

[4] Eric P.S. Baumer, Sherri Jean Katz, Jill E. Freeman, Phil Adams, Amy L. Gonzales, John Pollak, Daniela Retelny, Jeff Niederdeppe, Christine M. Olson, and Geri K. Gay. 2012. Prescriptive persuasion and open-ended social awareness: Expanding the design space of mobile health. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work (CSCW 2012)*. 475–484. doi:10.1145/2145204.2145279

[5] Erin Beneteau, Olivia K. Richards, Mingrui Zhang, Julie A. Kientz, Jason Yip, and Alexis Hiniker. 2019. Communication Breakdowns Between Families and Alexa. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2019)*. 1–13. doi:10.1145/3290605.3300473

[6] Marit Bentvelzen, Paweł W. Woźniak, Pia S.F. Herbes, Evropi Stefanidi, and Jasmin Niess. 2022. Revisiting Reflection in HCI: Four Design Resources for Technologies that Support Reflection. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 6, 1, Article 2 (mar 2022), 27 pages. doi:10.1145/3517233

[7] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77–101. doi:10.1191/1478088706qp063oa

[8] Virginia Braun and Victoria Clarke. 2019. Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health* 11, 4 (aug 2019), 589–597. doi:10.1080/2159676X.2019.1628806

[9] Narae Cha, Auk Kim, Cheul Young Park, Soowon Kang, Mingyu Park, Jae-Gil Lee, Sangsu Lee, and Uichin Lee. 2020. Hello There! Is Now a Good Time to Talk? Opportune Moments for Proactive Interactions with Smart Speakers. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 4, 3, Article 74 (Sept. 2020), 28 pages. doi:10.1145/3411810

[10] Stevie Chancellor, Jessica Annette Pater, Trustin Clear, Eric Gilbert, and Munmun De Choudhury. 2016. #thyghgapp: Instagram Content Moderation and Lexical Variation in Pro-Eating Disorder Communities. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW 2016)*. 1201–1213. doi:10.1145/2818048.2819963

[11] Janghee Cho, Tian Xu, Abigail Zimmermann-Niefield, and Stephen Voida. 2022. Reflection in Theory and Reflection in Practice: An Exploration of the Gaps in Reflection Support among Personal Informatics Apps. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI 2022)*. Article 142, 23 pages. doi:10.1145/3491102.3501991

[12] Eun Kyoung Choe, Saeed Abdullah, Mashfiqui Rabbi, Edison Thomaz, Daniel A. Epstein, Felicia Cordeiro, Matthew Kay, Gregory D. Abowd, Tanzeem Choudhury, James Fogarty, Bongshin Lee, Mark Matthews, and Julie A. Kientz. 2017. Semi-Automated Tracking: A Balanced Approach for Self-Monitoring Applications. *IEEE Pervasive Computing* 16, 1 (jan 2017), 74–84. doi:10.1109/MPRV.2017.18

[13] Chia-Fang Chung, Elena Agapie, Jessica Schroeder, Sonali Mishra, James Fogarty, and Sean A. Munson. 2017. When Personal Tracking Becomes Social: Examining the Use of Instagram for Healthy Eating. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2017)*, Vol. 2017-May. 1674–1687. doi:10.1145/3025453.3025747

[14] Chia-Fang Chung, Qiaosi Wang, Jessica Schroeder, Allison Cole, Jasmine Zia, James Fogarty, and Sean A. Munson. 2019. Identifying and Planning for Individualized Change: Patient-Provider Collaboration Using Lightweight Food Diaries in Healthy Eating and Irritable Bowel Syndrome. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 3, 1, Article 7 (mar 2019), 27 pages. doi:10.1145/3314394

[15] Orla Cooney, Kevin Doherty, Marguerite Barry, David Coyle, Gavin Doherty, and Benjamin R. Cowan. 2024. Using Speech Agents for Mood Logging within Blended Mental Healthcare: Mental Healthcare Practitioners' Perspectives. In *Proceedings of the 6th ACM Conference on Conversational User Interfaces (CUI 2024)*. Article 10, 11 pages. doi:10.1145/3640794.3645540

[16] Felicia Cordeiro, Elizabeth Bales, Erin Cherry, and James Fogarty. 2015. Rethinking the Mobile Food Journal: Exploring Opportunities for Lightweight Photo-Based Capture. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2015)*, Vol. 2015-April. 3207–3216. doi:10.1145/2702123.2702154

[17] Felicia Cordeiro, Daniel A. Epstein, Edison Thomaz, Elizabeth Bales, Arvind K. Jagannathan, Gregory D. Abowd, and James Fogarty. 2015. Barriers and Negative Nudges: Exploring Challenges in Food Journaling. In *Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2015)*, Vol. 2015-April. 1159–1162. doi:10.1145/2702123.2702155

[18] Alaina Darby, Matthew W Strum, Erin Holmes, and Justin Gatwood. 2016. A Review of Nutritional Tracking Mobile Applications for Diabetes Patient Use. *Diabetes Technology & Therapeutics* 18, 3 (mar 2016), 200–212. doi:10.1089/dia.2015.0299

[19] Trishita Deb. 2024. Diet and Nutrition Apps Statistics 2024 By Tracking, Health — media.market.us. https://media.market.us/diet-and-nutrition-apps-statistics/. [Accessed 08-09-2024].

[20] Anjali Devakumar, Jay Modh, Bahador Saket, Eric P S Baumer, Munmun De Choudhury, and Mun-Mun De. 2021. A Review on Strategies for Data Collection, Reflection, and Communication in Eating Disorder Apps; A Review on Strategies for Data Collection, Reflection, and Communication in Eating Disorder Apps. 21 (2021). doi:10.1145/3411764.3445670

[21] Tilman Dingler, Dominika Kwasnicka, Jing Wei, Enying Gong, and Brian Oldenburg. 2021. The use and promise of conversational agents in digital health. *Yearbook of Medical Informatics* 30, 01 (2021), 191–199.

[22] Elizabeth Victoria Eikey, Clara Marques Caldeira, Mayara Costa Figueiredo, Yunan Chen, Jessica L. Borelli, Melissa Mazmanian, and Kai Zheng. 2021. Beyond self-reflection: introducing the concept of rumination in personal informatics. *Personal and Ubiquitous Computing* (may 2021), 1–16. doi:10.1007/s00779-021-01573-w

[23] Elizabeth V. Eikey and Madhu C. Reddy. 2017. "It's Definitely Been a Journey": A Qualitative Study on How Women with Eating Disorders Use Weight Loss Apps. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI 2017)*. 642–654. doi:10.1145/3025453.3025591

[24] Daniel A. Epstein, Felicia Cordeiro, James Fogarty, Gary Hsieh, and Sean A. Munson. 2016. Crumbs: Lightweight Daily Food Challenges to Promote Engagement and Mindfulness. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2016)*. 5632–5644. doi:10.1145/2858036.2858044

[25] Giannina Ferrara, Jenna Kim, Shuhao Lin, Jenna Hua, and Edmund Seto. 2019. A Focused Review of Smartphone Diet-Tracking Apps: Usability, Functionality, Coherence With Behavior Change Theory, and Comparative Validity of Nutrient Intake and Energy Estimates. *JMIR mHealth and uHealth* 7, 5 (may 2019), e9232. doi:10.2196/mhealth.9232

[26] Andrea Grimes and Richard Harper. 2008. Celebratory Technology: New Directions for Food Research in HCI. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2008), 467–476. doi:10.1145/1357054.1357130

[27] William D. Heizer, Susannah Southern, and Susan McGovern. 2009. The Role of Diet in Symptoms of Irritable Bowel Syndrome in Adults: A Narrative Review. *Journal of the American Dietetic Association* 109, 7 (jul 2009), 1204–1214. doi:10.1016/j.jada.2009.04.012

[28] Grace Holland and Marika Tiggemann. 2016. A systematic review of the impact of the use of social networking sites on body image and disordered eating outcomes. *Body image* 17 (2016), 100–110.

[29] Jack F. Hollis, Christina M. Gullion, Victor J. Stevens, Phillip J. Brantley, Lawrence J. Appel, Jamy D. Ard, Catherine M. Champagne, Arlene Dalcin, Thomas P. Erlinger, Kristine Funk, Daniel Laferriere, Pao Hwa Lin, Catherine M. Loria, Carmen Samuel-Hodge, William M. Vollmer, and Laura P. Svetkey. 2008. Weight Loss During the Intensive Intervention Phase of the Weight-Loss Maintenance Trial. *American Journal of Preventive Medicine* 35, 2 (aug 2008), 118–126. doi:10.1016/j.amepre.2008.04.013

[30] Matthew B. Hoy. 2018. Alexa, Siri, Cortana, and More: An Introduction to Voice Assistants. *https://doi.org/10.1080/02763869.2018.1404391* 37, 1 (jan 2018), 81–88. doi:10.1080/02763869.2018.1404391

[31] Eunkyung Jo, Daniel A. Epstein, Hyunhoon Jung, and Young-Ho Kim. 2023. Understanding the Benefits and Challenges of Deploying Conversational AI Leveraging Large Language Models for Public Health Intervention. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI 2023)*. Article 18, 16 pages. doi:10.1145/3544548.3581503

[32] Eunkyung Jo, Yuin Jeong, Sohyun Park, Daniel A. Epstein, and Young-Ho Kim. 2024. Understanding the Impact of Long-Term Memory on Self-Disclosure with Large Language Model-Driven Chatbots for Public Health Intervention. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2024)*. Article 440, 21 pages. doi:10.1145/3613904.3642420

[33] David Jones. Accessed 08-09-2024. How the MyFitnessPal App got 165 Million Users | LinkedIn. https://www.linkedin.com/pulse/interview-how-myfitnesspal-app-got-165-million-users-david-jones/

[34] Ravi Karkar, Jessica Schroeder, Daniel A. Epstein, Laura R. Pina, Jeffrey Scofield, James Fogarty, Julie A. Kientz, Sean A. Munson, Roger Vilardaga, and Jasmine Zia. 2017. TummyTrials. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2017)*, Vol. 2017-May. 6850–6863. doi:10.1145/3025453.3025480

[35] Taewan Kim, Seolyeong Bae, Hyun Ah Kim, Su-Woo Lee, Hwajung Hong, Chanmo Yang, and Young-Ho Kim. 2024. MindfulDiary: Harnessing Large Language Model to Support Psychiatric Patients' Journaling. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2024)*. Article 701, 20 pages. doi:10.1145/3613904.3642937

[36] Young-Ho Kim, Bongshin Lee, Arjun Srinivasan, and Eun Kyoung Choe. 2021. Data@Hand: Fostering Visual Exploration of Personal Data on Smartphones Leveraging Speech and Touch Interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2021)*. Article 462, 17 pages. doi:10.1145/3411764.3445421

[37] A Baki Kocaballi and Enrico Coiera. 2020. Revisiting Habitability in Conversational Systems. *CHI'20 Extended Abstracts* (2020), 1–8. doi:10.1145/3334480.3383014

[38] Ahmet Baki Kocaballi, Emre Sezgin, Leigh Clark, John M Carroll, Yungui Huang, Jina Huh-Yoo, Junhan Kim, Rafal Kocielnik, Yi-Chieh Lee, Lena Mamykina, Elliot G Mitchell, Robert J Moore, Prasanth Murali, Elizabeth D Mynatt, Sun Young Park, Alessandro Pasta, Deborah Richards, Lucas M Silva, Diva Smriti, Brendan Spillane, Zhan Zhang, and Tamara Zubatiy. 2022. Design and Evaluation Challenges of Conversational Agents in Health Care and Well-being: Selective Review Study. *J Med Internet Res* 24, 11 (15 Nov 2022), e38525. doi:10.2196/38525

[39] Rafal Kocielnik, Raina Langevin, James S. George, Shota Akenaga, Amelia Wang, Darwin P. Jones, Alexander Argyle, Callan Fockele, Layla Anderson, Dennis T. Hsieh, Kabir Yadav, Herbert Duber, Gary Hsieh, and Andrea L. Hartzler. 2021. Can I Talk to You about Your Social Needs? Understanding Preference for Conversational User Interface in Health. ACM (ACM), 1–10. doi:10.1145/3469595.3469599

[40] Rafal Kocielnik, Lillian Xiao, Daniel Avrahami, and Gary Hsieh. 2018. Reflection Companion: A Conversational System for Engaging Users in Reflection on Physical Activity. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 2, 2, Article 70 (jul 2018), 26 pages. doi:10.1145/3214273

[41] Tobias Kowatsch, Marcia Nißen, Chen-Hsuan I Shih, Dominik Rüegger, Dirk Volland, Andreas Filler, Florian Künzler, Filipe Barata, Sandy Hung, Dirk Büchter, et al. 2017. Text-based healthcare chatbots supporting patient and health professional teams: preliminary results of a randomized controlled trial on childhood obesity. *Persuasive Embodied Agents for Behavior Change (PEACH2017)* (2017).

[42] Liliana Laranjo, Adam G. Dunn, Huong Ly Tong, Ahmet Baki Kocaballi, Jessica Chen, Rabia Bashir, Didi Surian, Blanca Gallego, Farah Magrabi, Annie Y.S. Lau, and Enrico Coiera. 2018. Conversational agents in healthcare: A systematic review. *Journal of the American Medical Informatics Association* 25, 9 (2018), 1248–1258. doi:10.1093/jamia/ocy072

[43] Josephine Lau, Benjamin Zimmerman, and Florian Schaub. 2018. Alexa, Are You Listening? *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (nov 2018). doi:10.1145/3274371

[44] Ian Li, Anind Dey, and Jodi Forlizzi. 2010. A Stage-Based Model of Personal Informatics Systems. *Conference on Human Factors in Computing Systems - Proceedings* 1 (2010), 557–566. doi:10.1145/1753326.1753409

[45] Brian Y Lim, Xinni Chng, and Shengdong Zhao. 2017. Trade-off between Automation and Accuracy in Mobile Photo Recognition Food Logging. In *Proceedings of the Fifth International Symposium of Chinese CHI on - Chinese CHI 2017*, Vol. Part F1283. ACM Press, New York, New York, USA, 53–59. doi:10.1145/3080631.3080640

[46] Xi Lu, Yunan Chen, and Daniel A. Epstein. 2021. How Cultural Norms Influence Persuasive Design: A Study on Chinese Food Journaling Apps. *DIS 2021 - Proceedings of the 2021 ACM Designing Interactive Systems Conference: Nowhere and Everywhere* (jun 2021), 619–637. doi:10.1145/3461778.3462142

[47] Xi Lu, Edison Thomaz, and Daniel A. Epstein. 2022. Understanding People's Perceptions of Approaches to Semi-Automated Dietary Monitoring. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 6, 3, Article 129 (sep 2022), 27 pages. doi:10.1145/3550288

[48] Ewa Luger and Abigail Sellen. 2016. "Like Having a Really Bad PA" The Gulf between User Expectation and Experience of Conversational Agents. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI 2016)*. 5286–5297. doi:10.1145/2858036.2858288

[49] Kai Lukoff, Taoxi Li, Yuan Zhuang, and Brian Y. Lim. 2018. TableChat: Mobile Food Journaling to Facilitate Family Support for Healthy Eating. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (nov 2018), 1–28. doi:10.1145/3274383

[50] Yuhan Luo, Young Ho Kim, Bongshin Lee, Naeemul Hassan, and Eun Kyoung Choe. 2021. FoodScrap: Promoting Rich Data Capture and Reflective Food Journaling through Speech Input. In *DIS 2021 - Proceedings of the 2021 ACM Designing Interactive Systems Conference: Nowhere and Everywhere*, Vol. 13. 606–618. doi:10.1145/3461778.3462074

[51] Yuhan Luo, Bongshin Lee, and Eun Kyoung Choe. 2020. TandemTrack: Shaping Consistent Exercise Experience by Complementing a Mobile App with a Smart Speaker. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2020)*. 1–13. doi:10.1145/3313831.3376616

[52] Yuhan Luo, Peiyi Liu, and Eun Kyoung Choe. 2019. Co-Designing Food Trackers with Dietitians. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2019) - CHI 2019*. New York, New York, USA, 1–13. doi:10.1145/3290605.3300822

[53] Deborah Lupton. 2013. Quantifying the body: Monitoring and measuring health in the age of mHealth technologies. *Critical Public Health* 23, 4 (dec 2013), 393–403. doi:10.1080/09581596.2013.794931

[54] Víctor López, Eduardo M. Eisman, and Juan Luis Castro. 2008. A Tool for Training Primary Health Care Medical Students: The Virtual Simulated Patient. In *2008 20th IEEE International Conference on Tools with Artificial Intelligence*, Vol. 2. 194–201. doi:10.1109/ICTAI.2008.50

[55] Lucas M. Silva and Daniel A. Epstein. 2021. Investigating Preferred Food Description Practices in Digital Food Journaling. In *Proceedings of the ACM Designing Interactive Systems Conference: Nowhere and Everywhere (DIS 2021)*. 589–605. doi:10.1145/3461778.3462145

[56] Suma Magge and Anthony Lembo. 2012. Low-FODMAP diet for treatment of irritable bowel syndrome. *Gastroenterology & hepatology* 8, 11 (2012), 739. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3966170/

[57] Lena Mamykina, Elizabeth Mynatt, Patricia Davidson, and Daniel Greenblatt. 2008. MAHI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2008)*. ACM Press, New York, New York, USA, 477. doi:10.1145/1357054.1357131

[58] Evelyn P Meier and James Gray. 2014. Facebook photo activity associated with body image disturbance in adolescent girls. *Cyberpsychology, behavior, and social networking* 17, 4 (2014), 199–206.

[59] Weiqing Min, Shuqiang Jiang, Linhu Liu, Yong Rui, and Ramesh Jain. 2019. A Survey on Food Computing. *Comput. Surveys* 52, 5 (oct 2019), 1–36. doi:10.1145/3329164

[60] Wei Peng Minjin Rheu, Ji Youn Shin and Jina Huh-Yoo. 2021. Systematic Review: Trust-Building Factors and Implications for Conversational Agent Design. *International Journal of Human–Computer Interaction* 37, 1 (2021), 81–96. doi:10.1080/10447318.2020.1807710

[61] Elliot Mitchell, Noemie Elhadad, and Lena Mamykina. 2022. Examining AI Methods for Micro-Coaching Dialogs. In *CHI Conference on Human Factors in Computing Systems*. 1–24. doi:10.1145/3491102.3501886

[62] Elliot G. Mitchell, Rosa Maimone, Andrea Cassells, Jonathan N. Tobin, Patricia Davidson, Arlene M. Smaldone, and Lena Mamykina. 2021. Automated vs. Human Health Coaching. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW1 (apr 2021), 1–37. doi:10.1145/3449173

[63] Joao Luis Zeni Montenegro, Cristiano André da Costa, and Rodrigo da Rosa Righi. 2019. Survey of conversational agents in health. *Expert Systems with Applications* 129 (2019), 56–67. doi:10.1016/j.eswa.2019.03.054

[64] MyFitnessPal. Accessed 08-04-2024. MyFitnessPal: Calorie Counter, Diet & Exercise Journal. https://www.myfitnesspal.com/

[65] Alicia L Nobles, Eric C Leas, Theodore L Caputi, Shu-Hong Zhu, Steffanie A Strathdee, and John W Ayers. 2020. Responses to addiction help-seeking from Alexa, Siri, Google Assistant, Cortana, and Bixby intelligent virtual assistants. *NPJ digital medicine* 3, 1 (2020), 11. doi:10.1038/s41746-019-0215-9

[66] Jon Noronha, Eric Hysen, Haoqi Zhang, and Krzysztof Z Gajos. 2011. PlateMate: Crowdsourcing Nutrition Analysis from Food Photographs. In *Crowdsourcing Nutrition Analysis from Food Photographs. Proceedings of the ACM symposium on User interface software and technology (UIST 2011)*. ACM Press, New York, New York, USA, 1. doi:10.1145/2047196.2047198

[67] Daisy O'Neill, Max V. Birk, and Regan L Mandryk. 2024. Unpacking Norms, Narratives, and Nourishment: A Feminist HCI Critique on Food Tracking Technologies. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI 2024)*. Article 514, 20 pages. doi:10.1145/3613904.3642600

[68] Mashfiqui Rabbi, Min Hane Aung, Mi Zhang, and Tanzeem Choudhury. 2015. MyBehavior: automatic personalized health feedback from user behaviors and preferences using smartphones. In *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp 2015)*. 707–718. doi:10.1145/2750858.2805840

[69] Bradley Rey, Yumiko Sakamoto, Jaisie Sin, and Pourang Irani. 2024. Understanding User Preferences of Voice Assistant Answer Structures for Personal Health Data Queries. In *Proceedings of the 6th ACM Conference on Conversational User Interfaces (CUI 2024)*. Article 17, 15 pages. doi:10.1145/3640794.3665552

[70] Ronda Ringfort-Felner, Matthias Laschke, Shadan Sadeghian, and Marc Hassenzahl. 2022. Kiro: A Design Fiction to Explore Social Conversation with Voice Assistants. *Proceedings of the ACM on Human-Computer Interaction* 6, GROUP (jan 2022). doi:10.1145/3492852

[71] John Rudnik, Sharadhi Raghuraj, Mingyi Li, and Robin N. Brewer. 2024. CareJournal: A Voice-Based Conversational Agent for Supporting Care Communications. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2024)*. Article 526, 22 pages. doi:10.1145/3613904.3642163

[72] Donald A Schön. 2017. *The reflective practitioner: How professionals think in action.* Routledge.

[73] Scott H. Sicherer and Hugh A. Sampson. 2014. Food allergy: Epidemiology, pathogenesis, diagnosis, and treatment. doi:10.1016/j.jaci.2013.11.020

[74] Katie A. Siek, Kay H. Connelly, Yvonne Rogers, Paul Rohwer, Desiree Lambert, and Janet L. Welch. 2006. When Do We Eat? An Evaluation of Food Items Input into an Electronic Food Monitoring Application. In *2006 Pervasive Health Conference and Workshops*. IEEE, 1–10. doi:10.1109/PCTHEALTH.2006.361684

[75] Lucas M. Silva, Elizabeth A. Ankrah, Yuqi Huai, and Daniel A. Epstein. 2023. Exploring Opportunities for Multimodality and Multiple Devices in Food Journaling. *Proc. ACM Hum.-Comput. Interact.* 7, MHCI, Article 209 (sep 2023), 27 pages. doi:10.1145/3604256

[76] Lucas M. Silva, Franceli L. Cibrian, Elissa Monteiro, Arpita Bhattacharya, Jesus A. Beltran, Clarisse Bonang, Daniel A. Epstein, Sabrina E. B. Schuck, Kimberley D. Lakes, and Gillian R. Hayes. 2023. Unpacking the Lived Experiences of Smartwatch Mediated Self and Co-Regulation with ADHD Children. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Hamburg, Germany) *(CHI 2023)*. Article 90, 19 pages. doi:10.1145/3544548.3581316

[77] Konstantin R. Strömel, Stanislas Henry, Tim Johansson, Jasmin Niess, and Paweł W. Woźniak. 2024. Narrating Fitness: Leveraging Large Language Models for Reflective Fitness Tracker Data Interpretation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2024)*. Article 646, 16 pages. doi:10.1145/3613904.3642032

[78] Tammy Toscos, Kay Connelly, and Yvonne Rogers. 2012. Best Intentions: Health Monitoring Technology and Children. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Austin, Texas, USA) *(CHI '12)*. 1431–1440. doi:10.1145/2207676.2208603

[79] Christopher C Tsai, Gunny Lee, Fred Raab, Gregory J Norman, Timothy Sohn, William G Griswold, and Kevin Patrick. 2007. Usability and Feasibility of PmEB: A Mobile Phone Application for Monitoring Real Time Caloric Balance. *Mobile Networks and Applications* 12, 2-3 (jun 2007), 173–184. doi:10.1007/s11036-007-0014-4

[80] Sarah Theres Völkel, Daniel Buschek, Malin Eiband, Benjamin R. Cowan, and Heinrich Hussmann. 2021. Eliciting and Analysing Users' Envisioned Dialogues with Perfect Voice Assistants. *Proceedings of the ACM Conference on Human Factors in Computing Systems* (feb 2021). doi:10.1145/3411764.3445536

[81] Jing Wei. 2021. Understanding User Perceptions of Proactive Smart Speakers; Understanding User Perceptions of Proactive Smart Speakers. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol* 5 (2021), 28. doi:10.1145/3494965

[82] Jing Wei, Sungdong Kim, Hyunhoon Jung, and Young-Ho Kim. 2024. Leveraging Large Language Models to Power Chatbots for Collecting User Self-Reported Data. *Proc. ACM Hum.-Comput. Interact.* 8, CSCW1, Article 87 (apr 2024), 35 pages. doi:10.1145/3637364

[83] Jordan Wirfs-Brock, Sarah Mennicken, and Jennifer Thom. 2020. Giving Voice to Silent Data: Designing with Personal Music Listening History. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2020)*. ACM (ACM), 1–11. doi:10.1145/3313831.3376493

[84] Svetlana Yarosh, Stryker Thompson, Kathleen Watson, Alice Chase, Ashwin Senthilkumar, Ye Yuan, and A. J.Bernheim Brush. 2018. Children asking questions: Speech interface reformulations and personification preferences. In *IDC 2018 - Proceedings of the 2018 ACM Conference on Interaction Design and Children*. 300–312. doi:10.1145/3202185.3202207

[85] Mila Zečević, Dejan Mijatović, Mateja Kos Koklič, Vesna Žabkar, and Petar Gidaković. 2021. User Perspectives of Diet-Tracking Apps: Reviews Content Analysis and Topic Modeling. *J Med Internet Res* 23, 4 (22 Apr 2021), e25160. doi:10.2196/25160