Methods for Co-Designing Conversational Interactions for Digital Food Journaling

Lucas M. Silva
University of California, Irvine
Irvine, CA, USA
silvald@ics.uci.edu

David V. Nguyen
University of California, Irvine
Irvine, CA, USA
dvnguye5@ics.uci.edu

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

ABSTRACT

Conversational voice interfaces have the potential to reduce some challenges of digital food journaling by leveraging availability in multiple devices, allowing for multi-tasking through hands-free interactions, and conversationally construct food logs. Traditionally, journaling has been supported mainly through database searches, barcode scanning, photo-taking, open-ended text description, and voice memos. To explore how technology can expand these journaling options to support conversational journaling, we have been preparing a co-design study to elicit people's desired conversational interactions and understand how those align with their personal eating goals and vary by situations or constraints.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in interaction design**; **User studies**; **Auditory feedback**.

KEYWORDS

Food journaling; personal informatics; voice assistants; design elicitation

Figure 1: Context cards to be used during design activities by study participants to describe situational circumstances around a meal, and what information about the meal should the VA record for later recollection (e.g., nutritional information, some context, time of meal)

INTRODUCTION

Tracking one's food has become one of the most popular forms of personal tracking, with 42% of U.S. adults having used a mobile app for food tracking as of 2017 [1]. Commercial food journaling apps and prior research tend to mainly support a limited set of input modalities through phone apps, but there is opportunity for leveraging conversational user interfaces (CUI), such as voice assistants (VA), to allow for food journaling. CUIs that leverage voice interactions afford multitasking, hands free interaction, and conversation [15], all of which can be situationally beneficial for logging one's foods. Additionally, CUIs have been incorporated in a plethora of devices, such as smart speakers, phones, cars, and smartwatches. This pervasiveness can increase availability for food journaling in different situations.

Prior research has primarily supported food journaling through barcode and database lookup of food items [9, 16] and capturing foods in the form of photos, open text description, and voice memos [5, 13]. However, studies have identified challenges with and limitations of these approaches. For example, food journaling can be burdensome, require significant effort for creating detailed logs, or not support accurate description of some kinds of foods and their portion sizes [6]. In addition, some foods can be hard to search for or not be available in databases (e.g., ethnic foods, home-cooked meals) [6, 9]. CUIs can potentially allow for additional ways of journaling and might lessen some of these challenges.

Despite the potential, little is known about people's preferences for interacting with CUIs to journal their foods. Also, less is known on how people's journaling goals and circumstances around journaling might influence desired voice interactions. For example, a person desiring to learn more about the nutritional makeup of their food might desire conversational feedback which elicits this information. In addition, a person's location, type of meal, and the presence of others close by might be relevant for how they wish to talk with CUIs.

In light of CUI's potential for food journaling and related open questions, we have been preparing a remote synchronous co-design study that will explore people's desires for voice interactions in different contexts and under different constraints. This will allow us to elicit CUI designs that align with people's goals and that will support collection of food logs and reflection on their eating behaviors. Our study is particularly focused on voice assistants (VAs), due to their increasing popularity and availability across many devices. The study consists of co-design role-playing activities using cards to describe desired back-and-forth utterances, understand the influence of circumstantial context and events, and elicit ideal underlying journaled data.

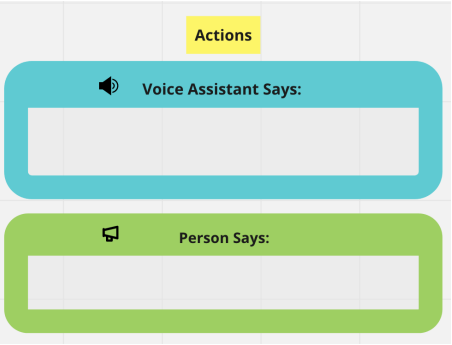

Figure 2: Action cards to elicit interactions between the study participant and the VA.

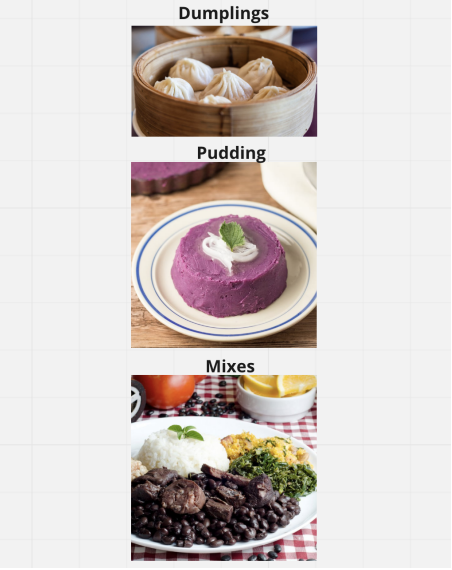

Figure 3: Participants will be presented with pictures of unfamiliar foods or foods with unclear ingredients to elicit CUI interactions under uncertainty.

BACKGROUND

Our study design is informed by previous research of food journaling, and CUIs for personal informatics.

Food Journaling

The popularity of food journaling has led to increased availability of systems that support different input modalities that allow for food logging. Digital food journaling has been used to support people's personal goals related to weight control [3, 16], disease management [4, 7], and being mindful of healthier food choices [11, 14].

Many digital systems seek to support collecting quantitative aspects of foods through barcode scanning and database searches, collating information such as calories and other nutrients. Nonetheless, database searches have challenges related to reliability of nutritional feedback, estimating amount, and missing foods [6, 9], while barcodes can nudge people towards less healthy packaged foods [6]. Other efforts have aimed to promote awareness, such as recording contextual and emotional aspects associated with meals. These systems often use more open-ended modalities, such as pictures and text description fields, to allow people to reflect about their food consumption and health while reducing some barriers to journaling present in other input modalities [5].

Conversational Interfaces for Personal Informatics

CUIs have been studied in a few personal informatics domains. For instance, in TandemTrack [12], Luo et al. examine how CUIs can support physical activity guidance and review jointly across mobile devices and VAs. Kim et al. explored the use of speech and touch interactions on phones for reflecting on physical tracking history [10]. Through the design and evaluation of Data@Hand, a mobile app, they indicated that multimodal interactions were useful to help people find personal insights about their health behavior. Wirfs-Brock et al. explored opportunity for VA interactions based on personal music listening data through co-design activities [17], positing that VAs could evolve to intelligent coaches that leverage personal data. We build on Wirfs-Brock et al.'s methods for eliciting interactions with VAs to explore food journaling capabilities under various circumstances and for different goals.

STUDY DESIGN

We will recruit participants with diverse food journaling goals, including weight control, disease management, and those with general awareness of health and eating habits. The study consists of co-design activities where participants will depict their ideal interactions between themselves and a VA for journaling and reflecting on their food consumption.

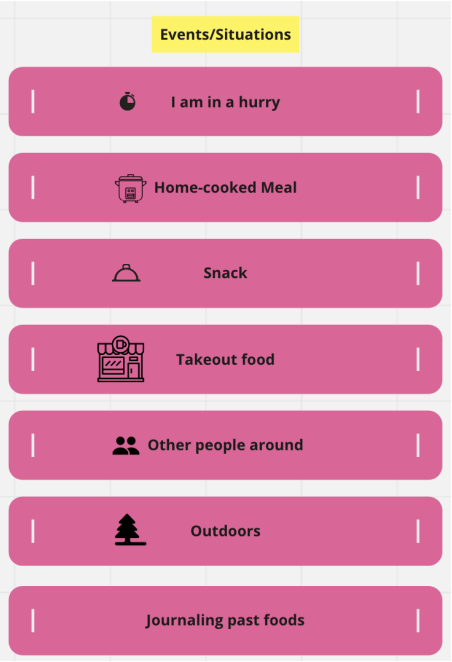

Figure 4: Cards representing situations which might impact the conversation a person desires having with a VA, which can be added to conversational flows in the co-design activity to contextualize role-playing scenarios.

Due to the COVID-19 pandemic, we will conduct our study virtually through video conferencing using a shared virtual whiteboard tool, such as Miro [2], to allow participants and researchers to collaboratively manipulate a shared visual space by managing shapes, notes, images, etc. The whiteboard tool will be used to describe everyday journaling scenarios and use cards to map conversation and contexts (Figures 1 and 2).

We will ask participants to take pictures of their consumed foods for one day before the co-design study. We will use these pictures to plan and role-play journaling with foods the participants are familiar with. For the pictures participants bring, we will select appropriate context cards (Figure 1) to role-play a situation where they might journal the same food with a VA instead. Throughout this activity, we will manipulate and fill in action cards (Figure 2) to describe utterances the person and the VA might make during a journaling interaction.

To better understand how participants might imagine using a VA for journaling in everyday settings, we will use another scenario to elicit conversational strategies for journaling an unfamiliar food. We will present participants a hypothetical situation where they are journaling a food that they did not make or purchase (e.g., a food they received as a gift, food at a party or gathering), where they are therefore unsure about the components of foods (e.g., contents of a dumpling) or might not be able to name it (Figure 3). Researchers and participants will then map voice interactions to journal the chosen food and highlight if and how such situations might impact interactions with VAs. We will then insert situational cards (Figure 4) into the conversational flows that participants designed to stimulate them to ponder on the effect of these circumstances on how they would wish to interact with a VA.

People often reflect on data as they collect it as well as posteriorly [8]. We will use the scenarios to explore what information a person might wish about their consumed foods as they journal, for a current day, previous week, or some other time frame. We expect participant preferences to be goal-dependent, enabling us to understand how VAs could support specific and holistic feedback. With participants who have a more quantitative goal, we will be able to probe how VA feedback should aim to summarize nutritional data. Participants with more awareness-focused goals might desire more open-ended feedback, enabling us to learn what data these participants want VAs to record and how to report on them.

PRELIMINARY STUDY PILOT

We piloted the study with one participant to evaluate the activities and technical procedures. We observed that the study design allowed for useful elicitation of interactions in various scenarios of food journaling. Using pictures from the participant's real-life eating moments enabled us to explore journaling of familiar foods under realistic contexts (e.g., Figures 5 and 6). The participant constructed different branches of conversation flow according to different situations. For example, journaling a full meal for the first time required detail of each food item, whereas if it is a repeated food they could

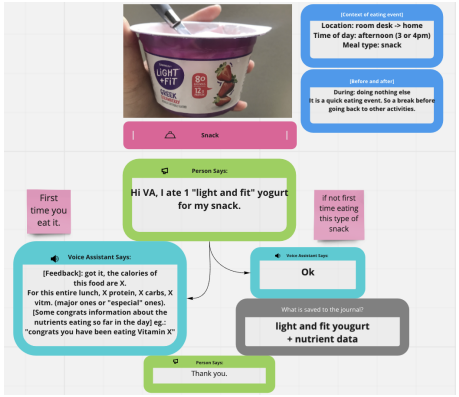

Figure 5: Pilot activity for journaling a snack. The participant wanted nutritional feedback only the first time this type of food was journaled.

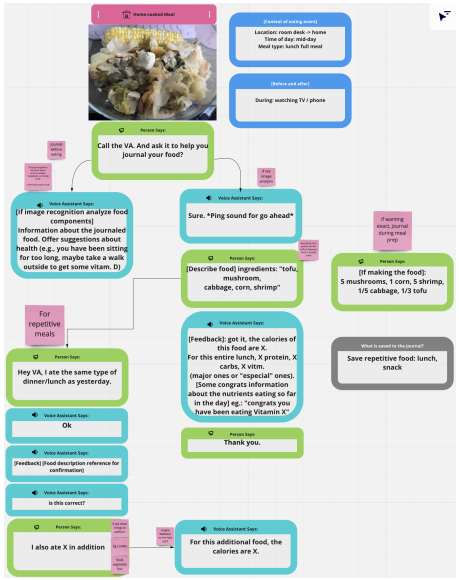

Figure 6: Pilot activity with a picture provided by the participant. The participant created different conversation flows based on several conditions, including if journaling while preparing the meal or as they eat, if this is a routine food, and when adding more food items (e.g., a dessert).

just reference the previous eating moment: "*Hey VA, I ate the same type of dinner/lunch as yesterday.*" (Figure 6). For her, conversations could also differ if journaling while eating versus while cooking, full meals versus snacks, and novel foods versus routine ones.

The use of a shared virtual whiteboard allowed for collaboration as well as for visual feedback about what was being discussed. However, as the participant was often answering activity prompts and thinking aloud, the researcher often had the responsibility of manipulating the cards to react to what participants were describing. Familiarity with the tool also impacts the ease of jointly manipulating elements. We therefore plan to incorporate a tutorial phase before the co-design activities. We also learned through our pilot that the freedom of a blank slate to map ideal voice interactions also allowed for flexibility, but required structure through role-playing and scenario-building to stimulate the participant to ponder on desired interactions.

Workshop Participation

We are excited to discuss methods for designing conversational user interfaces and learn from how others have elicited people's desired conversational interactions in their domains. Although support for VAs in multiple devices has become increasingly pervasive in people's lives, there are still many challenges in designing interactions that align with people's needs and expectations for collecting and reflecting on their personal data. We hope to discuss these expectations and ways to better design satisfying voice interactions.

ACKNOWLEDGMENTS

We thank our pilot participant. This research was supported in part by the National Science Foundation under award IIS-1850389.

REFERENCES

[1] 2017. *E-health application categories used by U.S. adults 2017 | Statista.* Retrieved February 26, 2021 from https://www.statista.com/statistics/378850/top-mobile-health-application-categories-used-by-us-consumers/

[2] 2021. *Miro, The online whiteboard for easy collaboration.* Retrieved February 26, 2021 from https://miro.com/

[3] Lora E. Burke, Molly B. Conroy, Susan M. Sereika, Okan U. Elci, Mindi A. Styn, Sushama D. Acharya, Mary A. Sevick, Linda J. Ewing, and Karen Glanz. 2011. The effect of electronic self-monitoring on weight loss and dietary intake: A randomized behavioral weight loss trial. *Obesity* 19, 2 (feb 2011), 338–344. https://doi.org/10.1038/oby.2010.208

[4] Chia-Fang Chung, Qiaosi Wang, Jessica Schroeder, Allison Cole, Jasmine Zia, James Fogarty, and Sean A. Munson. 2019. Identifying and Planning for Individualized Change. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 3, 1 (2019), 1–27. https://doi.org/10.1145/3314394

[5] Felicia Cordeiro, Elizabeth Bales, Erin Cherry, and James Fogarty. 2015. Rethinking the mobile food journal: Exploring opportunities for lightweight photo-based capture. In *Conference on Human Factors in Computing Systems - Proceedings*, Vol. 2015-April. 3207–3216. https://doi.org/10.1145/2702123.2702154

[6] 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. *Conference on Human Factors in Computing Systems - Proceedings* 2015-April (2015), 1159–1162. https://doi.org/10.1145/2702123.2702155

[7] Alaina Darby, Matthew W Strum, Erin Holmes, and Justin Gatwood. [n.d.]. A Review of Nutritional Tracking Mobile Applications for Diabetes Patient Use. *Diabetes Technology Therapeutics* 18, 3 ([n. d.]), 200–212. https://doi.org/cspv

[8] Daniel A. Epstein, An Ping, James Fogarty, and Sean A. Munson. 2015. A lived informatics model of personal informatics. In *UbiComp 2015 - Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. Association for Computing Machinery, Inc, 731–742. https://doi.org/10.1145/2750858.2804250

[9] Jisu Jung, Kalina Yacef, Margaret Allman-farinelli, Judy Kay, Lyndal Wellard-Cole, Colin Cai, Irena Koprinska, and Margaret Allman-Farinelli. 2020. Foundations for Systematic Evaluation and Benchmarking of a Mobile Food Logger in a Large-scale Nutrition Study. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol* 4, 2 (2020), 47. https://doi.org/10.1145/3397327

[10] Young-Ho Kim, Bongshin Lee, Arjun Srinivasan, Eun Kyoung Choe, 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. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)* 21 (jan 2021). https://doi.org/10.1145/3411764.3445421 arXiv:2101.06283

[11] 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. 53–59. https://doi.org/10.1145/3080631.3080640

[12] 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 2020 CHI Conference on Human Factors in Computing Systems*. ACM, 1–13. https://doi.org/10.1145/3313831.3376616

[13] Lena Mamykina, Elizabeth Mynatt, Patricia Davidson, and Daniel Greenblatt. 2008. MAHI: Investigation of Social Scaffolding for Reflective Thinking in Diabetes Management. In *Proceeding of the twenty-sixth annual CHI conference on Human factors in computing systems - CHI '08*. 477. https://doi.org/10.1145/1357054.1357131

[14] G. A. O'Reilly, L. Cook, D. Spruijt-Metz, and D. S. Black. 2014. Mindfulness-based interventions for obesity-related eating behaviours: A literature review. *Obesity Reviews* (2014). https://doi.org/10.1111/obr.12156

[15] Martin Porcheron, Joel E. Fischer, Stuart Reeves, and Sarah Sharples. 2018. Voice interfaces in everyday life. *Conference on Human Factors in Computing Systems - Proceedings* 2018-April (2018), 1–12. https://doi.org/10.1145/3173574.3174214

[16] 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. https://doi.org/10.1007/s11036-007-0014-4

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