# Facilitating Mindful Eating with a Voice Assistant

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## ABSTRACT

In our busy lives, meals are being squeezed into shorter times, or fit into multitasking routines of watching videos and scrolling through social media. This can lead to eating quickly without considering the food choices and overeating. Mindful eating has been promoted as an effective method to combat mindless eating with various tools available to facilitate mindfulness practices. However, the use of voice assistants to facilitate mindful eating is rather limited. We developed a voice assistant to facilitate mindful eating activities and conducted a field study with four participants over six days. We examined how the social role of the voice assistant, acting as a friend or a counselor, affects mindful eating experiences. The results suggest that voice assistants can assist users in mindful eating, however, participants preferred the friend version of the voice assistant. Implications for the design of voice assistants for mindfulness activities are provided.

## CCS CONCEPTS

• **Human-centered computing** → **Personal digital assistants**.

## KEYWORDS

mindfulness, eating, mindful eating, voice assistant

## 1 INTRODUCTION

In the last few years, HCI has shown a proliferation of interest in food [14, 15, 27], and a variety of technologies have been developed to support food preparation [39], choice of food [53, 54], and reflect on eating habits [52]. This is because food plays a significant role in all of our daily lives, it is not only a necessity for survival but also a way of socializing, as taking part in the preparation and consumption of food can bring people together [27, 29]. However, in their busy daily life, people finish meals without being aware of how much they ate, what type of food they consumed, and when they have reached the point of satiety [4]. They often rely on external cues in order to identify how much they have eaten and when to stop, such as empty bowls or plates, or the end of a television program rather than the physical experience of being satisfied, which can lead to an increase in food intake [38].

Mindlessness has been defined as the automatic acceptance of information without consideration of new or different information, resulting in a constant acceptance of the existing state of affairs, autopilot behavior, and paying less attention to when and what to eat [29]. As a result, mindlessness can lead people to avoid unfamiliar foods [29] and pay less attention to the nuances of food they eat. Mindfulness has been promoted as a means to combat mindless eating [4] resulting in the individual becoming aware of their habits and responding appropriately [20]. Often, mindfulness practices are conducted in groups with a facilitator who guides the participants through a variety of exercises [34]. This can present some challenges to the participants since they must attend meetings that fit into their schedules and some participants feel uncomfortable participating and disclosing in social sessions [60]. There are several other ways to practice mindfulness, including videos, books, and mobile applications and a variety of technologies have been developed to support mindfulness, such as virtual reality (VR) systems [24, 28, 32, 33, 43, 47], mobile applications [12, 21, 23], or tangibles [5, 59]. Recently, voice assistants have been gaining popularity and acceptance, taking up roles in our lives helping in various contexts, such as support social interactions for older adults [44], promote the development of self-regulated learning [49], facilitate self-reflection on collaborative activities [41], persuade people to exercise [40], and controlling entertainment consumption [10]. Nevertheless, limited research has been conducted in the past concerning the use of voice assistants in mindfulness practices.

In this paper, we share outcomes from a pilot study we conducted with a voice assistant taking the roles of either a friend or a counselor that facilitates mindful eating through conversational interactions. The findings provide detailed accounts of how participants responded to the assistants. We distill the findings into three implications for the design of voice assistants for supporting mindfulness activities.

## 2 RELATED WORK

### 2.1 Mindfulness

Mindfulness is defined as *"the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment [16]."* It is a form of meditation and was first introduced by Jon Kabat-Zinn in the 1970s [51]. In general, mindfulness is characterized by two features, paying attention and being aware of the present moment experiences and being open or accepting of one's experiences. According to a study by Ghanizadeh [25], people's minds wander 47% of the time away from the present moment. In order to practice mindfulness, many practices have been established, such as breathing meditation, eating meditation, and walking meditation for the purpose of reduction in anxiety, depression, stress, and eating disorders [48]. Mindfulness is both an ability and a practice that can be learned and practiced through various attention exercises including formal and informal activities [7, 57].

## 2.2 Mindful eating

Mindful eating is essentially *"non-judgmental awareness of physical and emotional sensations while eating or in a food-related environment" [31]*. It is one of the mindfulness-based practices, which is used to assist people to reduce unhealthy eating habits. By practicing mindful eating, people are encouraged to be fully present with the food they are eating by engaging their five senses, such as sight, touch, smell, taste, and sound, and help people to become aware of their eating habits as well as make appropriate changes. In addition, a study by Allirot et al [1] shows that mindful eating has also been shown to reduce emotional eating, uncontrolled eating, and improve reactions to the craving, resulting in people being able to resist snack temptations and reduce the consumption of unhealthy foods [1].

Arch et al. [2] conducted a study to determine whether mindful eating practices can improve their enjoyment of food. In the study, they explored the effect of mindfully tasting foods with generally positive associations, such as chocolate, and with more neutral or mixed associations, such as raisins. Findings showed that mindful eating was able to enhance people's enjoyment and desire to continue eating. Additionally, they also found mindfulness can promote more healthy food choices as it reduces people's consumption of unhealthy foods [2] and can promote a willingness to try unfamiliar foods [29].

In a recent study with a smart environment prototype, a conversational agent was used to support mindful eating [42]. In that study, participants interacted with a voice agent that guided mindfulness while drinking tea or listened to music while drinking tea. Their findings suggest that mindfulness can be encouraged using a voice agent, however, that study was conducted in a lab-based setting with sessions lasting 20 minutes.

## 2.3 Voice Assistants

Voice assistants have become increasingly popular and effective for digital mental health interventions [6, 8, 22] often taking the role of a counselor to assist with challenges including anxiety, depression, and eating disorders, among others. As a complement to traditional support, voice assistants offer convenience for users, low cost, quick response, and accessibility whenever needed [11]. A study by Vaidyam et al. [58] explored the role of conversation agents in the screening, diagnosis, and treatment of mental illness and found that a chatbot can be more effective for those people who feel uncomfortable speaking with a therapist or unwilling to share sensitive information with a human therapist [58]. Stawarz and Ottaviano [55] explored various types of social support that can be provided by artificial agents and developed "a friend who always listens" and has the ability to express feelings and to ask questions in order to encourage users to open up and share their emotions [17]. In their study [55], the chatbot offered companionship and advice that reduced loneliness and increased well-being by sending encouraging messages to make them feel loved and cared for.

## 3 RESEARCH QUESTION

Voice assistants have been shown to be helpful in various contexts, however, there is little research regarding the use of voice assistants

**Table 1: An example of the two voice assistants' conversation styles**

| Role | Example of conversation |
|------|-------------------------|
| Counselor | *"Now, I would like you to engage your taste. When you are ready, shift your attention from awareness of smells to awareness of taste. Place the chocolate in your mouth and begin to chew, observing any flavors that arise. Allow yourself to experience and savor the taste. As best as you can, pay attention to the texture of the chocolate change as you are chewing and breaks down with every bite. How does the chocolate taste?"* |
| Friend | *"Good, now, let's taste the chocolate. Are you ready to shift your attention from sense of smell to your sense of taste? Put the chocolate in your mouth, chew it slowly. Do you notice any flavors? What does the chocolate taste like? Can you notice any changes in taste and texture?"* |

to practice mindful eating. Therefore, in this paper, we are interested in exploring: *How can a voice assistant encourage mindful eating? Furthermore, how would the role of voice assistant be helpful in this process for example could it take the role as a friend or a counselor and how could it affect the encouragement of mindful eating?*

## 4 METHOD

We present a field study in which participants used two versions of a voice assistant (VA) application to practice mindful eating. The purpose of the study is to identify which VA role users prefer and to understand how a VA application can encourage mindful eating.

### 4.1 Participants

We recruited four participants from Denmark aged 23 to 29 with an average age of 26 including two females and two males. Participants had varying experiences with voice assistants, whereas 3 claimed to have used voice assistants on phones or physical devices, and one claimed to have had no previous experience with voice assistants.

### 4.2 Materials

A mindfulness VA application was implemented using Google Actions and accessed with Google Nest Mini 2 devices. We used Firebase to store the user information and the speech synthesis markup language (SSML) to modify the speed of the voice to create more natural-sounding speech. We designed two versions of the application with different conversation styles inspired by Rhee and Choi's study [46] and chose different words and conversation styles in order to distinguish the two versions. In the counselor version, the context of the conversation is based on Wnuk and Du's [62] mindful eating script and has a formal conversational tone, using professional words with a more specific recommendation and guidance. The friend version has a casual conversational tone, using words that are commonly used in daily conversations, and asking more
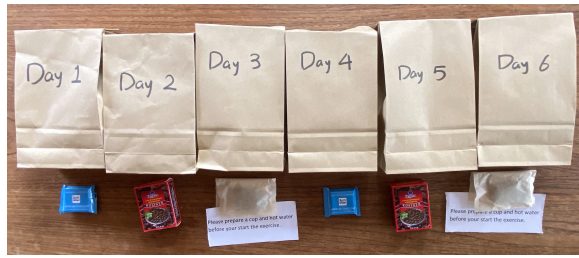
Figure 1: *Six bags with the food for the study*

questions rather than just giving a specific recommendation. In addition, the friend version provides less guidance than the counselor version. Example scripts are shown in Table 1.

When the participants began the study, the VA provided a brief introduction to Mindeating. Then, they were guided through a mindful eating exercise. After each activity, the VA asked the participant to discuss their feelings and experiences.

### 4.3 Measures

We measured participants' responses to the two versions of the VA application with conversation logs and self-reported feedback. Conversation logs provided a measure of the response length (word count) in conversations, and evidence of mindfulness, which can improve the ability to put sensations, perceptions, emotions, thoughts, or feelings into words [3].

Self-reported data was gathered from the semi-structured interview and a SUS questionnaire. In the semi-structured interview, the participants were asked about their experience with using the voice assistant to practice mindful eating. In addition, they were also asked to answer a SUS questionnaire [30] twice, once after interacting with each VA for the 3 days.

### 4.4 Procedure

We conducted a field study over six days with the VAs deployed in the homes of the participants. Six bags were given to them, one to be opened for each days' activites–see Figure 1. The bags contained chocolate [2], raisins [2], and Chinese tea [26].

They were instructed to decide for themselves where to place the voice assistant. We provided a brief presentation of the project and guided them through the main functions of the VA application. In order to avoid experimental bias, we did not inform the participants of the role of each voice assistant, but simply referred to them as "version A&B." Participants were guided through the tasting tasks each day in the following order: chocolate, raisins, and then Chinese tea, as sweet tastes are easier to identify [56], while other tastes are more challenging to identify [56], and can require more experiences of mindfulness. In order to control for the effects of presentation order, participants were randomly asked to engage with either the Counselor version or the Friend version of the VA application first. Participants were informed that their conversations with the VAs would be recorded.

## 5 RESULTS

Participants overall rated the usability of both VAs quite high with SUS scores on average 78.75 for the counselor version and 81.75 for the friend version. Further analysis of the logs and self-reported feedback provides deeper insights about the differences.

Participants were asked about their feelings about the food they ate during the mindful eating exercises. The length of responses in total word count increased with time of use for both VAs. The average length of response was from 47.5 (SD=16,8) to 89.5 (SD=10) words for the friend version and from 114 (SD=19.8) to 135 (SD=18.4) words for the counselor version. In addition, we found that when the participant used the friend version, they reported more about their feelings about the food (M=117, SD=24.4) words, than when they used the counselor version (M=78.5, SD=19.1) words.

The data from the logs and interviews were analyzed using thematic analysis. We now discuss the emergent themes relating to overall use, the counselor and friend versions, and future use.

### 5.1 Overall experiences

All four participants reported that both versions of the VA application could help them pay more attention to the food they eat, and both seemed to help them have a better understanding of mindful eating. P1 expressed that: *"I have learned how to enjoy the food. It teaches me how to eat, how to smell and taste food, instead of just eating the food without thinking so much."* In addition, most participants were positive about using the voice assistant guiding them through mindful eating exercises as P4 mentioned: *"I can see the benefit of using a voice assistant to do exercises because I can pay full attention to the food while listening to guidance."* All the participants thought a reminder function is needed. P2 stated: *"if I have a busy day, I will just forget to do the exercise."* later she added: *"A reminder function would be helpful to remind me that it is time to exercise."*

Participants also mentioned ways to improve the interaction. P1 stated: *"I would like to have some feedback from the voice assistant, such as if I am doing the exercise too fast, then it can tell me I should slow down next time."* P4 suggested: *"It could log what I have eaten for one week, and at the beginning of next week it could tell what I ate last week and give some suggestions about how I can improve my eating behavior."*

### 5.2 Counselor VA

Some feedback was unique for the counselor VA. Two of the participants indicated that it was similar to a counselor or facilitator because it provides detailed guidance in order to help them practice mindful eating. However, two of the participants explained this version of the voice assistant as a machine, as P1 expressed: *"it did not give me any response, and just asked me to do a similar thing every time."* In the conversation log of the counselor version, two participants mentioned, that using the application while eating helped them enjoy the food more.

P4 was the most positive toward this version: *"I think this version is good, especially for the people who never practice mindful eating. it provides a detailed description of how I can engage my sensation while eating."* However, other participants found the detailed description led them to lose motivation as P3 stated: *"It is nice to have a detailed description of exercise for a few times or for the new user, so I can*

*learn how to eat, but when I already know how to do the exercise, I will lose patience to listen to the long description."* Additionally, P2 expressed: *"I think I pay more attention to listen to the guidance instead of the food when I am using it for the first time."* later, she added: *"the guidance is a little bit too detailed and too long, I will spend time to think about how to perform the exercise rather than enjoy the food."*

### 5.3 Friend VA

There was feedback unique to the friend version as well. Overall, three of the four participants preferred it over the counselor version. P2 mentioned: *"I like the way it spoke, these questions help me think more, I think I am more aware of the food I am eating."* According to the conversation log in the friend version, two participants said that using the application while eating increased their enjoyment of the food. Two participants expressed a desire to eat the food again, although it was described as food they normally disliked. All the participants remarked that the conversation style of this version was different than the other version. Most participants could feel this version tried to act as a friend because it shared its own thoughts on the food the participant eat as a friend did. However, the participants found it difficult to see it as a friend, as P2 stated: *"I know it tries to act as a friend, and share with me some feelings about the food in the beginning, but it did not give me any response to what I said later, so I can not really see it as a friend."*

### 5.4 Future use

Three of the four participants raised doubts about using the VAs for an extended time noting that it seemed repetitive in how it guided them in the activities. However, one participant claimed that he would continue to use the application afterward: *"...I have found a way to slow down my eating speed. So I think I will use it afterward, I hope it can help me to improve my eating habits."*

## 6 DISCUSSION

### 6.1 Motivation

According to our questionnaire results and the participant reports, we found that motivating users to use our app over the long term can be difficult. Based on the responses of the participants, we determined that a technical issue might lead to a decrease in motivation to use the application as technical issues may cause a user to become frustrated and lose patience even when resolved quickly. There are various studies in which the use of voice assistant applications reported high levels of user satisfaction, but low levels of intention to continue engaging with the technology [41, 45]. With this in mind, we should consider some improvements to the VA to motivate users to continue using the application. An improvement could be to make the data visible so that participants could see how much time they spent on the exercise and what they ate during the week. This enables the user to compare past eating behavior with current eating behavior, allowing them to see how their eating practices have changed over time.

### 6.2 Mindfulness

According to all four participants, the applications improved their awareness of the food they ate. Furthermore, most participants reported that the application increased their willingness to try novel foods and dislike food, as well as their enjoyment of food, which is consistent with the results of Hong et. al [29]. In addition, the results of conversation logs have also shown the participant's levels of mindfulness increase by using the application over time.

### 6.3 Identity: Friend vs Counselor

The majority of participants stated that they preferred the have the friend version of the VA rather than the counselor version. Even though some participants claimed that detailed guidance they received from the counselor can help a new user learn how to practice mindful eating easier, they noted that repeated exposure to the detailed description over time could result in a loss of patience to practice exercising. The design and presentation of the identity of the VA should be investigated further. Research on behavior and emotional responses to AI teammates in games also suggest that beyond the actual behaviors and actions, the identity of the agent shapes the expectations, and perceptions [36]. Attitudes toward virtual agents have been shown to be rather negative in cooperative tasks [37] in comparison to interactions with another person [35]. Recent work exploring humor as a repair strategy in conversation breakdowns with virtual assistants suggests that people respond in unpredictable ways to the personalities of a voice assistant [13].

### 6.4 Design implications

To benefit other researchers or designers who would like to use virtual assistants for mindfulness activities with users, we distill the main findings into three implications for design [19, 50].

**1) Break down complex tasks:** Similar to Branham et al.'s [9] study, our participants found that longer responses are particularly difficult to follow and can lead to feelings of being overwhelmed. It can be beneficial to break down complex guidance into a number of smaller steps to reduce the mental workload and keep the activity simple so the user can more effectively practice mindful eating.

**2) Choose Level of Detail:** In the VA roles we developed, the counselor was perceived as giving more detailed guidance, which users remarked could be best for new users, however, once they become proficient in the tasks, the friend version providing less detail might be more enjoyable and can allow them to think for themselves about the food. Choosing the level of detail and adjusting the level of detail along the way may beneficial and is similar to the strategy of "tapering" [18].

**3) Provide context-specific feedback:** Participants asked if the counselor VA could provide feedback about their daily eating habits and adjust the guidance based on the previous day's results. Participants also suggested that the friend VA could show more empathy and provide context-specific feedback, which has been shown to make conversation agents seem more human [61].

### 6.5 Limitations and future work

There are limitations to this study including the duration and sample size of the study. The study took place over six days, which does not provide insights about long-term effects, however, our

results provide initial indications about how people experience mindfulness guidance by a VA. The sample size was relatively small and may not tell us about how a wide diverse group of people will respond. However, we found recurring issues and common threads between the participant experiences as evidenced in their feedback and objective data.

## 7 CONCLUSION

We conducted a six-day study to investigate how a voice assistant can encourage mindful eating by taking the role of a friend or a counselor. Our findings indicate that using a voice assistant to guide the user through a mindful eating exercise could be helpful in promoting mindful eating. Moreover, participants preferred the friend version of the voice assistant as they thought it would be more effective at promoting mindful eating. We also found the two versions have different strengths–the counselor seems more suitable for new users as it provides detailed guidance to help them practice mindful eating more easily, and for frequent users, the friend version might be a better choice. There is exciting work ahead in studying the ways advanced VAs can take important roles in care and counseling.

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