

Food Messaging: Using an Edible Medium for Social Messaging

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ABSTRACT

Food is more than just a means of survival; it is also a form of communication. In this paper, we investigate the potential of food as a social message carrier (a.k.a., food messaging). To investigate how people accept, use, and perceive food messaging, we conducted exploratory interviews, a field study, and follow-up interviews over four weeks in a large information technology (IT) company. We collected 904 messages sent by 343 users. Our results suggest strong acceptance of food messaging as an alternative message channel. Further analysis implies that food messaging embodies characteristics of both text messaging and gifting. It is preferred in close relationships for its evocation of positive emotions. As the first field study on edible social messaging, our empirical findings provide valuable insights into the uniqueness of food as a message carrier and its capabilities to promote greater social bonding.

Author Keywords

Food messaging; edible social messaging; food printer; field study; affective communication; food HCI

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]: User Interfaces - Interaction styles.

INTRODUCTION

It is not unusual for people to convey information with food. Examples include frosted words piped on cakes and chocolates, letters carved into cookies, and logos or ads painted onto food for business promotion. However, due to the special skills required to make such decorated food, edible media has not yet been widely adopted for daily communication.

Advances in personal fabrication and food printing technology make it much easier to embed personalized messages in the food we eat [8]. With rapidly reduced costs in hardware, food printers have become increasingly affordable and practical for consumer use. They may even enter the kitchens of many households as an ordinary home appliance in the near future.

Food printing makes possible an envisioned form of communication, i.e., words are not delivered digitally or on

paper; instead, they are impressed in or decorated on edible products. To send a food message, users can simply enter the message content on any digital device and specify how they want the message to be printed on a piece of food. The message can then be sent to either a third party service for processing and delivery to the recipient, or simply to the food printer installed in the recipient's home or office.

Unlike other communication media (such as paper or electronics), food messaging allows recipients to not only touch and feel the messages, but also to smell and taste them. Inclusion of other senses adds additional expressive power, providing an added sense of reality that results in deeper interpretation and reflection on emotion and mood [6]. Sensory stimulation by food extends the communicative richness and impressiveness of information and can enhance the social bonds between parties involved in the communication.

While food messaging is already used for some specific cases (e.g., birthday cakes with a greeting message), it has thus far been quite overlooked by research. Yet, this new way to communicate raises some important questions, not only about food itself, but also about communication between people. Questions about the viability of food messaging, its effects, its uniqueness, and scenarios of use remain to be answered.

Intrigued by the potential of this new form of messaging, we conducted a series of studies, including exploratory interviews with 12 potential users; a field study in a large IT company involving 768 participants (senders and receivers); and follow-up interviews with 20 field study participants. Our goal was to investigate: 1) whether or not people would use food messaging in a real social setting and what the typical scenarios could be; 2) what would motivate people to use this novel social messaging medium; and 3) how food messaging differs from conventional forms from users' perspectives.

To the best of our knowledge, this is the first empirical exploration of food messaging, and our field study is one of the first large-scale studies on this topic to be conducted in an actual corporate office setting. Our findings provide valuable insights into the uniqueness of food as a social messaging channel and its potential to strengthen social bonds.

In terms of viability, we found that food messaging can raise and maintain a steady customer base. Though used mainly to express positive feelings to people with close relationships, food messaging conveys a range of topics and fosters sender-receiver relations with varying closeness. It was shown to favorably affect recipients by evoking positive emotional

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reactions beyond that of what similar messages sent over existing forms would have elicited.

These results suggest that food messaging has the potential to become an important complementary channel of social messaging. It produces and delivers messages that can be literally consumed and more deeply felt by recipients than traditional forms of messaging. As a hybrid between explicit communication via words and implicit expression through sensations and emotions, food messaging affords a unique niche in social communication that could greatly facilitate group dynamics and social cohesion.

BACKGROUND AND RELATED WORK

Food printing

Machine-controlled food message crafting began in research and has resulted in commercially-available food printing technology. Two-dimensional edible printers manufactured by Canon or Epson can ink pre-designed patterns in food colors onto edible rice or sugar papers or onto frosting sheets, which can then be attached to various confectionery products, such as cookies, cakes, or pastries (Figure 1). Alternatively, a hot air gun mounted on a computer-controlled X-Y system can impress designs on a piece of toast [1], or a mounted print cartridge can draw on liquids, like coffee [30].



Figure 1: Examples of products using printed edible images.

The emergence of the 3D printer enabled the creation of customized physical food objects using liquidized and viscous food (e.g., soft chocolate or melted cheese) [28]. CandyFab uses a bed of granulated sugar to build 3D prototypes using hot air sintering and melting [18]. The noodle printer is a modified 3D printer that extrudes noodle materials into custom shapes [24]. The MIT Cornucopia project proposed a number of designs and prototypes for digital gastronomy that address different fundamental processes of cooking [33].

As food printing technology becomes cheaper and easier to use, it is highly likely that printing devices will be widely available for ordinary households in the near future. However, the question remains: how can this increasingly accessible technology facilitate everyday communication, including both practical and emotional communication, according to people's needs? This study seeks to answer this question.

Food in Social Communication

Given food's psychological and cultural significance, it is no wonder that it has always been a part of the history of social communication. Food is present at nearly every social occasion, where its preparation and consumption naturally facilitate interaction and bond people together [22]. Eating has been identified as "the primary way of initiating and maintaining human relationships" [12]. People also practice friendship and hospitality with food. Its presence creates an atmosphere of generosity and familiarity. In short, food is widely regarded as a means of expression, manifestation of identities, and a

hallmark of social relationships, all of which are important properties of the communication process [11].

In the area of human-computer interactions (HCI), Grimes et al. drew from social science research on food and proposed new directions of "Food HCI." They suggested emphasis on studying the positive aspects of people's interactions with food including social connectedness, creativity, and cultural engagement, and highlighted the celebratory design space rather than corrective technology [14]. Following this trend, recent works have explored the use of food to enhance social engagement [8]. Gamelunch [31] maps different dining actions, such as cutting and slicing, onto corresponding music to create physically-based sound synthesis, which enhances dining engagement. To allow remote people to enjoy food together, "Telematic Dining" uses real-time tracking, recognition, and projections to incorporate synchronous overlaid video to support remote activities [4]. For users in different time zones, researchers have employed video recording and replaying to allow asynchronous communication while eating [27].

Although the social roles of food have been discussed in sociology and psychology [5,10,21] and various systems have been developed that involve food in enhancing social experience, little has been studied on food messaging. As food printing links computers with human-to-human communication, food messaging presents an opportunity to put into practice the many benefits of food for social engagement.

Social Messaging

To envision the potential of food messaging, it is important to understand current messaging practices. Researchers have thoroughly investigated the use of popular text-based social messaging channels. Grinter et al. studied teenagers' Short Messaging Service (SMS) practices in Europe and provided rich analysis of their linguistic characteristics and content [15]. Microsoft conducted a longitudinal survey of their employees' use of Facebook, LinkedIn, and Twitter [3] and revealed different patterns of acceptance and growth for each message type in relation to gender, age, and status level in the company. Nardi et al. conducted an ethnographic study of Instant Messaging (IM) use and identified its most popular communicative functions: quick questions, coordination, scheduling, and keeping in touch [26]. Generally, people use digital messages for both emotional and instrumental purposes.

In spite of empirical research on messaging with digital media, we are not aware of existing studies that have looked into the possibilities of using an edible medium. In this paper, we explore if this new form of message medium fits into and further influences established social practices.

METHODOLOGY

To better understand this new form of communication, we performed a series of investigations including 1) exploratory interviews with 12 potential users to capture participants' impressions of food messaging as compared with other well-established messaging methods, such as paper and digital formats; 2) a field study involving 768 users to verify the practicability of food messaging in a real world setting; and 3) follow-up phone interviews with 20 field study users to further

examine the motivations behind their usage of food messaging. Concerning the robustness, efficiency, and operation complexity of our current 3D food printer prototype, we employed the commercially available Canon MG5320 edible printer, which is capable of printing edible messages on supreme icing sheets (Figure 2). We summarized all stages of the study in Table 1 with elaborations in the following sections.

Study	Method	Users	Length	Focus
1	Semi-structured interview	12	40 min. each	Exploration of food messaging's uniqueness and viability with other media
2	Field study	768	Four weeks	Investigation of real world usage patterns of food messaging
3	Follow-up interview	20	40-60 min. each	Deeper investigation of motivation and reasoning behind food message usage

Table 1: Overview of conducted studies.

EXPLORATORY INTERVIEW

Participants

We recruited 12 volunteers (5 male, 7 female) aged from 24 to 38 years (M=27.6, SD=4.1) from the university community. Five of them were students from the departments of engineering, computer science, and design, and seven were university administrative staff. They represented diverse cultural backgrounds, coming from 11 different countries in Asia, Europe, and North America. All participants reported that they were familiar with paper and digital messages. Regarding messages using food, their only prior experiences recalled were words on birthday or wedding cakes.

Procedure

To enhance participants' understanding of food messaging, interviews began with the demonstration of a sample message drafted and printed using a prototype printer. The interview was then conducted in a semi-structured format with the key prompt being, "Please describe in what scenarios you would use paper/digital/food messages and why in these scenarios," with the order of the message medium randomized. Individuals were encouraged to recall and explore personal experiences and thoughts on using different media for messaging. The results also allowed us to gauge expectations and accepted norms regarding the use of food for social messaging.

Results

Perceptions of Three Media for Communication

In general, participants liked food messaging; it was perceived as an interesting and impressive form of communication. People felt more connected and engaged in the sending and receiving of messages made of food, as compared with other forms of messaging.

As expected, digital messages were perceived to have "the lightest" value (p2), as "you rarely feel something when reading a message on the screen" (p1). Paper offers a moderate value: "paper is a little heavier" (p5). And food was described as the most impressive and special because people not only see and touch it, but also consume it, so it "becomes part of your body" (p12). Because of this, participants believed food messaging would be more suitable for special occasions and particular audiences.

Participants saw these three types of media as suitable for different contexts. Cheap and convenient, digital messages can be used "almost for everything, anytime and anywhere" (p4), while paper messages are used for more serious and formal occasions, such as to "express gratitude and show respect to my parents, boss or supervisor" (p8). Food, alternatively, was perceived as "something more special and personal" than either digital or paper media; therefore, it should be "only prepared for someone you really care" (p10) and "delivered in special occasions" as "it need some reasons to spend the extra resources and efforts" (p4). Because of this, many participants believed food messaging is only suitable for people in close ties: "it would be weird if I received a food message from a stranger" (p3).

Food as a Communication Medium

Food is considered to be a better carrier for emotional than for instrumental messages; moreover, its use has a strong bias towards positive emotions. This is in contrast with the other two media, with which people are generally fine expressing all types of emotions.

Participants associate food itself primarily with positive feelings. Giving food is usually a social gesture to express kindness, such as "Happy Birthday", "I Love You", "Be Happy", "Thank You", "Get Well Soon", "I Miss You", or "Good Luck." Using food to express negative emotions seems counterintuitive. However, the goodwill and positive feelings of food can help to mitigate or repair damaged relations. "After a fight, we can say sorry using food messaging... it seems easier to be touched" (p3).

Our exploratory interviews revealed several findings. People generally welcome the idea of food messaging. They believe it can enhance social relationships and is especially useful to express thankfulness, gratitude, good wishes, love, and other good feelings. On the other hand, due to the cost and required efforts, people believe food messages should only be used for close relationships and special occasions. They seem to be less willing to receive them from unfamiliar people.

The findings in our exploratory interviews seem to suggest that food messaging can be a useful social communication method. However, what people say may not parallel what they do. We wanted to further verify these findings and explore more dimensions of food messaging in a real world study.

FIELD STUDY AND FOLLOW-UP INTERVIEWS

Study Site

Our selection of the head base of a large IT company in China was pragmatic. This company has a large pool of potential

users who matched our expected user group (young, technologically savvy users who are more willing to try new things). The company’s size also enabled us to test the application in a variety of social relationships and with users of different backgrounds (e.g., engineers, staff, etc.). Moreover, it was easier for us to keep track of the large group of participants because they stayed in a centralized location. These reasons make it a more appropriate study site than alternative candidates, such as a university campus, restaurant or food court, or supermarket.

Participants

Field study participants

A total of 768 individuals (520 females, 248 males) took part in the study. They were recruited using a snowball sampling method [20] through an email advertisement sent to 20 people randomly selected from the company employee list. Among them, 208 participants both sent and received messages using this service, 135 only sent messages, while the other 425 were recipients only. Participants’ ages were between 20 and 60 years; 67.3% were aged 20-29, 27.7% were 30-39, and the remaining 5% were 40 or older. Participants held a variety of positions in the company including hardware engineer, programmer, secretary, human resources (HR), sales, and marketing. Use of this service was voluntary with no incentive other than the food messages collected by recipients.

Follow-up Interview Participants

No. of Messages (sent or received)	1	2~5	6~10	11~20	>20
No. of Interviewees	7	4	4	3	2

Table 2. Distribution of interviewees’ usage frequency.

Upon completion of the field study, we contacted 20 participants (5 males and 15 females, ages 21 to 35 years M=26.5, SD=4.5) from the 728 field study participants for follow-up interviews. All had either sent or received at least one food message using our service. Each interview lasted 40-60 minutes. Among them, 13 participants had both sent and received, 5 only sent, and 2 only received food messages. They came from different divisions of the company, including 6 secretaries, 6 software engineers, 4 hardware engineers, 2 management staff, 1 financial officer, 1 HR officer, and 1 translator. Each successful sending or receipt of a message was counted as one use. Usage frequency of follow-up interviewees is listed in Table 2. Each participant received 50 Chinese Yuan (~8.2USD) in cash for participating in our interview.

Food Messaging Service

We set up a simple food messaging service (Figure 2) in the IT company. It provided a website in HTML5 and PHP for users to enter text messages as well as the name and contact information of both sender and recipient (Figure 3). Because the study was carried out in China, we allowed both English and Chinese as the input languages. As a basic service, the message box included a list of 25 common emoticons but did not support photos.

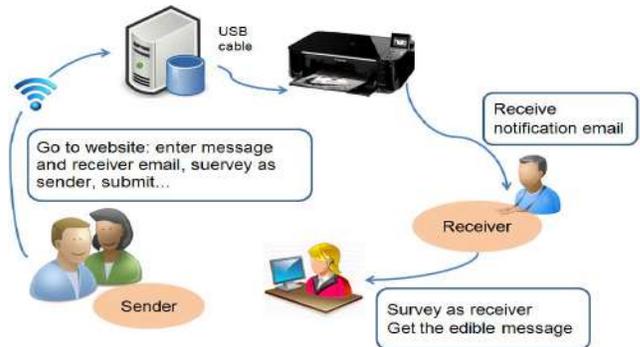


Figure 2. Overview of how to use food messaging service.



Figure 3. Online interface and samples of messages printed on icing sheets and pasted onto cookies.

We used a commercially available Canon MG5320 edible printer equipped with colorful edible ink cartridges (PGI225/CLI226) to print messages on supreme icing sheets, each with 12 pre-cut circles (2.5 inch diameter) in one A4 page. The icing sheets, made from starch and sugar, have a sweet taste and a creamy aroma. All components are FDA compliant. Printed circle sheets were manually pasted onto tea-flavored biscuits of similar size using jam (Figure 3). Each message was prepared and sealed in a plastic bag and ready for collection within a half day of request receipt. Each message cost about 0.45 USD, which is averaged over the cost of the printer, ink, icing sheets, cookies, and plastic bags. With managerial approval, we opened the pick-up counter in the employees’ canteen during lunch (12-1pm) and dinner (5:30-6:30pm), so as not to interfere with regular working hours. Twice daily, we sent a reminder email to the recipients informing them of the next available collection time and location. Printed food messages were kept up to 10 days for collection before being discarded.

Data Collection

Three types of data were collected during the field study: the sender survey, the recipient survey, and follow-up interview recordings. Both surveys were carefully designed to only contain demographic information and a few 5-point Likert-scale questions. This was to avoid inconveniencing the users to an extent that may stop them from using the service. Senders were asked to fill out the survey online after they submitted each food message request. On average, senders spent 6 min. on the two steps. Recipients filled out a paper survey at the time of collection. There were no complaints about the process.

In the follow-up interviews, participants began by describing their first use of food messaging. They then detailed other messages they sent or received, regarding their motivation, reaction, feelings, and how these experiences compared with other messaging methods (e.g., SMS, IM) when applicable. Specifically, they were guided through these core questions: how did they know about this service, what motivated them to participate, what did they feel when sending or receiving food messages, what motivated them to use or not use it repeatedly, why did they choose a food message over another form of communication, and was there any difference when using food to deliver a message? Participants also described some scenarios in which they might use this service in the future.

DATA ANALYSIS

We collected 904 messages, a total of 899 copies of sender surveys and 727 copies of receiver surveys. Only five senders skipped the online survey. Some receivers did not collect their messages, as they missed the notification email or were out of town. We kept 900 minutes of audio recordings of the 20 follow-up telephone interviews. All interview data were manually transcribed, translated to English, and coded with the key dimensions we attempted to explore in the study.

Message Coding

Codebook Creation

Our coding scheme was developed based on existing works on content analysis of social messaging [2,15,23]. We reviewed the collected messages, carefully adjusted the categories to better present our data, and refined the coding scheme iteratively. More specifically, we first adopted Ma et al.’s categorization of Chinese SMS communication into Expressive and Instrumental categories as well as its further elaboration of the Instrumental category [23]. We then split the Expressive category into positive, neutral, and negative, and elaborated on each category following Acar and Kimula’s method [2]. Ultimately, the codebook divided food messages into four categories: Expressive-Positive, Expressive-Neutral, Expressive-Negative, and Instrumental (Table 3).

Coding Process

We recruited three coders who were not involved in the development of the codebook. All were native Chinese speakers proficient in English, majoring in education or with a background in linguistics and communication. To label a message, coders first identified its main category and then narrowed it down to a specific subcategory. Each coder could only assign one subcategory to each message. We asked the coders to familiarize themselves with the coding scheme using a set of 30 randomly sampled messages. This process ensured that coders understood the codebook and the entire coding process thoroughly and that they had reached substantial agreement on coding sample messages. They then proceeded to manually label the whole dataset. We had a fourth coder review controversial items to resolve disagreements. We combined all three coders’ results and successfully generated the final labels for 829 of the 904 entries. Coders did not agree on the remaining 75 messages. We computed the agreement on all the messages including the 30 training items at the

subcategory level. The Kappa coefficients of every two coders were all greater than 0.63 (substantial agreement) [20]. We did not include the undecided 75 messages in the final analysis, because we decided they might be semantically ambiguous, making it difficult to interpret senders’ intentions.

Category	Subcategory
Expressive-Positive	Greeting, gratefulness, wish/blessing, encouragement, congratulations, respect/praise, trust/belief, miss, like/love
Expressive-Neutral	Sympathy/comforting, expectation/intention, teasing
Expressive-Negative	Apology, complaint, dislike/hate, worry, confusion/doubt, farewell
Instrumental	Question/answer/response, suggestion/reminder, gift, request, coordination, information sharing, personal update, miscellaneous

Table 3. Codebook: Structural categorization of messages based on communicative functions.

RESULTS

Acceptance and interest

In total, 904 messages were sent using the service during the four-week study. The average numbers of messages sent per day for each week are: 60.6, 20.4, 38, and 61.8, respectively. We speculate the one-day public holiday in week 2 contributed to the drop. But usage increased steadily afterwards.

Through the field study, we learned that 1) there is a significant interest in this method of social messaging; 2) users’ interests were converted into actual usage of the service; and 3) users found the service offered something unique and valuable as compared to other means of social communication.

Evidence for the first point can be observed in the participant recruitment process. Among the 20 recipients of our first advertisement email, 12 tried food messaging. The information quickly spread via word of mouth. By the end of the first week, we got 101 new users who sent messages using this service. Another 242 people joined in as new senders in the next three weeks. Even after study completion, we received about 60 additional requests and many phone calls asking if participants could continue to use the service. Although some people stopped using the service after the first week, probably due to the novelty effect, more people joined in and continued to use the service in later weeks, suggesting that food messaging had acquired a group of loyal users with growing interest in the community.

Furthermore, 43% of senders composed more than one message, contributing 61.8% of all collected messages. We explored the reasons for the discontinuation after first use in follow-up interviews. They revealed two reasons why the retention rate was not very high. One was the disruption of communication flow. Recipients’ doubt and ignorance of notification emails led to messages not being collected. If the sender did not get confirmation from the recipient, he or she

may stop trying the service. “I thought it was a trick, so I ignored it, I felt regret when I saw my colleague pick up the food message” (P4). “I sent a food message to a friend, but she found the email in the spam box, which was already quite late to collect it. If I know the service is working, I would definitely try to send more” (P15). The other reason was the closure of our study: “I went to the website to try more, but realized that the study has closed, what a pity” (P7). That is to say, we could anticipate a higher percentage of return users if we could ensure the message receipt and offer the service for a longer period of time.

Overall Rating in Surveys

The surveys were drafted based on the exploratory interviews and aimed to examine the sensory, relational, and emotional aspects of food messages. Overall, both senders and receivers acknowledged the advantages of food messages in terms of intimacy enhancement, impressiveness, specialty, playfulness, and emotional impact, which verified our findings from the exploratory interviews. Particularly, playfulness (67.4%) and specialty (64%) were rated “strongly agree” more frequently than the others. The survey results are shown in Figure 4 and Figure 5.

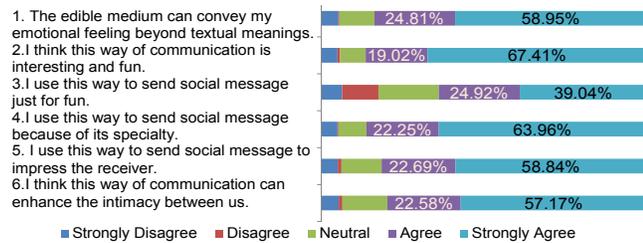


Figure 4. Overview of sender surveys.

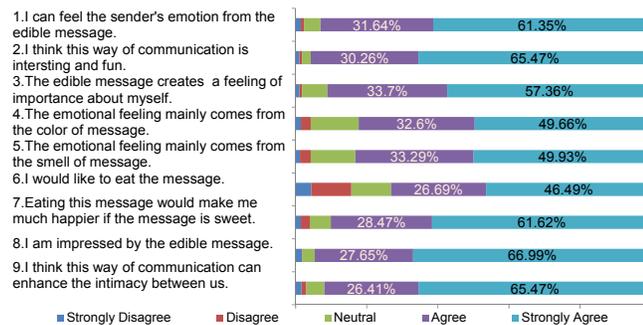


Figure 5. Overview of recipient surveys.

Although they classified the experience as playful, 64% of senders disagreed with the statement that they “used this kind of message just for fun” (Item 3 in Figure 4). This suggests that many users found other utilitarian values of food messaging, though they may have initially been attracted by its hedonic thrill. On average, return users rated survey questions higher than did new users, except Item 3. They also reported a higher level of satisfaction throughout their later usages than they did when using the service for the first time. We believe return users’ interest did not decrease when the novelty wore off.

Dimensions of Usage

Having illustrated that the practice was widely accepted, we proceeded to examine detailed usage patterns. In the study, we did not instruct users on to whom a food message could be sent nor what could be written. This enabled us to explore people’s natural behaviors.

Gender Bias

More detailed analysis showed that the user population had a slight gender bias toward females. Although the majority of the company’s employees were male (~80%), 74% of senders were female. Also, more female users continued to use the service after trying it once (68.7% of females vs. 41.6% of males). One possible reason is that females are generally more sentimental and more willing to express their feelings [19]. Another possible reason is the attitude and behavior difference between genders towards gift giving, as “women are more likely to possess a positive orientation towards gift giving, and they are largely responsible for the practice of giving” [32]. Some male interviewees told us that they felt shy or unnatural using the service, although they liked and appreciated the food messages.

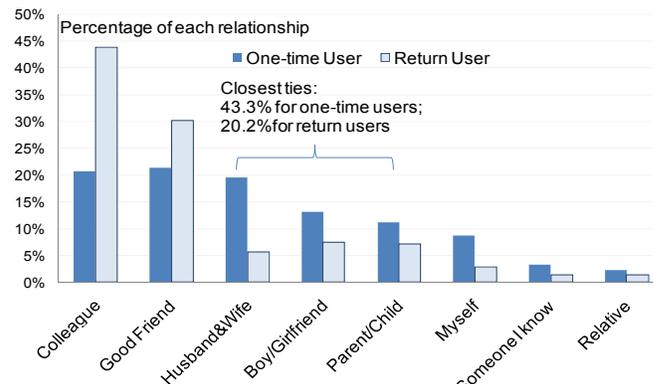


Figure 6. Overview and cross analysis of user type vs. relationship.

Tendency toward Close Relationships

We observed heavier usage of food messaging between dyads with relatively closer relationships (Figure 6): colleagues, good friends, husbands/wives, parents/children, and boy/girlfriends. Although the total number of messages sent to people in close relationships did not rank first, the results showed that people were more likely to send their first food message to their closest ties, such as family or boy/girlfriend, and then expanded to colleagues and good friends as return users (Figure 6). Because food messages are deemed distinctive and precious, they are prioritized for love ones. Although both genders showed greater tendency towards food messaging close ties, a larger portion of male users sent to significant others (a total of 38% of males and 15% of females), like husband/wife or boy/girlfriend, while females were more keen to message colleagues and friends (Figure 7, n.s.). We speculate males are relatively more prudential than females when using food messaging. This again reflects the literature on gift giving, which indicates “women give to a wider network of receivers, while men are more likely to give substantial gifts confined to spouses and quasi-spouses” [32].

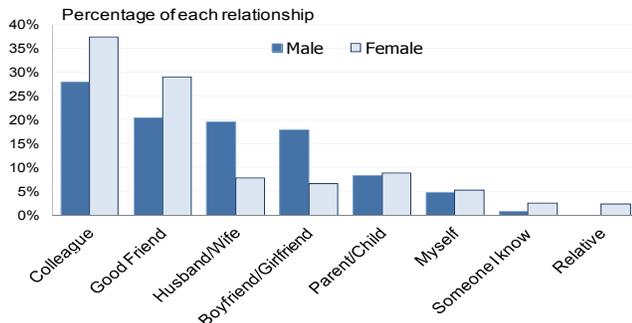


Figure 7. Cross analysis: gender vs. relationship.

Types of Messages

Figure 8 shows the overall distribution of food messages’ communicative functions based on our manual coding. Senders used food messages primarily for expressing positive emotions. Seventy-eight percent of messages fell into the Expressive-Positive category, followed by the Instrumental category (18.1%). People rarely used food messaging for negative or neutral expression. Only a few messages were complaints (“you are not easy to get along with”), or confusion/doubt (“maybe it is a trick”). These findings are quite different from the conclusions of previous studies on mature communication methods. SMS was reported to be mainly instrumental for planning events, coordinating meals times, organizing rides [7], and exchanging information [23]. Common types of digital messages, such as coordination and personal updates, did not appear in our data. More specifically, although expressive messages dominated communication initiated by both genders, males were slightly more inclined to send informative messages. Of senders, 80.8% of females and 70.4% of males composed expressive messages with positive emotions, while 15.4% of females and 25.5% of males sent instrumental messages. These results are compatible with the initial interviews, in which participants described their preferred use of food messages to deliver positive messages, especially greetings, congratulations, and good wishes.

As for the subcategories, 55% of messages were wishes/blessings (Figure 9). We further labeled the specific topics of each message of this type. Results reveal that wishes covered a range of topics: happy and smooth life, health, career, romantic relationship and marriage, etc. Many messages have several topics, e.g., “Be happy and find your Mr. Right soon.” Different topics targeted different recipients. Happiness was the most frequently mentioned, especially among colleagues and good friends. People also sent career wishes to colleagues, marriage/childbirth wishes to good friends, and health wishes to family members. We can clearly see such differences when one sender delivered messages to several receivers. Food messages provide an edible substitute for traditional wishes.

As shown in Figure 9, other common subcategories include liking/love, gratefulness/appreciation, encouragement, and respect/praise, all of which are positive expressions. The more commonly used instrumental uses include information sharing, suggestion/reminder, and command/request. Participants did not send negative expressions of dislike/hate or worry in the study, which agreed with our initial interviews.

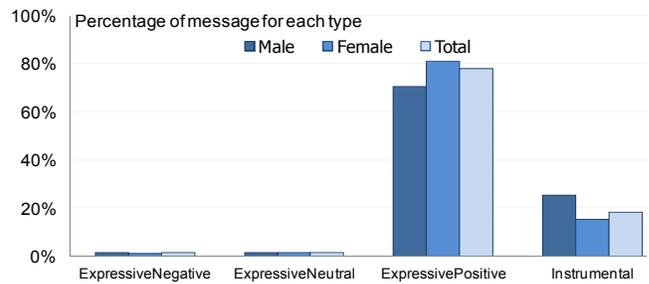


Figure 8. Distribution of message category between genders.

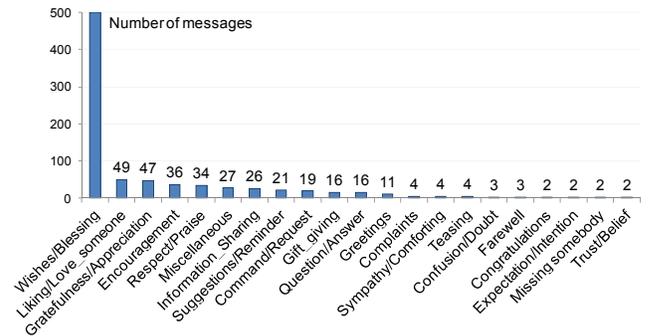


Figure 9. Distribution of messages among subcategories.

DISCUSSION

Our results from the field study and subsequent interviews have drawn a rich picture of how participants communicated with others through food messaging. In this section, we discuss the fundamental and distinctive properties of food as a messaging medium and suggest its appropriate niche among mainstream communication media.

Impacts of Physical Properties

A food message’s physical presence makes it a unique communication channel. First, food is tangible and also edible. It can stimulate the sensations of smell and taste besides sight and touch, enhancing communication richness [14]. In addition, physicality plays an important role in interpersonal communication [9]. Food not only provides a tangible platform to display text that traditionally appears on paper or screen, but also serves as a physical embodiment of affection and care [29]. Unlike a note or Facebook message, recipients could better sense such emotional expression via consumption of the edible messages, “It’s physical, I can feel it, when I eat it, feels like the good words go into my body” (P3). This triggers a multimodal sensational and emotional response, and the taste of food nicely complements the meaning of the message [5]. Different types of foods can be combined with different types of messages to create enriched and unique experiences: “I can taste and digest the words slowly when eating the food message, it’s not like just see it, and then forget about it. Food message is more impressive for me” (P11).

Second, the production of a food message takes effort and involves physical materials, and thus people were more attentive and careful when crafting food messages. Sixteen out of the 20 interviewees indicated that they would go over the content cautiously, “I would carefully write nice sentences, revise them a few times, and check for typos or grammar errors. It is like writing an essay, and has all words to be

meaningful” (P16). *“For SMS, I rarely pay much attention. I use slang and usually don’t bother with spelling”* (P 20).

Consequently, recipients were often impressed and touched by such efforts, *“It’s not just a sentence; I can feel his efforts and care for me”* (P9). Digesting the messages also motivated recipients to memorize the content by heart, as it could not be reprocessed once consumed. One interviewee noted, *“I usually forgot the content I sent or received from SMS and IM, but I can remember clearly the words on food, and also who sent it to me”* (P18). Our data show most receivers, especially females, opted not to eat food messages immediately. Some even expressed interest in preserving the message. They first took photos, displayed messages on their desks, or kept them in the refrigerator. As suggested, if senders devoted greater efforts to composing a text or multimedia message, recipients were more likely to save and cherish it [17].

Third, food as a physical medium also has limitations, such as low immediacy and synchronicity, difficulty in preservation - especially the smell and taste - in spite of the lasting psychological impact on receivers, relatively higher monetary cost of materials and delivery, and the concern of food safety.

In sum, food’s physicality and multimodality afford extra meanings in communication, implicitly and explicitly. But they also suggest that food messages would not be practical for chatting. It is difficult to keep the flow of an instant conversation as text messaging does because it takes more time to compose and deliver. Similarly, it is not for urgent situations or other contexts that require quick responses.

Impacts of Social and Emotional Properties

Many people considered food messaging as *“informal gift-giving,”* rather than a simple exchange of factual information. As a common practice in daily life, gifting ties people together [16]. This suggests that food messaging, if used widely and wisely, can enhance social connection in many ways.

First, people tended to use food messaging for special people or on special occasions (birthday, wedding, etc.). Closeness in relationship affected the priority and characteristics of social communication [16]. *“I would be willing to allocate more efforts to people I really care, and I think food message is worth my time”* (P2). Even if the same user delivered food messages to different people, he or she likely used the service differently. *“I would send multiple messages to my girlfriend regularly, but only once in a while to other friends”* (P5). In other words, receiving a food message makes people feel more valued in the sender’s social circle [16].

Second, most food messages were used to *“bring happiness to the receiver.”* Comfort food often positively evokes sentimental feelings [21]. *“Food naturally makes people happy; it would contradict with the meaning of food if you used unsavory food to express negative feelings”* (P15). The emotional impact can also come from its *“recollection of happy moments.”* *“This reminds me of the festival traditions when we greet each other with food, and everyone feels delightful”* (P7). Therefore, people are more likely to use the exchange of food messages to signify thanks, caring, love, and trust with the intention of promoting well-being and the feeling

of warmth for recipients [16]. *“It contracts with the nature of food if you use food message to criticize people”* (P1).

In other words, food has a stronger and longer emotional impact, which makes it generally unsuitable for delivering negative information. *“We don’t want to keep the unhappy feelings for long, so we won’t use food for unpleasant messages”* (P3). Notably, people agreed that communicating apology or regret via food is rather sincere and acceptable. Food may alleviate pain brought along with negative experiences associated with the words.

Third, food messages may be used to repair and strengthen distant social bonds. For example, some participants recovered friendship via the service. *“I haven’t talked with a friend for some time. Neither of us wants to say sorry. Knowing this service, I sent her a food message with normal greeting – ‘Happy Everyday!’ We got over the unhappiness and are good friends again”* (P10). Food messaging was even more powerful in maintaining social relationships. As mentioned by one user, *“I actually don’t text my friends any more recently. We are just too busy and lazy, and it seems that we have nothing to say. But this kind of message really shows your care for others. It feels good to read the words from their hearts, which people might be too shy to speak out directly”* (P14).

Fourth, although people are more inclined to keep it personal, food messages can potentially encourage productive group dynamics and generate positive social climate. As one user noted, *“All the people in my office are using this, and we are telling our friends about it. We are interacting more often now across different divisions in the company”* (P13). In our data, many users wrote back via food messaging. Interviewees also mentioned using conventional channels (phone calls, online chat) to contact senders, similar to gift giving communication. This suggests food messaging can facilitate social dynamics and rebuild social connections. If this service becomes more accessible to people, they can use it to increase group cohesion in organizations or other social groups (e.g., family, friends, and communities).

Fifth, in the study, we also noticed a phenomenon that rarely occurs in traditional messaging. Although we introduced food messaging as a social channel, 46 messages (5%) were addressed to the senders themselves. Different from self-reminders on sticky notes, these messages served mostly as encouragement, appreciation, or expectation, all of which are in Expressive-Positive type. Examples include *“I am the best,”* and *“I will be successful.”* This actually follows the common practice of using food as an incentive or reward, as *“food is a source of both bodily and spiritual empowerment”* [10].

Motivation

In our follow-up interviews, we found the most common initial motivation to try our service was curiosity, but the strong appreciation of recipients motivated senders to use the service again and also turned recipients into senders. *“My girlfriend likes it so much, and she asked me to send more to her”* (P10), *“I tried it first to see what it is, soon my friend asked me for the link, since she and her colleagues all want to use it”* (P14), *“I feel very happy to receive it, and I would like to receive more”* (P1). Specifically, 208 of 633 receivers turned into senders,

which broadened the participant circle. Exploratory interviews and field study revealed that emotional impact is a significant factor that makes food messaging distinctive [21]. Increased intimacy was frequently mentioned, *“I feel so warm when seeing the message on food, it brings us closer”* (P1). *“I never feel so close when reading my friend’s words”* (P3).

People have a strong desire to send and receive emotional expressions. Therefore, the intention to impress receivers and make them feel important and special has sustained and broadened food messaging usage. One user even sent as many as 55 messages during the study.

In summary, food as a message medium seems to facilitate emotional and impressive communication beyond information exchange. Because of this, our participants leveraged food messaging to express wishes, affection, and appreciation to those they care for in a way that combines traditional gift giving and messaging.

Implications for Future Design

We have gained a better understanding of how food may function as a social messaging medium in practice. Our findings uncovered the factors that motivate food messaging besides playfulness and novelty and provide implications for future design and research on communication via food.

We consider food not as a replacement for current messaging, but more as a complementary channel in specific contexts that can benefit from its unique advantages in emotional expression. R. Harper considered sending and receiving mobile text messages a form of gift-giving [16]. The physical presence of a food message provides an even stronger sense of gifting than a message alone. However, as it is not meant for high frequency and cannot be kept because it decays, food messaging is less formal than traditional gifts. It can be used together with other media or traditional gifts to create a new communication experience. All interviewees expressed their desire to use food messaging in the future, especially with more convenient composition and delivery services. One possible design is to extend existing messaging apps to allow users to produce an edible message with a specified food printer.

Food acts both literally and symbolically as a gift [14]: individuals give food (e.g., chocolate) as gifts at festivals like Valentine’s Day in Western countries and Spring Festival in China. The process of preparing food becomes embedded in the gift that can be consumed by the recipient. Chinese and many other cultures share similar values regarding the symbolism of gifting, *“it is always not the gift, but the thought that counts.”* Edible words make messages more explicit than the traditional practice of food giving, but the ritual’s intent is maintained. In this case, the recipient could literally and symbolically consume an offering of wishes and care. Interviewees indicated the profound feeling beyond words, *“It’s more touching than digital messages”* (P12), *“I care more about the text content than food itself; but food definitely makes the words more impressive”* (P5).

In Eastern Asia’s culture (Chinese or Japanese), people tend to express feelings in subtle ways, like gifting. As copious emotional messages were sent in our study, we believe Chinese

people may benefit from this messaging method as a channel to express emotions more explicitly. Future design could take advantage of food to facilitate and enhance expressions of love and care in daily life. For example, if the service is embedded in cooking appliances, users could express different messages to each family member on their dishes, customizing the message content and flavor with different foods.

Moreover, as McLuhan says, *“the medium is the message”* [25]. For food messages, their physicality, emotional and cultural associations, and evoked sensations can enrich receivers’ interpretations. Every food could carry different meanings based on its color, texture, smell, and taste. Chocolate means love and intimacy, while fruit may represent health and freshness. When preparing food as a gift, the person often takes into account the likes and dislikes of the intended recipients and the context of gifting. For example, the types of food may vary with the subject or occasion, and reflect cultural tradition as well. *“I like to send my wishes with rice dumplings on Dragon Boat Day, moon cake on Middle Autumn Day, and chocolate on Valentine’s Day”* (P8). Therefore, it is necessary and of great value to allow selective food ingredients in the food messaging service in the future.

Although the service in this study did not support 3D printing or full automation of message delivery, the insights were informative. Our participants did not seem to be concerned about the operator’s access of message content, as the content typically did not contain sensitive information. Privacy concerns can be mitigated when food messaging service becomes further expedited and automated by food printers marketed for use at work and home with higher efficiency. Moreover, a 3D food printer would bring an additional expressive dimension in designing the shape and look of food messages, which can be investigated in future research.

CONCLUSION AND FUTURE WORK

In this paper, we presented a series of investigations on the applicability of food as a messaging medium. We demonstrated people’s acceptance and perception of food messaging and identified its scenarios of use. Generally, people used food messages for positive expressions to relatively closed people, motivated by its physical and emotional modalities beyond words.

This research builds on and contributes to the growing body of literature on social messaging. Studies of human communication with interactive technology tend to emphasize effectiveness improvement, which may overlook users’ emotional experience. Therefore, we particularly focused on how food promotes *“consummatory communication”* (versus *“instrumental communication”*), which typically involves affective satisfaction, social connectedness, sharing of experience, emotions, etc. [13]. In other words, we consider food messaging to be user-oriented, rather than task-oriented.

As this paper reveals, a communication medium can influence users’ experiences not only by the content delivered over it, but also by the characteristics of the medium itself. This finding provides a foundation for future controlled experiments to compare different media in detail. We hope this research can

facilitate further exploration of the affordance of food-based communication as well as its influence on social cohesion.

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