

---

# Influence of Dining-Progress Synchrony in Time-Shifted Tele-Dining

**Tomoo Inoue**

Faculty of Library, Information  
and Media Science  
University of Tsukuba  
Tsukuba, Japan  
inoue@slis.tsukuba.ac.jp

**Mamoun Nawahdah**

Computer Science  
Department  
Birzeit University  
Birzeit, Palestine  
nawahdah@gmail.com

**Abstract**

A system "KIZUNA" was recently proposed enabling time-shifted people to enjoy a meal together in a virtual environment involving the transmission of recorded video messages. The system achieves synchrony through adapting the displayed video's playback speed to the difference in the dining progress between local and remote person. A subjective system evaluation revealed that the adaptation method enhanced participants' communication behavior and perceived presence of remote person. In this paper, we further explored the influence of synchrony on diners' behavior through analyzing the recorded experiment dining sessions. The results revealed that the

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s). Copyright is held by the author/owner(s).  
*CHI 2014*, April 26–May 1, 2014, Toronto, Ontario, Canada.  
ACM 978-1-4503-2474-8/14/04.  
<http://dx.doi.org/10.1145/2559206.2581369>

participants engaged more in communication, while their eating and drinking behaviors were almost not changed.

**Author Keywords**

Tele-dining; time-shifted communication; adaptation; videoconferencing; behavioral mimicry.

**ACM Classification Keywords**

H.5.3 Group and Organization Interfaces:  
Asynchronous interaction.

**Introduction**

In real-time group dining the participants tend to wait each other to start dining together. The dining typically starts when the food is placed on the dining table and all the involved participants are seated around the table. Several studies show that the presence of others affects the amount of consumed food in a meal, where people eat more in the presence of others than alone [2, 3]. Similarly, the person's eating can be modified by the partner's eating behavior, where the person tends to eat as much or as little as do those with whom they eat [4, 5, 6]. A possible explanation for this behavior is that both participants' food intake becomes synchronized through processes of behavioral mimicry [1]. Watching the partner taking a bite activates, within the person, the same type of action, which may makes him/her more likely to take a bite as well. This natural dining behavior makes dining process goes smooth

where all the participants enjoy the meal, conversation, and finish dining more or less together. In time-shifted tele-dining environment, achieving this kind of natural synchrony is not that easy. Therefore it has been researched.

A system "KIZUNA" was recently proposed to overcome the problem of eating alone [7]. The system is principally based on time-shifted communication involving the transmission of recorded video messages. To achieve a sort of real synchrony between local dining and the displayed video, KIZUNA controls the start time to display video message and then adapts video's playback speed to the difference in dining progress (DDP) between the local and remote user. The KIZUNA's adaptation method was validated by an actual dining experiment using the Wizard of Oz (WoZ) system simulation technique. The participants subjective impression, which was collected by a questionnaire filled after each experiment, revealed that KIZUNA's adaptation method enhanced communication behavior and perceived presence of remote person.

In this paper, the influence of video playback speed adaptation on participants is further exposed. In this regard, the participants' communication, eating, and drinking behaviors were objectively analyzed. The analysis result revealed a significant difference in participants' communication when using KIZUNA, in comparison with a conventional time-shifted tele-dining, while their eating and drinking behavior were almost not changed.

## Related Works

Family members and close friends tend to have meals together, but lack of time or proximity often makes this hard to achieve. To overcome this situation, Accenture introduced a tele-dining prototype called the Virtual Family Dinner<sup>1</sup>. This prototype was essentially a highly automated videoconferencing system targeting people with limited knowledge of technology, such as the elderly. It monitored the site and when it detected a meal dish on the table, it went through a list of contacts, trying to reach one who was available for a dinnertime chat. However this system only enabled real-time communication, which could be achieved by a variety of videoconferencing systems..

In the situation when only one participant is available, asynchronous (time-shifting) techniques may offer a general solution. As a video system for time-shifted communication, VideoPassage was proposed [8]. This enabled asynchronous exchange of video message by overlaying new video recordings on the replayed old video message.

For time-shifted dining communication over video, CU-Later was proposed [9]. This prototype played a recorded video of remote dining automatically, when the local user was in front of the display placed on the dining table. It recorded the local user's session as well when the video was played, so that the remote user could watch the local user's session later on.

However, Social dining communication means more than just information exchange; it typically also involves affective satisfaction and social connectedness.

---

<sup>1</sup> <http://gizmodo.com/accenture-virtual-family-dinner/>

### Experiment Specification

#### Dining Conditions:

\* The following two time-shifted tele-dining conditions were considered:

- **Conventional:** participant dines while watching a recorded video with audio of a familiar person eating sometime earlier.
- **KIZUNA:** same as conventional condition, but with the video playback speed adjusted according to the DDP.

\* The following meal amounts were considered according to each participant preference:

- **Small meal:** 300g. 10 participants
- **Large meal:** 500g. 12 participants

#### Participants:

A total of 22 participants took part in the experiment. The participants were divided into two groups:

- **Group 1:** performed under the conventional condition.
- **Group 2:** performed under the KIZUNA condition.

### KIZUNA System

Figure 1 shows a user having a meal while watching a recording of a remote person through KIZUNA system. The system automatically starts when the user get seated and some dishes are placed on the dining table to simulate real dining setup. This increases the system-usage portability, especially for people with limited knowledge of the technology. The system starts playing the video of remote person (recorder earlier) on a large display in front of the local dining table with life-size scale. It also starts recording the user's dining and his/her responses to the remote person's video message. Similarly, the system automatically starts working at remote site when the remote person gets seated and some dishes are placed on his/her dining table, and the same process is repeated.



Figure 1. A user dines while watching a recorded video message.

This automatic playback and recording of videos might provide the illusion of co-dining for the users, though they may be dining at different times and/or in different places. We assume that merely watching the other user's video may not, by itself, arouse a sense of co-dining, but that the synchrony of both dining activities (not only the start and end time but also the entire process) may create a sort of real-time behavioral mimicry. Specifically, we

thought this synchrony can be artificially achieved by controlling the video playback speed according to the DDP between the user and remote person. This pseudo synchrony is expected to enhance the proposed asynchronous video-mediated tele-dining experience.

Figure 2 shows the KIZUNA's playback speed adaptation procedure flowchart. By experimentation, we found that the person was able to watch a video with adjusted playback speed in the range from 0.7X to 1.5X without losing any information or feeling any distraction. Thus, the playback speed adaptation method is configured to work within this range.

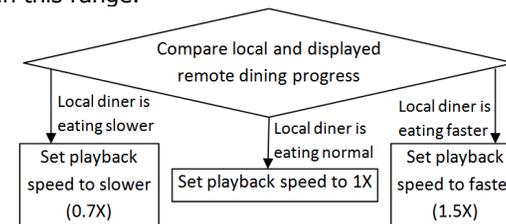


Figure 2. KIZUNA's playback speed adaptation procedure flowchart.

### Evaluation

An experiment was conducted to investigate how this pseudo synchronization of time-shifted tele-dining influences the participant's dining and communication behavior. All the recorded experiment sessions were analyzed to find influence of KIZUNA's adaptation method in comparison with a conventional time-shifted tele-dining.

#### Analysis:

ELAN tool was used to annotate the recorded video of experiment sessions, where each session was around 9 minutes. A total of 22 recorded video were annotated for participants' basic communication and dining behaviors

such as talking, eating, and drinking. The following terms were used in the annotation process:

- **Talking:** happens when a person speaks for at least 1.5 seconds [10].
- **Turn Taking:** is the manner in which orderly conversation normally takes place. The number of turn taking in this study is the number of continuous segments of speech intervals for at least 1.5 seconds [11].
- **Bite:** Happens when the person fill a spoon from the dish and move it into his/her mouth.
- **Eating:** Starts when the person enters some food to his/her mouth and start chewing the food until he stops chewing the current bite or start a new bite.
- **Drinking:** Happens when the person moves the juice cup to his/her mouth until he takes it away.

**Results:**

Figure 3 through 9 shows the resulted average data and the analysis of participants' dining behavior across the two conditions grouped by the provided meal amount. A comparison was done using a between-groups t-Test to examine whether the two conditions mean are significantly different from one another. We found a significant differences in participants' number of turn-taking [300g: ( $t(8)=-2.64, p<0.05$ ), 500g: ( $t(10)=-1.97, p<0.1$ )], the talking periods [300g: ( $t(8)=-1.82, p<0.1$ ), 500g: ( $t(10)=-1.92, p<0.1$ )], and the drinking periods [300g: ( $t(8)=-1.91, p<0.1$ ), 500g: ( $t(10)=-1.95, p<0.1$ )]. While no significant differences were found in the participants' number of bites [300g: ( $t(8)=-0.24$ ), 500g: ( $t(10)=-0.82$ )], the number of drinks [300g: ( $t(8)=-1.11$ ), 500g: ( $t(10)= 0.28$ )], the eating periods [300g: ( $t(8)=-1.37$ ), 500g: ( $t(10)=$

1.1)], and the total dining time [300g: ( $t(8)=-1.28$ ), 500g: ( $t(10)= 0.83$ )].

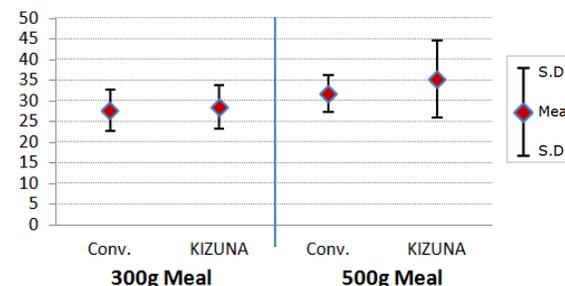


Figure 3. The number of bites per condition result.

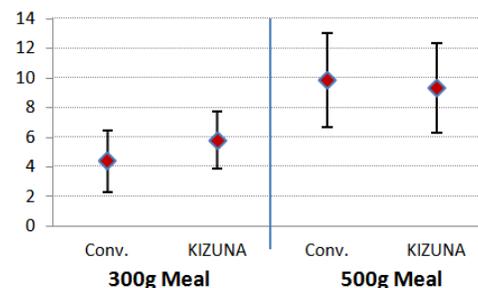


Figure 4. The number of drinks per condition result.

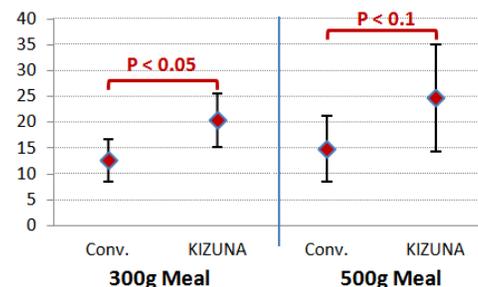


Figure 5. The number of turn taking per condition result.

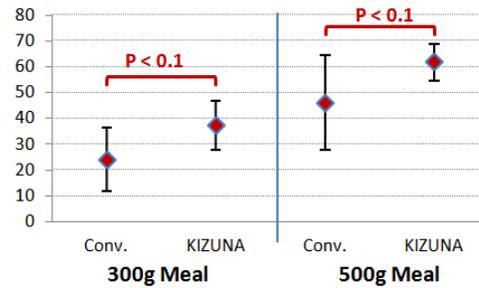


Figure 6. The drinking periods per condition result.

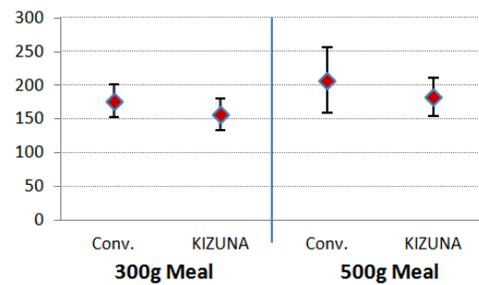


Figure 7. The eating periods per condition result.

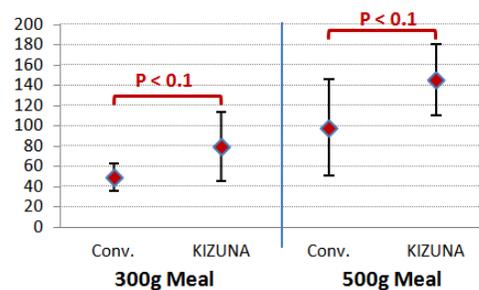


Figure 8. The talking periods per condition result.

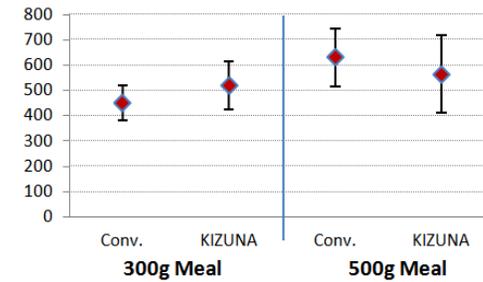


Figure 9. The total dining time result.

### Discussion

The analysis of the experiment recorded video supports the fact that KIZUNA affects person's interaction with other person when dining; while the eating process itself was not affected. For the same amount of food, the number of bites and the total time needed to chew the food were almost the same across the conditions. Regarding participants' communication, the result shows that the number of turn taking and talking periods were significantly increased in KIZUNA sessions compared with conventional sessions. Moreover, we found that the participants spent more time drinking while the number of drinks was not affected.

In social dining it is natural behavior for a person to look at other person and to watch his dining progress. In this regard, some of participants mentioned that they adopted a strategy of watching partner's plate. This gives them an indication how partner's dining progress was proceeding and accordingly they estimated how much time left for the dining session. We also noticed a common behavior across participants by following partner's actions. Most noticeably was the drinking action. Whenever the partner performed a drinking action, the participant performed a similar

action synchronously or once he/she finishes the current performed action of talking or eating. In this regard, we found no differences across the two conditions. This simulates a natural mimicry behavior similar to the bite mimicry reported in [1].

As with any study, there are limitations on our ability to generalize from the achieved results. For example, the validation experiment was performed in the lab environment which was quite different from actual dining in daily life. In the future we would like to validate and extend the current findings with qualitative studies, such as longitudinal observations and investigations of more dining behaviors.

### Conclusion

In time-shifted tele-dining, artificial dining synchrony is likely to influence diner's communication and eating behaviors. Dining synchrony was achieved by adapting the playback speed of the displayed remote recorded dining session based on the difference in dining progress. The analysis results revealed that the participants engaged more in communication, while their eating and drinking behavior were almost not changed.

### Acknowledgements

This research was partially supported by the JSPS Grant-in-Aid for scientific research 22500104, 23500158.

### References

[1] Hermans, R., Lichtwarck-Aschoff, A., Bevelander, K., Herman, P., Larsen, J., and Engels, R. Mimicry of food intake: The dynamic interplay between eating companions. *PLoS ONE*, 7(2), (2012), 1-6.

- [2] Castro, J. and Brewer, M. The amount eaten in meals by humans is a power function of the number of people present. *Physiology and Behavior*, 51(1), (1992), 121-125.
- [3] Patel, K. and Schlundt, D. Impact of moods and social context on eating behavior. *Appetite*, 36(2), (2001), 111-118.
- [4] Conger, J., Conger, A., Costanzo, P., Wright, K., and Matter, J. The effect of social cues on the eating behavior of obese and normal subjects. *J Pers*, 48(2), (1980), 258-71.
- [5] Hermans, R., Engels, R., Larsen, J., and Herman, P. Modeling of palatable food intake. The influence of quality of social interaction. *Appetite*, 52(3), (2009), 801-804.
- [6] Herman, P., Roth, D., and Polivy, J. Effects of the presence of others on food intake: A normative interpretation. *Psychological Bulletin*, 129 (2003), 873-886.
- [7] Nawahdah, M. and Inoue, T. Virtually dining together in time-shifted environment: KIZUNA design. *In Proc. CSCW'13*, (2013), 779-788.
- [8] Takada, T. and Harada, Y. Citation-capability of video messages and its supporting system. *Computer Software*, 16(6), (1999), 562-570.
- [9] Tsujita, H., Yarosh, S., and Abowd, G. CU-Later: a communication system considering time difference. *In Proc. Ubicomp'10*, (2010), 435-436.
- [10] Jaffe, J. and Feldstein, S. *Rhythms of dialogue*. Academic Press, 1970.
- [11] Sellen, A. speech patterns in video-mediated conversations. *In Proc. CHI'92*, (1992), 49-59.