CAN AUDITORY ICONS INDUCE FOOD INTAKE MIMICRY?

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ABSTRACT. This research hypothesized that auditory icons that represent eating can be used to induce mimicry in food intake behavior. Numerous studies show that, when two people are eating together, they mimic each other's eating behavior. To test this hypothesis, participants were asked to eat diced apples. While eating, they can hear auditory icons that represent other people's eating sound. In reality, the auditory icons used were a sound loop. Their food intake was monitored. If eating occurred within 5 seconds after the participants heard the auditory icons, they were considered to mimic the sound. It was found that, auditory icons that represent eating cause food intake mimicry in human. In the future, results gained from this research may be applied in the design and development of persuasive technology to persuade people to eat slowly since it is beneficial to health.

Keywords: mimicry, auditory icons, food intake, persuasive technology

INTRODUCTION

Many current persuasive technologies fail to produce the desired result because designers do not fully understand the factors that lead to behavioural change (B.J Fogg, 2009b). In order to produce a good persuasive technology, consideration on factors that can change human behaviours must be understood. This paper argues that one way to persuade people to change their behaviour is through inducing mimicry. Human unintentionally mimic each other's behaviour when interacting. Behavioural mimicry has social advantages. Those who mimicked their interlocutor are viewed as more friendly and trustworthy (Luo, Ng-Thow-Hing, & Neff, 2013).

This paper argues that since mimicry is socially motivated, it may be used in technology design to persuade people to mimic desirable behaviours. Eating slowly is beneficial to health. Research shows that eating slowly can lessen food intake (Stuart, 1967) and thus decrease calorie intake (Andrade, Greene, & Melanson, 2008). Meanwhile eating quickly can cause overeating (Zandian et al., 2012). People eating together tend to mimic each other's food intake behaviour (Hermans et al., 2012). However, physical presence is not necessary for mimicry to occur. Virtual agents, such as actors on television, may also induced mimicry (Koordeman et al., 2011). Therefore, this paper argues that auditory icons that represent a remote person eating may also be used to induce mimicry. The research reported in this paper was undertaken to test this hypothesis: hearing auditory icons that represents eating will result in food intake mimicry in human. Testing of this hypothesis contribute to the body of knowledge which may be applied in persuasive technology in order to make people eat more slowly.

RELATED WORK

Mimicry

In human-human interaction, people automatically mimic their interaction partner in speech accent, posture, gesture and mannerism (Lakin, Jefferis, Cheng, & Chartrand, 2003). Mimicry occurs when humans eat; people perceiving other people taking a bite will take a bite too. Hermans et al. (2012) show that when two women eat together, they tend to mimic each other's food intake. In a similar vein, Koordeman, Kuntsche, Anschutz, van Baaren, and Engels (2011) look at alcohol consumption to study if young adults mimicked an actor's drinking behaviour in a 60-minute movie. The results of the study show that male participants were more likely to take a sip directly after the actor's sip.

Eating Behaviour

Eating behaviour differs from one person to another. Eating speed of a person is one of the most important aspects of eating behaviour (Zandian et al., 2012). Time constraint might be one of the factors that influence eating speed. People who eat at a fast speed, tend to increase their amount of food intake while people who eat at a slow speed decrease the amount of energy intake but only for men, not in women. Music influences people's behaviour and its effect vary according to tempo, volume and type of sound (Dalton & Behm, 2007). People who eat while listening to fast tempo music are more likely to increase their eating speed (Roballey et al., 1985). Based on the fact that sounds can influence eating behaviour, this research argues that auditory icons that represent food intake may induce mimicry in eating behaviour.

Auditory Icons In Oz-Of-Wizard Study

Auditory icons are everyday sounds that represent processes or actions in computers (Gaver 1986). Humans have the ability to identify what actually happened from the sounds they heard. Since sounds give information about events, sounds can be used to represent information in computer interface such as location, size, type and load time. One of the earliest examples in using auditory icons can be found in SonicFinder (Gaver 1989). An example of auditory icon used in SonicFinder is the sound of pouring water; it is used to represent the process of copying files.

This paper used auditory icons in a similar manner to Oz-of-Wizard (OzW) technique used by Baharin and Muhlberger (2010) to study presence induced by auditory icons in a virtual environment. In their experiment, the participants were asked to play domestic environment simulation game, named The Sims. Auditory icons were used in the game to represent a remote player. The participants were told that the auditory icons was triggered by another player who played the same game at a remote place, but actually, sounds heard by the participants were auditory icons played in a loop. Baharin and Muhlberger (2010) demonstrate that the participants who paid attention to the auditory icons have higher level of presence. This type of inverse Wizard-of-Oz (WOz) technique was used in this paper. The WOz is an experimental technique used to test uncompleted system (Salber & Coutaz, 1993). Users of the system believe that they are interacting with a complete system but actually, the functionalities of the system are manipulated by a hidden 'wizard', which is actually a human (Steinfeld, Jenkins, & Scassellati, 2009).

In this research, auditory icons were used to represent a consistent sound of eating throughout the experiment. Auditory icons used were actually a pre-recorded sound loop played by a computer, therefore, the consistency of eating speed was kept at the same pace. In this sense, it is not an aspect of a computer system that is simulated by a human (Wizard), but it is the human that is simulated by a computer via auditory icons. Since the auditory icons in

this experiment is considered as wizard, this experiment is inverse to the WOz technique (Mäkelä, Salonen, Turunen, Hakulinen, & Raisamo, 2001). This inverse method of WOz was introduced by Steinfeld et al. (2009).

Persuasive Technology

If the hypothesis is proven, it will add to the body of knowledge, which may be applied in developing persuasive technology that encourages people to eat slowly. Persuasive technology is defined as any interactive devices that affect change in people behaviours and attitudes (Brian J Fogg, 1998). Fogg Behavior Model (FBM) explains three factors of behavioural change: motivation, ability and triggers (Fogg, 2009a). Triggers factor is defined as something that influence people to perform certain actions. (B.J. Fogg, 2009a). Therefore this paper studies the usage of auditory icons as trigger to influence food intake behaviour.

In this research, auditory icons used were recorded sounds of human eating behaviour in the duration of three minutes. This recorded sound represents a person eating, which consist of fork stabbing and apple crunching sound. An experiment to test whether auditory icons can be used to induce mimicry in food intake behaviour was conducted.

EXPERIMENT

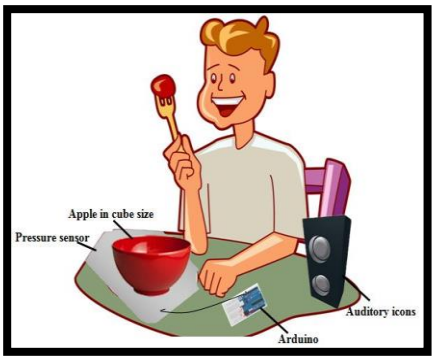

Figure 1. Experiment Setup Illustration

Setting and Procedure

The session took place in a room occupied with a table and a chair. Participants were given eleven pieces of diced apple on a plate and a fork. Speakers to play the auditory icons were placed in front of the participants. The plate was placed on top of the digital pressure sensor. Digital pressure sensor was connected to Arduino, which was connected to a computer. During experiment, participants were instructed to eat the apples in the plate for the duration of three minutes but they were told they could stop eating at any time. Participants were told that there was another person currently sitting with the same experiment setup and when the remote person stabbed and bit the apple, the remote person's experiment setup would send a signal to speakers that were placed near the participants and produced the stabbing and crunching sounds.

In actuality, only a sound loop of auditory icons of apple munching and fork stabbing were used. When the participants used the fork to stab a piece of apple, the pressure sensor sent a signal to Arduino, which would record the timestamp of fork stabbing made by the participant through CoolTerm software on the computer. The researcher played the auditory icons loop on the speaker at the same time when the participants were instructed to start eating. Figure 1 illustrates the experimental setup. As a backup to data collected by Arduino, the participants

were also video-recorded. They were told that they were being recorded but the camera was not in direct view of the participants.

Measure

Arduino used in this study was programmed to detect the 'mimicked stabbed' and 'non-mimicked stabbed'. Mimicked stabs occurred when participants stabbed the apple within five-second interval after hearing stabbing sound auditory icons whereas non-mimicked stabs occurred when participants stabbed the apple outside five-second interval after hearing stabbing sound auditory icons. Five seconds time was used based on studies by Hermans et al. (2012) and Koordeman et al. (2011). Five seconds was used in order to avoid over representation of mimicry (Hermans et al., 2012).

Participants

13 females and a male student participated in the experiment. All participants were undergraduate students. The sample size is adequate for auditory display study as shown by Garzonis, Jones, Jay, and O'Neill (2009).

Strategy for Analysis

Total interaction time (i.e., 180 seconds) was divided into 'sensitive' and 'non-sensitive' periods. Sensitive periods (i.e., 55 seconds) indicate fork stabbing that occurred within five seconds interval after hearing the auditory icons. Since the auditory icons loop represents 11 stabs of apples, there were 11 sensitive periods of five seconds each. Non-sensitive periods (i.e., 125 seconds) indicates stabs that happened outside five seconds after hearing the auditory icons throughout the experiment which were the remaining time periods (i.e., total time =180 seconds) minus sensitive period (55 seconds) which equals to 125 seconds. Total of 'mimicked stabs' were added. Sum of these 'mimicked stabs' was than divided with total sensitive periods (i.e., 55 seconds). Total of 'non-mimicked stabs' were added and divided by 'non-mimicked' stabs with non-sensitive periods (i.e., 125 seconds). This indicates the ratio of mimicked and non-mimicked stabs. Both ratios were calculated for each participant separately. In order to determine whether hearing auditory icons will result in food intake mimicry, sensitive and non-sensitive stabbed ratio were tested using paired t-test.

RESULT

Analysis reported from paired t-test between sensitive and non-sensitive stabbed ratio shows that, there is a significant difference in time participants stab on the apple during sensitive ($M=0.0754$, $SD=0.0371$) and non-sensitive ($M=0.0446$, $SD=0.0171$) periods; $t(13) =2.222$, $p = 0.045$. Since $p \leq 0.05$, these results prove that participants tend to stab the apple during the sensitive periods, which was within 5 seconds after hearing the fork sound from the auditory icons. This finding supports the hypothesis.

DISCUSSION

The result shows that participants mimicked food intake behaviour of an imaginary other whose eating behaviour was represented using auditory icons. This is in correlation with previous research that shows human actions are influenced by sounds (Caldwell & Hibbert, 2002; Guéguen, Hélène, & Jacob, 2004; Jacob, 2006; Mandila & Gerogiannis, 2012; Roballey et al., 1985). Thus, listening to the fork stabbing and apple crunching sounds influences the participants to mimic the sounds.

It is interesting to note that mimicry was induced by sounds only, because the participants were not eating with co-located partners. In comparison to previous research that also results in mimicry such as by Hermans et al. (2012), participants were collocated with their eating

partners. The result is in accordance with research by Koordeman et al. (2011) which proves that alcohol sipping behaviour mimicry occurs even though drinking behaviour is perceived from actors in a movie. However, in experiments conducted by Hermans et al. (2012) and Koordeman et al. (2011), eating partners were in the participants view.

CONCLUSION

From this research, it can be concluded that hearing auditory icons that represent eating will result in food intake mimicry. This research was conducted with the motivation to add to the body of knowledge, which may be applied in future persuasive technology. This is because many current persuasive technologies fail to produce desired results due to the fact that designers do not fully understand the factors that lead to behavioural change.

Since auditory icons may be used to induce food intake mimicry, this paper suggests that auditory icons may be used in persuasive technology to change human eating behaviour. In the future, a study will be undertaken to find out if auditory icons set at a slow pace would make people eat slowly too. Eating at slow pace gives a lot of benefits such as lessening food and calorie intake, meanwhile eating too quickly can cause overeating. However, more research must be undertaken to study the effectiveness of using auditory icons to induce mimicry of slow eating pace in persuasive technology.

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