Evaluation of a Smart Fork to Decelerate Eating Rate

OVERWEIGHT IS ASSOCIATED with a range of negative health consequences, such as type 2 diabetes, cardiovascular disease, gastrointestinal disorders, and premature mortality.[1] One means to combat overweight is through encouraging people to eat more slowly.[2] People who eat quickly tend to consume more[3-5] and have a higher body mass index,[6-9] whereas people who eat more slowly feel sated earlier and eat less.[10-13]

Unfortunately, eating rate is difficult to modify, because of its highly automatic nature.[14] In clinical settings, researchers have had some success changing behavior by using devices that deliver feedback in real time.[15-17] However, existing technologies are either too cumbersome[18] or not engaging enough[19] for use in daily life contexts. Training people to eat more slowly in everyday eating contexts, therefore, requires creative and engaging solutions. This article presents a qualitative evaluation of the feasibility of a smart fork to decelerate eating rate in daily life contexts. Furthermore, we outline the planned research to test the efficacy of this device in both laboratory and community settings.

*This article was written by **Sander Hermsen,** senior researcher, Faculty of Communication and Journalism, Utrecht University of Applied Sciences, Utrecht, The Netherlands; **Jeana H. Frost,** PhD, assistant professor, Faculty of Social Sciences, VU University Amsterdam, The Netherlands; **Eric Robinson,** PhD, tenure track fellow, Institute of Psychology, Health and Society, University of Liverpool, Liverpool, United Kingdom; **Suzanne Higgs,** PhD, associate professor, School of Psychology, University of Birmingham, Birmingham, United Kingdom; **Monica Mars,** PhD, assistant professor, Division of Human Nutrition, Wageningen University, Wageningen, The Netherlands; and **Roel C. J. Hermans,** PhD, postdoctoral fellow, Behavioural Science Institute, Radboud University, Nijmegen, The Netherlands.*

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EVALUATION

Assessment

We performed a qualitative study to assess the acceptability, perceived efficacy, and user experience of a smart fork (10SFork, SlowControl). The augmented fork contains sensors and actuators that provide real-time feedback (Figure). The fork delivers feedback at 10-second intervals between bites. If users take a bite too quickly (ie, before the end of the 10-second interval), they feel a gentle vibration in the handle of the fork and see a red indicator light. The fork provides a series of data recording methods. First, the fork determines the exact time at which the meal is started and ended (ie, meal duration). Second, it counts the total number of bites per meal and per minute (ie, eating speed). Third, it calculates the average interval between bites, and, fourth, it determines the ratio of over-speed bites. The fork stores all data for later review via USB or Bluetooth. The desired interval between bites and feedback modalities (lights and vibrations) can be adjusted in an online control panel. In addition to the vibrotactile and visual feedback, the fork is connected to a secure online platform. After logging on to the platform, users can review their past behavior: number of bites, percentage of bites eaten too quickly, and duration of the meals.

To test this fork, 11 participants (three male, eight female, aged 18 to 35 years, all self-perceived fast eaters (mean=7.2, standard deviation=1.82 on a scale of 1 to 10, where 1 is "extremely slow" and 10 is "extremely fast"), ate a meal using the fork in our laboratory. Subsequently they used the fork for 3 consecutive days in their home setting, eating as many meals as possible with the fork. All participants ate the main meal of the day, dinner, with the fork. Three participants also used the fork for other meals, including breakfast and lunch. After the laboratory meal and on returning the fork, participants shared their experiences in semistructured interviews covering the following topics: perceived effect on eating rate, comfort of use, feedback accuracy, social aspects of fork use, and motivation for using the fork. Interviews were recorded and transcribed, and a thematic classification on the transcripts was performed. The study protocol was approved by the Institutional Review Board of the Faculty of Social Sciences of Radboud University Nijmegen, The Netherlands. All participants provided written informed consent.

Participant Feedback

All participants believed that the feedback from the fork was generally accurate and consistent, and they found the technology acceptable. Everyone found the fork's size and weight acceptable, thought the fork was easy to handle, and thought that the fork's vibrotactile feedback was not uncomfortable, but could not be ignored either. Although each participant reported some false positives (eg, vibrations when not taking a bite), no participant saw that as a threat to the usability of the fork. However, all participants found it hard to estimate when the 10-second wait was over.

All participants report a heightened awareness of eating rate, and all but one participant reported that they ate more slowly when using the fork. When eating in company, none of the participants felt ashamed when using the fork; rather, it sparked humor and started some lively conversations about eating rate and healthy eating. Surprisingly, a few participants reported some

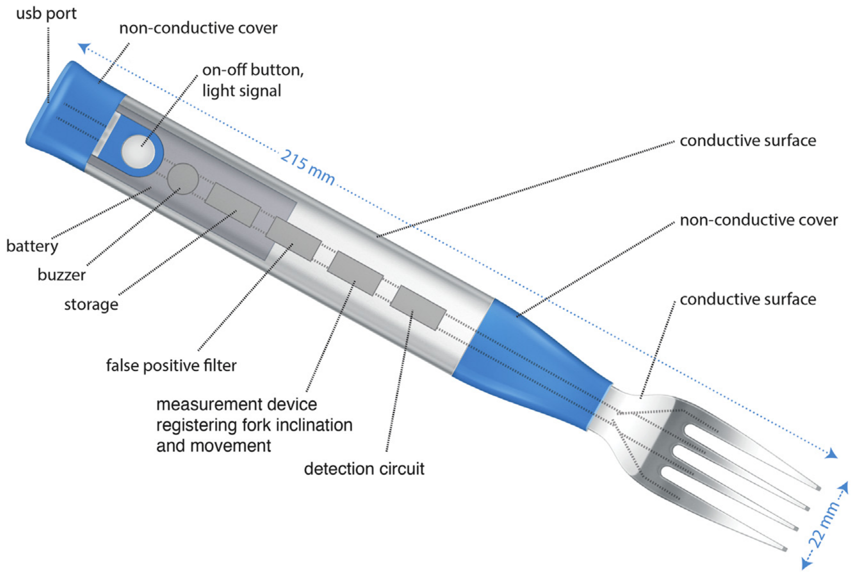

Figure. Smart fork used to evaluate the feasibility of decelerating eating rate in daily life contexts (10SFork, SlowControl). When taking a bite, the conductive surface on the fork prongs connects through the body of the user with the conductive surface of the steel; this short circuit is detected, assessed, and if it represents a bite, its timestamp is stored. If two bites occur within a preset time limit, the fork delivers vibrotactile (buzzing) and visual (light) feedback.

frustration with decelerated eating rate, expressing a desire to return to their former speedier eating habits.

All participants were motivated to try the fork. After a few meals, however, motivation waned in a minority of the participants; the majority remained motivated to use the fork throughout the 3-day period. All participants could imagine the fork being effective in retraining eating rate in the long run. However, none of the participants thought that they were part of the product target group; that is, they did not perceive their high eating rate as a major problem for their health.

FURTHER EVALUATION

Users reported enhanced awareness of their eating rate and felt comfortable using the fork in social settings. However, self-perceived target group membership, and the incapacity of the fork to take meal characteristics into account, may be issues affecting acceptance of the fork as an intervention for healthy eating in real life.

Further studies will assess the effect of the feedback on eating rate, satiety, and intake in a single, standardized meal. Also, we plan on examining the efficacy of a smart fork over time in naturalistic eating contexts. Results from these studies will contribute to answering the question of whether a smart fork can be a viable tool to reduce eating rate and control food intake.

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DISCLOSURES

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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