Evaluation of a smart fork to decelerate eating rate

Hermsen, Sander; Frost, Jeana H; Robinson, Eric; Higgs, Suzanne; Mars, Monica; Hermans, Roel C J

DOI:
10.1016/j.jand.2015.11.004

Document Version
Peer reviewed version

Citation for published version (Harvard):
Hermsen, S, Frost, JH, Robinson, E, Higgs, S, Mars, M & Hermans, RCJ 2016, 'Evaluation of a smart fork to decelerate eating rate', *Academy of Nutrition and Dietetics. Journal* . https://doi.org/10.1016/j.jand.2015.11.004

Introduction

Overweight is associated with a range of negative health consequences, such as type II diabetes, cardiovascular disease, gastro-intestinal disorders, and premature mortality[1]. One promising means to combat overweight is through encouraging people to eat more slowly [i.e. 13]. People who eat quickly tend to consume more [e.g. 2, 3, 4] and have a higher body mass index[5, 6, 7, 8] while people who eat more slowly feel sated earlier and eat less[9, 10, 11, 12].

Unfortunately, eating rate is difficult to modify, due to its highly automatic nature[14]. In clinical settings, researchers have had some success changing behaviour using devices that deliver feedback in real time [15, 16, 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. The purpose of this paper is to present 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.

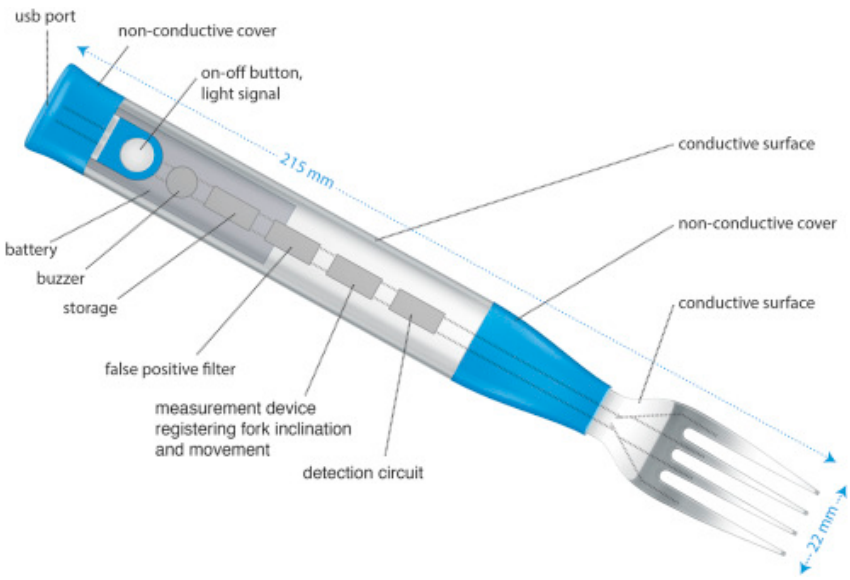

Figure 1: the 10sFork, produced by SlowControl (Paris, France). When taking a bite, the conductive surface on the fork prongs connects through the body of the user with the

conductive surface of the steel; this short circuit is detected, assessed, and if it represents a bite, its timestamp is stored. If two bits occur within a pre-set time limit, the fork delivers vibrotactile (buzzing) and visual (light) feedback. The fork weighs 83,5 grams and measures 215 x 22 x 13 milimeters (length x width x thickness).

Evaluation

Assessment

We performed a qualitative study to assess the acceptability, perceived efficacy and user experience of the 10SFork. The augmented fork contains sensors and actuators that provide real time feedback (see figure 1). The fork delivers feedback at 10-second intervals between bites. If users take a bite too quickly (i.e. 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 (i.e. meal duration). Second, it counts the total number of bites per meal and per minute (i.e. eating speed). Third, it calculates the average interval between bites and, fourth, 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 behaviour: number of bites, percentage of bites eaten too quickly, and duration of the meals. Possibilities for sharing and integration with social media are provided.

To test this fork, 11 participants (3 male, 9 female, age 18–35, all self-perceived fast eaters (M=7.2, SD = 1.82 on a scale from 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 three 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 upon returning the fork, participants shared their experiences in semi-structured 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 <blinded for review>. All participants provided written informed consent.

Participant feedback

All participants felt that the feedback was generally accurate and consistent and found the technology acceptable. Everyone found the fork's size and weight acceptable, felt the fork was pleasant to handle, and felt that the fork's vibrotactile feedback was not uncomfortable, but could not be ignored either. While each participant reported some false positives, e.g. 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 ten-second wait was over.

Interviews suggest the fork may result in changes in both perceptions and behaviour. 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 humour and started some

lively conversations about eating rate and healthy eating. Surprisingly, a few participants reported some 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 three-day period. All participants could imagine the fork being effective in retraining eating rate in the long run. Yet, none of the participants felt they were part of the product target group, i.e. they did not perceive their high eating rate as a major problem for their health.

Conclusions

The 10SFork has the potential to become a successful intervention in slowing down eating rate. Users feel it is an acceptable product that is sufficiently comfortable and accurate. They report enhanced awareness of their eating rate and feel 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.

To formally evaluate the efficacy of the 10SFork in slowing down eating rate, we have received funding of the Netherlands Organisation of Scientific Research (NWO). We will conduct two studies. The first study will assess the effect of the feedback on eating rate, satiety, and intake in a single, standardized meal. In the second study, we will examine the efficacy of the fork over time in naturalistic eating contexts. Results from these studies will contribute to answering the question of whether this tool can be a viable instrument to reduce eating rate, and control food intake.

References

1. Berenson GS. Health consequences of obesity. Pediatr Blood Cancer. 2012;58(1):117-121.
2. Viskaal-Van Dongen M, Kok FJ, De Graaf C. Eating rate of commonly consumed foods promotes food and energy intake. Appetite, 2011;56:25-31.
3. De Graaf C, & Kok FJ. Slow food, fast food and the control of food intake. Nat Rev Endocrinol, 2010;6:290-293.
4. Robinson E, Almiron-Roig E, Rutters F, de Graaf C, Forde CG, Tudur Smith C, Nolan SJ, & Jebb SA. A systematic review and meta-analysis examining the effect of eating rate on energy intake and hunger. Am J Clin Nutr 2014;ajcn-081745.
5. Otsuka R, Tamakoshi K, Yatsuya H, Murata C, Sekiya A, Wada K, & Toyoshima H. Eating fast leads to obesity: Findings based on self-administered questionnaires among middle-aged Japanese men and women. J EPIDEMIOL, 2006;16:117-124.
6. Lee HA, Lee WK, Kong KA, Chang N, Ha EH, Hong YS, & Park H. The effect of eating behavior on being overweight or obese during preadolescence. J Prev Med Public Health, 2011;44(5):226.
7. Tanihara S, Imatoh T, Miyazaki M, Babazono A, Momose Y, Baba M, ….& Une H. Retrospective longitudinal study on the relationship between 8-year weight change and current eating speed. Appetite, 2011;59:179-183.
8. Maruyama K, Sato S, Ohira T, Maeda K, Noda H, Kubota Y, ... & Iso H. The joint impact on being overweight of self reported behaviours of eating quickly and eating until full: cross sectional survey. BMJ, 2008;337.
9. Rolls ET. Sensory processing in the brain related to the control of food intake. Proc Nutr Soc, 2007;66:96-112.
10. Zijlstra N, De Wijk R, Mars M, Stafleu A, & De Graaf C. Effect of bite size and oral processing time of a semisolid food on satiation. Am J Clin Nutr, 2009;90:269-275.

11. Cassady BA, Hollis JH, Fulford AD, Considine RV, Mattes RD. Mastication of almonds: effects of lipid bioaccessibility, appetite and hormone response. Am J Clin Nutr, 2009;89:794–800.
12. Kokkinos A, Le Roux CW, Alexiadou K, Tentolouris N, Vincent RP, Kyriaki D, & Katsilambros N. Eating slowly increases the postprandial response of the anorexigenic gut hormones, peptide YY and glucagon-like peptide-1. J Clin Endocrinol Metab, 2010;95:333–337.
13. Martin CK, Anton SD, Walden H, et al. Slower eating rate reduces the food intake of men, but not women: implications for behavioral weight control. Behav Res Ther, 2007;45(10):2349-2359.
14. Petty AJ, Melanson KJ, & Greene GW. Self-reported eating rate aligns with laboratory measured eating rate but not with free-living meals. Appetite, 2013;63:36-41.
15. Berg C, Sabin M, Shield J, et al. A framework for the treatment of obesity: early support. Obesity: causes, mechanisms, preventions, and treatment. Sunderland: Sinuaer Associates, Inc; 2008:399-425.
16. Ford AL, Bergh C, Södersten P, et al. Treatment of childhood obesity by retraining eating behaviour: randomised controlled trial. Bmj, 2010;340.
17. Van Elburg AA, Hillebrand JJG, Huyser C, et al. Mandometer Treatment Not Superior to Treatment as Usual for Anorexia Nervosa. Int J Eat Disord, 2011;45:193-201.
18. Zandian M, Ioakimidis I, Bergh C, et al. Decelerated and linear eaters: effect of eating rate on food intake and satiety. Physiol Behav, 2009;96(2):270-275.
19. Hamilton-Shield J, Goodred J, Powell L, et al. Changing eating behaviours to treat childhood obesity in the community using Mandolean: the Community Mandolean randomised controlled trial (ComMando)-a pilot study. Health Technol Assess, 2014;18(47):1-75.