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Promoting healthy food choices: The effect of a social proof heuristic and cognitive load on the proportion of healthy food choices.

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Abstract

Objective: High cognitive load evokes impulsive responses, such as unhealthy food choices. Previous studies show that similar negative effects evoked by self-control and hunger can be eliminated in the presence of a heuristic promoting the healthy food products. The present study aims to extend the current literature by investigating whether the negative consequences of cognitive load on food choice can also be eliminated by presenting a social proof heuristic.

Design: In a single empirical laboratory study, participants were offered the hypothetical choice between an unhealthy but attractive and a healthy but considerably less attractive food product. These pairs pose a trade-off dilemma between the short-term and long-term goals. During the task, cognitive load and the presence of a social proof heuristic was manipulated. The present study analyzed the responses of the participants to the trade-off pairs.

Results: As hypothesized, the presence of a social proof heuristic did not influence the proportion of healthy food choices among participants under low cognitive load. Contrarily to our hypotheses, cognitive load did not influence the proportion of healthy food choices in the absence of a heuristic and no interaction effect of heuristic and cognitive load was found. However, significant differences in the reaction times of the participants suggested that the social proof heuristic was noticed.

Conclusion: Future research would benefit from presenting the food choice unexpectedly and having a larger sample with more variety in education level. As it stands, the present study is inconclusive.

Keywords: Nudging; Food choice; Cognitive load; Social proof heuristic

Introduction

On a daily basis, people make on average more than two hundred food related choices, while people only estimate this amount of choices at slightly more than fourteen (Wansink & Sobal, 2007). This discrepancy is due to the fact that food choices are often established automatically (Cohen & Babey, 2012), impulsively (Hofmann, Friese, & Wiers, 2008) and outside the awareness of the individual (Wansink & Sobal, 2007). The type of food one consumes plays a substantial role in the increasing rates of overweight and obesity (Mela, 2001), which in turn can increase the risk of heart diseases and diabetes mellitus type 2 (Malik, Popkin, Bray, Després, & Hu, 2010). Driven by the motivation to tackle the negative consequences of unhealthy food choices, many policy makers have been aiming to positively influence food choices. To date, the largest part of these interventions are focusing on information provision (Beauchamp, Backholer, Magliano, & Peeters, 2014). Although these interventions are shown to be effective in creating awareness among individuals (Grunert & Wills, 2007), the success in terms of behavioral change and measurable health indicators (e.g. weight loss) seems to be modest (Pérez-Cueto et al., 2012). Moreover, the effectiveness of these interventions is especially limited among people with a low socioeconomic status (Beauchamp et al., 2014), who are found to have a lower cognitive capacity (Singh-Manoux, Richards, & Marmot, 2005). This leads to the health disparities between people with low and high socioeconomic status to even grow wider (Beauchamp et al., 2014). This situation shows the demand for accessible interventions that can be effective in populations with lower socioeconomic status and lower cognitive capacities.

With the automatic nature of many food choices in mind, nudges seem to suit as a promising intervention (Arno & Thomas, 2016). Thaler and Sunstein (2008) describe nudges as subtle changes in the choice environment that are anticipated to positively influence the decision-making process, without forbidding options or changing their economic incentives. Several systematic reviews suggest that nudges can serve as a low-cost and broadly applicable intervention, but also acknowledge that the empirical evidence of the effectiveness of nudges is scarce (Arno & Thomas, 2016; Bucher et al., 2016). The present study aims to address the gap in the literature as to whether nudges are an effective strategy for promoting healthy food choices among people with a low cognitive capacity.

The different approach of the traditional interventions and nudges traces back to the perspective of Kahneman (2011) on the human decision-making processes. The dual systems theory of Kahneman (2011) posits that information is processed via two distinct systems:

system 1 and system 2. System 1 is fast, automatic and highly susceptible to environmental cues, whereas system 2 is slow, rational and reflective (Kahneman, 2011). In terms of eating behavior, this means that system 2 uses rational thinking to come to healthy food choices to satiate the long-term goals of being healthy (Hofmann et al., 2008). The traditional interventions create awareness of the negative effects of unhealthy food choice and therefore make use of system 2 to stimulate the consumption of healthy food products (Beauchamp et al., 2014; Grüne-Yanoff & Hertwig, 2016). Contrarily, system 1 bases choices on impulsivity (Grüne-Yanoff & Hertwig, 2016) and heuristics (Kahneman, 2011), which often results in unhealthy food choices and big portion sizes (Hofmann et al., 2008). In the mean time, it is theoretically assumed that nudging uses the impulsivity and heuristics of system 1 to regulate the behavior in the desired way (Thaler & Sunstein, 2008; Grüne-Yanoff & Hertwig, 2016). This means that with the help of nudging, individuals are not required to engage in effortful thinking to come to beneficial decisions (Grüne-Yanoff & Hertwig, 2016), such as healthy food choices. Examples of nudges are setting the preferred option as the default or making social norms salient (*social proof heuristic*) (Thaler & Sunstein, 2008).

Pliner and Mann (2004) performed two studies in which they examined the effect of social norms on food intake and food choice. They found that social norms can influence food intake, because people have an unclear idea of how much they should eat. However, people have a clearer idea of what they should eat and therefore the social norms did not affect the food choice (Pliner & Mann, 2004). In a similar vein, studies assessing the effect of a social proof heuristic on food choice also found no main effect of heuristic (Salmon, Fennis, De Ridder, Adriaanse, & De Vet, 2014; Cheung, Kroese, Fennis, & De Ridder, 2017). In line with these findings, we propose that the presence of a social proof heuristic will not influence the proportion of healthy food choices among people under low cognitive load.

The study of Salmon et al. (2014) additionally manipulated self-control and the study of Cheung et al. (2017) manipulated hunger to evoke impulsive responses. Conforming to the idea that high self-control concerns the ability to override impulsive responses (Baumeister, Vohs, & Tice, 2007), Salmon et al. (2014) found that participants in the low self-control condition made less healthy food choices than participants in the high self-control condition. Similarly, Cheung et al. (2017) found that hungry participants made more unhealthy food choices than satiated participants. However, these negative consequences were eliminated when the social proof heuristic showed that the majority of the people chose the healthy option (Salmon et al., 2014; Cheung et al., 2017). In the presence of a social proof heuristic, the proportion of healthy food choices was higher among people low in self-control compared to people high in self-control (Salmon et al., 2014) and hungry people chose healthy food products equally often as satiated people (Cheung et al., 2017). Agreeing with the assumption that nudges make use of the impulsivity and heuristics of system 1 (Thaler & Sunstein, 2008), the social proof heuristic was able to influence food choice when the impulsive responses were evoked.

Another way of activating system 1 and evoking impulsive eating behavior is by heightening cognitive load (Kahneman, 2011). Several studies show the negative impact of cognitive load on different types of eating behavior (Friese, Hofmann, & Wänke, 2008; Van der Wal & Van Dillen, 2013), one of which is conducted by Shiv and Fedorikhin (1999). In their study, participants were assigned to either a low cognitive load condition (remembering a 2-digit number) or a high cognitive load condition (remembering a 7-digit number). The participants had to walk to another room and recall the number. During this walk, they were presented the choice between a chocolate cake and a fruit salad. 41% of the participants in the low-cognitive load condition chose the chocolate cake, whereas in the high cognitive load-condition this percentage rose to 63%. Shiv and Fedorikhin (1999) explain this significant difference by impulses and feelings of affect. The study concluded that people have a higher impulsive reaction and affect towards most of the unhealthy foods (e.g. chocolate cake) than most of the healthy foods (e.g. fruit salad). In line with these results, we expect a lower proportion of healthy food choices among people under high cognitive load (vs. under low cognitive load), but only when there is no heuristic promoting the healthy food products.

The concepts self-control and cognitive control (which is diminished under high cognitive load) are often used interchangeably (Scherbaum, Frisch, Holfert, O’Hora, & Dshemuchadse, 2018). Where high self-control leads to resisting temptations and delaying immediate gratification (Kim & Lee, 2011), high cognitive control leads to distracting attention from irrelevant information (Miller & Cohen, 2001). Because cognitive control is embodied in thinking skills, such as learning, reasoning and problem solving (Gottfredson & Deary, 2004), it can be argued that cognitive control is also partly responsible for to the acting of self-control (Junger & Van Kampen, 2010). From this perspective, self-control and cognitive control seem to have substantial conceptual overlap. Junger and Van Kampen (2010) measured the effect of cognitive control and self-control on health related behaviors. They found that both cognitive control and self-control were positively related to healthier dietary habits (e.g. higher intake of vegetables). Nonetheless, no relationship was found between cognitive control and self-control, suggesting that both concepts are independent predictors of health related behavior (Junger & Van Kampen, 2010). Moreover, recent research shows no evidence for common underlying processes of self-control and cognitive control. In this study, Scherbaum et al. (2018) manipulated the level cognitive control. Afterwards, participants had to choose between a small but immediate or a large but delayed reward. They proposed that when cognitive control and self-control have the same underlying mechanisms, activating cognitive control would lead to choosing the large but delayed reward more often. Results did not reveal this spill-over effect, which suggests that cognitive control and self-control have different underlying mechanisms (Scherbaum et al., 2018).

Because of the different underlying mechanisms of self-control and cognitive control, the question whether the negative effects of cognitive load (Shiv & Fedorikhin, 1999) can also be removed by the presence of a social proof heuristic favoring the healthy option remains unanswered by the current literature. However, several studies provide interesting insights in whether cognitive load moderates the influence of different external cues on different types of eating behavior. Hunter, Hollands, Couturier and Marteau (2018) used the proximity effect as an external cue and examined whether this effect is moderated by cognitive load. They found that placing food further away reduced the likelihood of consumption in the low, as well as in the high cognitive load condition. This result suggests that this external cue could be effective population-wide in promoting healthy eating behavior, but also indicates that its effectiveness is unlikely to be moderated by cognitive load (Hunter et al., 2018).

Contrarily, the study of Zimmerman and Shimoga (2014) revealed that cognitive load did moderate the influence of the provided external cue. Again, participants were randomly assigned to a low (remembering a 2-digit number) or a high cognitive load condition (remembering a 7-digit number). Within each of these groups, participants were either exposed to a video commercial containing a non-food advertisement or containing a food advertisement promoting the unhealthy snacks. The food advertising, which served as the external cue, did not influence food choice among the participants under low cognitive load. However, the participants under high cognitive load seemed to choose 43% more unhealthy snacks as a response to the food advertising, which was a large and significant effect (Zimmerman & Shimoga, 2014). Zimmerman and Shimoga (2014) concluded that people under high cognitive load show greater vulnerability to the external cues than people under low cognitive load. Further analyzes showed that the socioeconomic status of participants appeared to magnify this effect, with participants with low (vs. high) socioeconomic status being more susceptible to the external cue. In this respect, one could analogously imply that the people under high cognitive load would have a higher proportion of healthy food choices than people under low cognitive load, if the external cues promote the healthy food products. While the two aforementioned studies (Hunter et al., 2018; Zimmerman & Shimoga, 2014) do not agree on whether the effect of an external cue is moderated by cognitive load, they do agree on it being effective in promoting healthy eating behavior among populations with a high cognitive load. Taken together the theoretical assumption that nudges are effective via system 1 (Thaler & Sunstein, 2008) and that a high cognitive load predisposes individuals to predominant system 1 processing (Kahneman, 2011), it is expected that decisions made under high cognitive load could result in choices that align with individuals' health interests when there are external cues promoting them, such as a social proof heuristic.

The Present Study

The present study aims to extend the research of Salmon et al. (2014) by examining whether the negative consequences of cognitive load can also be removed by the presence of a social proof heuristic. In order to find appropriate stimuli for the present study, we first conducted a pilot study where participants were asked to rate the attractiveness, healthiness and familiarity of forty food products. Afterwards, ten trade-off pairs were created, consisting of one item that is evaluated as attractive but unhealthy and one item that is evaluated as less attractive but healthy. These pairs pose a dilemma between the short-term and long-term goals of the participants (Salmon et al., 2014). The participants were randomly assigned to a condition with low or high cognitive load and with or without a social proof heuristic. In the present study, the responses of the participants to the trade-off pairs were analyzed as the proportion of healthy food choices.

In line with earlier research on food choice (Salmon et al., 2014; Cheung et al., 2017), we expect that the presence of a social proof heuristic does not affect the proportion of healthy food choices when there is no manipulation evoking impulsive responses. More specifically, it is hypothesized that when participants are under low cognitive load, the proportion of healthy food choices is not influenced by whether a social proof heuristic is presented or not. Furthermore, we hypothesize that participants under high (vs. low) cognitive load are more inclined to react on impulses and affect (Shiv & Fedorikhin, 1999), which will result in a lower proportion healthy food choices, but only when there is no heuristic promoting the healthy food products. However, we expect that this effect is eliminated in the presence of a social proof heuristic. Stated differently, we hypothesize that participants under high cognitive load are just as likely to make healthy choices compared to participants under low cognitive load, when there is a social proof heuristic promoting the healthy food products.

Pilot Study

The aim of the pilot-study was to find appropriate stimuli to create trade-off pairs and food related filler pairs. A trade-off product pair consists of one item that is evaluated as attractive but unhealthy and one item that is evaluated as less attractive but healthy. These pairs pose a trade-off dilemma between the short-term goals of immediate gratification and the long-term goals of being healthy (Salmon et al., 2014). Moreover, we used products that do not differ significantly on familiarity because this might also influence food choice (Hofmann et al., 2018). In total, ten trade-off pairs without significant differences on familiarity were made. Additionally, five food related filler pairs were added to not reveal the aim of promoting healthy food choices. The filler pairs were composed of food products with either non-significant differences on attractiveness or significant differences on familiarity.

The sample of the pilot study consisted of 50 participants (42 female, 7 male, 1 other) with an average age of 23.70 years (*SD* = 3.91). The pilot study was performed on a computer and took approximately ten minutes. Students of Utrecht University could receive 0.25 course credits for their participation. Forty food products were presented one by one. The participants were asked to evaluate the forty food products on attractiveness (*How attractive is the food displayed above?*), healthiness (*How healthy is the food displayed above?*) and familiarity (*How familiar are you with the food displayed above?*) using a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*). The means, standard deviations, results of the paired samples t-test, and Cohen's *d*'s of the trade-off pairs and the food related filler pairs can be found in Appendix A.

Method

Participants and Design

One hundred eighty participants (143 female, 36 male, 1 other: Non-Binary) with an average age of 22.69 years (*SD* = 2.91) participated in exchange for 2 euros or 0.25 course credits.

The study used a 2x2 mixed design with cognitive load (low vs. high cognitive load) and social proof heuristic (no heuristic vs. social proof heuristic) as categorical independent variables. The proportion of healthy food choices was measured as the quantitative dependent variable.

Procedure

The study was run in the laboratory of Utrecht University. Participants were recruited on the campus of Utrecht University and the study was presented as a “Marketing Study”. The participants were individually seated in a cubicle, where all parts of the study were instructed and run on the computer. Participants were randomly assigned to a condition with a low or high cognitive load and with no heuristic or a social proof heuristic. Participants had to fulfill twenty trials in which they had to choose between two products that were displayed simultaneously. After completing this task, all participants answered questions to check the cognitive load manipulation, filled in a demographic questionnaire and read the debriefing. In total, the study took approximately ten minutes.

Measures

Cognitive Load. Participants were randomly assigned to a condition with either low or high cognitive load. In the low cognitive load condition, participants were asked to remember a 2-digit number (73), while in the high cognitive load condition, participants were asked to remember a 7-digit number (5341740). This is an established and validated task to manipulate cognitive load, originating from Shiv and Fedorkhin (1999) but also often used in other experiments in the domain of eating behavior (e.g. Shiv & Fedorikhin, 2002; Van der Wal & Van Dillen, 2013; Zimmerman & Shimoga, 2014; Hunter et al., 2018). To prevent the participants from writing down the number, they were asked to leave their telephone and any pieces of paper with the experiment leader. When the number was presented on the screen, participants could take as much time as needed to remember it. When they were convinced they could remember the number, they could click ‘next’ to continue with the experiment. To stress the importance of remembering the number, participants were informed that they had to recall the number in the correct order at the end of the experiment.

Food Choice Task. During the Food Choice Task, two products were displayed simultaneously. Participants had to complete twenty trials in which they had to choose one of the two paired products by clicking on it. The order of the twenty product pairs was randomized per participant. As a result of the pilot-study, ten trade-off pairs (e.g. kiwis vs. ice cream) and five food related filler pairs (e.g. grapes vs. apple pie) were presented. The healthy and unhealthy food products were deliberately placed at the right and left side of the screen equally often. To avoid revealing the aim of promoting healthy food choices, five non-food related filler pairs were added (e.g. toothpaste vs. mouthwash). The responses of the participants to the ten filler pairs were not analyzed in the present study. The responses to the ten trade-off pairs were used to calculate the proportion of healthy food choices, ranging from 0 (*zero healthy food choices*) to 1 (*ten healthy food choices*).

Social Proof Heuristic. Participants were randomly assigned to a condition with no heuristic or with a social proof heuristic. In the condition with the social proof heuristic, a pie chart was presented between the two products. The pie chart displayed the choices of fictitious previous participants (Salmon et al., 2014). Providing statistical information about the majority of a reference group is shown to be an effective way to manipulate social proof (e.g. Salmon et al., 2014; Goldstein, Cialdini, & Griskevicius, 2008). In the present study, a fabricated reference group was used. Participants were informed that the study had been conducted before and that previous participants had also chosen between twenty product pairs. However, the displayed percentages were simulated to constitute as a social proof heuristic.

Analogously to the study of Salmon et al. (2014), the social proof heuristic at trade-off pairs varied from 65% to 85%, with the majority always in favor of the healthy option. The social proof heuristic at the food related filler pairs ranged from 45% to 55% and favored the unhealthy option. By doing this, we aimed to minimize the possibility that the participants realized that we were trying to promote healthy food choices and therefore minimize the possibility of demand effects or reactance. Lastly, the non-food related product pairs had a social proof heuristic ranging from 65% to 85%, with a random direction. Participants assigned to the condition without a heuristic did not receive any instructions about a previous study, nor did they see pie charts.

Cognitive Load Manipulation Check

The aim of the cognitive load manipulation was to guarantee that participants in the high cognitive load condition found it more difficult, more effortful, more preoccupying and less easy to remember the number compared to the participants in the low cognitive load. To check whether this effect was reached, participants had to answer four questions using a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*): *"How difficult was it to remember the number?", "How much effort did it cost to remember the number?", "How much were you preoccupied with remembering the number during the choice task?"* and *"How easy was it to remember the number?"*. The scores on the last question were reverse-coded before conducting the reliability analysis. To test whether the four questions reflect the same construct, a reliability analysis was performed. This analysis showed that the four questions to check whether the cognitive load manipulation was successful were highly reliable ($\alpha = .82$). Therefore, the scores on these four questions were combined into one scale ranging from 1 (*not at all*) to 7 *(very much*) indicating to what extent the participants found it difficult, effortful and preoccupying to remember the number. This scale is from now on referred to as the cognitive load-scale.

Control Variables

In order to get a clearer picture of the sample, age, gender, education level, hunger, body mass index (BMI) and the goal to eat healthily were measured. Hunger (*How hungry are you at this moment?*) and the goal to eat healthily (*To what extent do you have the goal to eat healthily?*) were measured using a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*). BMI was measured by asking the height in centimeters and weight in kilograms of the participants.

Results

Descriptives and Randomization Check

On average, participants had a healthy BMI ($M = 22.49$, $SD = 3.12$) and reported a moderate level of hunger ($M = 3.44$, $SD = 1.15$). The goal to eat healthily was on average valued with a 5.11 ($SD = 1.15$) on a 7-point scale. To see whether the randomization of participants was successful, four separate ANOVAs with condition as independent variable and BMI, hunger, goal to eat healthily and age as dependent variables were performed. All ps > .427 reveal no significant differences between the four conditions, which suggests that the randomization of participants was successful. To see whether gender was distributed randomly across the four conditions, a chi-square test of independence was performed. This analysis revealed no significant relationship between the four conditions and gender, $x^2(6) = 4.95$, $p = .551$, again suggesting that the randomization of participants was successful. Additionally, results showed that the level of reported hunger was negatively related to the proportion of healthy food choices ($r = -.20$, $p = .008$), while the reported goal to eat healthily was positively related to the proportion of healthy food choices ($r = .38$, $p < .001$). BMI was not found to be significantly related to the proportion of healthy food choices ($r = -.11$, $p = .135$).

Manipulation Check

To test if participants under high cognitive load scored higher on the cognitive load-scale than participants under low cognitive load, an independent samples t-test was performed. In this analysis, cognitive load served as the independent variable and the cognitive load-scale as the dependent variable. Results showed that participants under low cognitive load ($M = 1.70$, $SD = .80$) scored significantly lower on the cognitive load-scale than participants under high cognitive load ($M = 3.11$, $SD = 1.32$), $t(178) = -8.45$, $p < .001$, $d = -1.30$. This result suggests that the participants under low cognitive load found it less difficult, less effortful, less preoccupying and easier to remember the number compared to participants under high cognitive load, which in turn suggests that cognitive load manipulation was successful.

In the low cognitive load condition, all 81 participants remembered the 2-digit number correctly. Within the high cognitive load condition, 86 participants were able to recall the 7-digit number correctly, while 13 participants recalled the 7-digit number incorrectly. An independent samples t-test was performed to see whether the participants who remembered the 7-digit number correctly scored significantly different on the cognitive load-scale from participants who remembered the 7-digit number incorrectly. This analysis revealed that participants who remembered the 7-digit number correctly scored significantly lower on the cognitive load-scale ($M = 3.00$, $SD = 1.31$), than those who remembered the 7-digit number incorrectly ($M = 3.85$, $SD = 1.22$), $t(97) = -2.18$, $p > .001$, $d = -.67$. This result suggests that participants who remembered the 7-digit number incorrectly, found it more difficult, more effortful, more preoccupying and less easy to remember the 7-digit number. Based on this result, we see no reason to exclude these participants. However, for completeness we will also report the results for the participants who remembered the number correctly separately.

Proportion of Healthy Food Choices

The proportion of healthy food choices ranged from zero to one, with an average of .46 (*SD* = .25). An ANOVA was performed to investigate whether cognitive load, social proof heuristic and their interaction affected the proportion of healthy food choices. Cognitive load and heuristic served as independent variables and the proportion of healthy food choices as the dependent variable. We expected that, in the absence of a heuristic, participants under high cognitive load would have a lower proportion of healthy food choices compared to participants under low cognitive load. In contradiction to our hypothesis, the ANOVA showed no main effect of cognitive load ($F(1, 176) = .003$, $p = .958$). We further hypothesized that the presence or absence of the social proof heuristic would not influence the proportion of healthy food choices among participants under low cognitive load. In line with this hypothesis, no effect of heuristic on the proportion of healthy food choices was found ($F(1, 176) = 2.06$, $p = .153$). Moreover, we hypothesized that participants under high cognitive load are just as likely to make healthy choices compared to participants under low cognitive load, when there is a social proof heuristic promoting the healthy food products. Contrarily, the ANOVA revealed no significant interaction effect of heuristic and cognitive load on the proportion of healthy food choices, $F(1, 176) = 2.71$, $p = .102$.

To examine whether cognitive load, social proof heuristic and their interaction affected the proportion of healthy food choices among the participants who remembered the 2-digit or 7-digit number correctly, a separate ANOVA was performed. In this analysis, cognitive load and heuristic served as independent variables and the proportion of healthy food choices served as the dependent variable. Similarly to the ANOVA including all participants, all *p*s > .088 revealed no main effect for cognitive load ($F(1, 163) < 1$), no main effect for heuristic ($F(1, 163) = 1.50$) and no main effect for their interaction ($F(1, 163) = 2.95$).

Reaction Time

The reaction time of the participants was calculated as the sum of the twenty trials of the Food Choice Task and expressed in milliseconds. The participants had an average reaction time of 59266.79 milliseconds (*SD* = 23878.25). This result shows that the participants completed the twenty trials of the Food Choice Task averagely in just under a minute. To see whether the manipulations affected the reaction time of the participants, an ANOVA was performed with heuristic and cognitive load as independent variables and the reaction time as the dependent variable. The analysis revealed that the reaction time of participants was significantly lower when no heuristic was presented (*M* = 48290.78, *SD* = 2229.44) than when the social proof heuristic was presented (*M* = 70763.41, *SD* = 2275.47), $F(1, 176) = 49.77$, $p < .001$, $\eta_p^2 = .22$. This results shows that participants in the condition with the social proof heuristic averagely took 70.60 seconds to complete the Food Choice Task, whereas participants in the condition without a heuristic only took 48.29 seconds. This result suggests that participants paid attention to the pie chart which presented the social proof heuristic. Additionally, the ANOVA did not show a main effect of cognitive load ($F(1, 176) = .03$, $p = .866$) and no interaction effect of cognitive load and heuristic ($F(1, 176) = .86$, $p = .356$) on the reaction time.

Discussion

Through conducting a single empirical study, the present study aimed to extend the research of Salmon et al. (2014) by examining whether the negative consequences of cognitive load can also be removed by the presence of a social proof heuristic. In line with our hypothesis, we found that social proof heuristic did not influence the proportion of healthy food choices among participants under low cognitive load. High cognitive load is assumed to heighten the propensity for system 1 processing (Kahneman, 2011), which is typically related with impulsive behavior, such as unhealthy food choices (Shiv & Fedorikhin, 1999). We therefore expected to find a lower proportion of healthy food choices among participants under high cognitive load compared to participants under low cognitive, but only when there was no heuristic promoting the healthy food product. In contrast to our hypothesis, we found no differences in the proportion of healthy food choices among participants under low or high cognitive load. It was hypothesized that the expected negative effects of cognitive load on the proportion of healthy food choices would be eliminated in the presence of the social proof heuristic. Instead, the results of the present study did not reveal an interaction effect of cognitive load and heuristic on the proportion of healthy food choices.

In contrast to previous research that reported the negative effects of cognitive load on several types of eating behavior (Shiv & Fedorikhin, 1999; Van der Wal & Van Dillen, 2013; Zimmerman & Shimoga, 2014), the results of the present study revealed no significant differences between participants under low and high cognitive load. Conforming to these studies, we expected a lower proportion of healthy food choices among participants under high (vs. low) cognitive load in the absence of a heuristic. An additional study of Shiv and Fedorikhin (2002) sheds a light on decision-time as a moderator for the effect of cognitive load on food choice. In this study, participants got either 3 to 6 seconds (low decision-time) or 1.5 minutes (high decision-time) to make their decision in a binary food choice task. The binary food choice task also consisted of trade-off pairs. They found that when the time available was low, the proportion of healthy food choices was lower among participants under high cognitive load compared to participants under low cognitive load. However, this effect was reversed when people had a high decision-time. In that case, the proportion of healthy food choices was even higher among participants under high cognitive load (Shiv & Fedorikhin, 2002). During the present study, participants were not specifically instructed to make a decision within a certain amount of time. Therefore, one could suppose that the participants had a high decision-time, which could possibly explain that we did not find a lower proportion of healthy food choices among participants under high cognitive load. However, analyzing the reaction times in the present study shows that the participants under low as well as under high cognitive load came to a single decision within 4 seconds, which corresponds to the low decision-time in the study of Shiv and Fedorikhin (2002). In line with the results of Shiv and Fedorikhin (2002), one would expect that the low decision-time in the present study also led to a lower proportion of healthy food choices among participants under high cognitive load. Since the decision-time in the present study corresponds to the available time in the low decision-time condition of Shiv and Fedorikhin (2002), one could argue that this is not the actual factor influencing whether participants would base their choices on impulses or cognitions. Possibly, the subjective feeling of experiencing time-pressure, instead of the actual time-pressure, explains why the present study did not reveal the same effects as the study of Shiv and Fedorikhin (2002). Future research should examine whether the decision-time or the subjective feeling of experiencing time-pressure influences the effect of cognitive load on the proportion of healthy food choices.

A limitation of the present study was its sample, including primarily university students. Since the education level of the sample is higher than the general population, the cognitive capacity is also likely to be higher (Singh-Manoux et al., 2005). The manipulation check showed that participants under high cognitive load found it significantly more difficult, more effortful, more preoccupying and less easy to remember the number compared to participants under low cognitive load. However, the participants in the high cognitive load condition reported an average of 3.11 on the 7-point cognitive load-scale, compared to a 1.70 in the low cognitive load condition. The average score of 3.11 indicates that participants under high cognitive load found it moderately difficult, effortful and preoccupying. Therefore, the cognitive load manipulation of remembering a 7-digit number might not have been difficult enough for this specific population to actually lead to interference with decision-making.

Additionally, the present study did not find an interaction effect of cognitive load and heuristic on the proportion of healthy food choices. Self-control (Salmon et al., 2014), hunger (Cheung et al., 2017), and cognitive load (Kahneman, 2011) are related to the impulsive and heuristic decision-making of system 1. We proposed that this would not necessarily lead to unhealthy food choices, when there is a social proof heuristic promoting the healthy food products. Similar to Salmon et al. (2014) and Cheung et al. (2017), we expected to eliminate the negative effects of system 1 decision-making in the presence of a social proof heuristic. A possible explanation that comes to mind for not finding this effect is that participants did not pay attention to the pie chart representing the social proof heuristic. However, results showed that the reaction time of the participants who got to see the social proof heuristic was significantly higher than the reaction time of participants who did not get to see a heuristic. This result suggested that the participants did pay attention to the social proof heuristic during the Food Choice Task. However, another limitation of the present study is that the perceived credibility of the social proof heuristic among the participants is unclear. The social proof heuristic presented statistical information of the choices of apparent previous participants. Future research should also measure to what extent the participants considered the social proof heuristic as credible.

It is assumed that nudges, such as the social proof heuristic, are effective when system 1 decision-making is used (Thaler & Sunstein, 2008). The cognitive load manipulation was possibly not interfering enough to activate system 1 decision-making. Additionally, the nature of the Food Choice Task in the present study could also have contributed to the lack of system 1 decision-making processes. Participants were instructed that they had to make decisions between two products, after which a few general questions would follow. In this respect, participants could possibly imply that their responses to these product pairs served as the main element of the experiment. In the study of Shiv and Fedorikhin (1999) the food choice was offered in a more unexpected manner. While the participants were walking to another room, the food choice was offered without being introduced as a part of the study. The difference in presenting the food choice may suggest that participants in the present study were more deliberately making a decision than the participants in the study of Shiv and Fedorikhin (1999). To guarantee that participants are using their impulsive and heuristic decision-making, future research should consider presenting the food choice unexpectedly.

The strength of the present study was its tailored design. By offering a binary choice in a laboratory setting, the present study aimed at eliminating the influences of any irrelevant noise. Generally, the present study aimed to find empirical evidence for the effectiveness of nudges, in particular a social proof heuristic, among people with a low cognitive capacity. People of low socioeconomic classes tend to choose more energy-dense food (Monsivais & Drewnoski, 2009) and fewer fruits and vegetables (Stringhini et al., 2011). These people are also found to have a lower cognitive capacity. Therefore, nudging could have been a promising intervention strategy to decrease the health disparities between people with low and high socioeconomic statuses. The conclusions of the present study are ambiguous. As it stands, the present study is inconclusive. Future research would benefit from presenting the food choice in an unexpected manner and having a larger sample with more variety in terms of education level. With these elements, the social proof heuristic still has great potential to be implemented as a low-cost intervention to promote healthy food choices among individuals under high cognitive load.

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Appendix A

Scores of Pilot-Study on Trade-Off Pairs

Table 1

Scores on Attractiveness for Trade-Off Pairs

		Attractiveness		
Pair	*M*	*SD*	*t*-test, *p*	Cohen's *d*
1. Nutella	5.54	1.45	$t(49) = 4.54, p < .001$	.80
1. Avocado	4.02	2.25		
2. Chocolate chip cookies	5.30	1.30	$t(49) = 6.09, p < .001$	.98
2. Rice cakes	3.92	1.50		
3. Pizza	5.10	1.72	$t(49) = 2.73, p = .009$	.57
3. Broccoli	4.16	1.60		
4. Croissant	5.78	1.30	$t(49) = 4.41, p < .001$	.79
4. Bell pepper	4.64	1.56		
5. Chocolate bar	5.80	1.18	$t(49) = 4.15, p < .001$	.80
5. Pear	4.72	1.49		
6. Muffins	5.36	1.45	$t(49) = 1.89, p = .002$	.68
6. Oatmeal	4.18	1.96		
7. Ice cream	5.98	1.19	$t(49) = 5.29, p < .001$	1.03
7. Kiwis	4.52	1.61		
8. Crisps	5.46	1.34	$t(49) = 2.06, p = .045$	.40
8. Carrots	4.88	1.55		
9. M&M's	5.60	1.67	$t(49) = 2.87, p = .006$	.60
9. Walnuts	4.58	1.73		
10. Oreo cookies	5.12	1.52	$t(49) = 3.79, p < .001$	.73
10. Yoghurt	3.98	1.61		

Table 2

Scores on Healthiness for Trade-Off Pairs

Healthiness				
Pair	*M*	*SD*	*t*-test, *p*	Cohen's *d*
1. Nutella	1.60	.83	$t(49) = -26.77$, $p < .001$	-5.47
1. Avocado	6.28	.88		
2. Chocolate chip cookies	1.74	.80	$t(49) = -17.84$, $p < .001$	-3.62
2. Rice cakes	5.28	1.13		
3. Pizza	1.86	.70	$t(49) = -32.73$, $p < .001$	-7.25
3. Broccoli	6.72	.64		
4. Croissant	2.24	.94	$t(49) = -27.31$, $p < .001$	-6.03
4. Bell pepper	6.74	.49		
5. Chocolate bar	1.90	.89	$t(49) = -28.64$, $p < .001$	-5.44
5. Pear	6.40	.76		
6. Muffins	1.76	.77	$t(49) = -16.14$, $p < .001$	-3.31
6. Oatmeal	5.28	1.29		
7. Ice cream	1.50	.74	$t(49) = -38.06$, $p < .001$	-8.15
7. Kiwis	6.68	.51		
8. Crisps	1.78	.82	$t(49) = -37.90$, $p < .001$	-7.59
8. Carrots	6.80	.45		
9. M&M's	1.48	.71	$t(49) = -27.41$, $p < .001$	-5.08
9. Walnuts	5.80	.97		
10. Oreo cookies	1.44	.58	$t(49) = -23.58$, $p < .001$	-5.06
10. Yoghurt	5.48	.97		

Table 3

Scores on Familiarity for Trade-Off Pairs

		Familiarity		
Pair	*M*	*SD*	*t*-test, *p*	Cohen's *d*
1. Nutella	5.96	1.53	$t(49) = 1.56$, $p = .126$	.27
1. Avocado	5.46	2.12		
2. Chocolate chip cookies	5.20	1.78	$t(49) = -1.24$, $p = .220$	-.20
2. Rice cakes	5.52	1.47		
3. Pizza	5.72	1.65	$t(49) = -1.66$, $p = .103$	-.29
3. Broccoli	6.16	1.32		
4. Croissant	6.06	1.24	$t(49) = -1.48$, $p = .146$	-.22
4. Bell pepper	6.34	1.29		
5. Chocolate bar	5.88	1.42	$t(49) = -.15$, $p = .881$	-.03
5. Pear	5.92	1.50		
6. Muffins	4.92	1.72	$t(49) = 1.42$, $p = .162$	.26
6. Oatmeal	4.40	2.24		
7. Ice cream	5.42	1.64	$t(49) = -1.62$, $p = .112$	-.27
7. Kiwis	5.82	1.27		
8. Crisps	6.12	1.21	$t(49) = .22$, $p = .828$	.03
8. Carrots	6.08	1.37		
9. M&M's	5.90	1.39	$t(49) = .09$, $p = .927$	.02
9. Walnuts	5.88	1.26		
10. Oreo cookies	5.26	1.76	$t(49) = 1.51$, $p = .137$	.26
10. Yoghurt	4.80	1.83		

Table 4

Scores on Attractiveness for Food Related Filler Pairs

		Attractiveness		
Pair	*M*	*SD*	*t*-test, *p*	Cohen's *d*
1. Donuts	4.82	1.70	$t(49) = -1.53, p = .132$	-.28
1. Oranges	5.24	1.29		
2. Fries	5.12	1.75	$t(49) = 4.20, p < .001$	.73
2. Rice	3.96	1.41		
3. Bastogne cookies	4.74	1.68	$t(49) = -2.02, p = .049$	-.38
3. Apples	5.30	1.22		
4. Sweets	3.86	1.89	$t(49) = -5.62, p < .001$	-.85
4. Tomatoes	5.24	1.30		
5. Apple pie	5.06	1.75	$t(49) = -1.09, p = .283$	-.21
5. Grapes	5.38	1.23		

Table 5

Scores on Healthiness for Food Related Filler Pairs

		Healthiness		
Pair	*M*	*SD*	*t*-test, *p*	Cohen's *d*
1. Donuts	1.16	.37	$t(49) = -52.63, p < .001$	-10.59
1. Oranges	6.50	.61		
2. Fries	1.94	.89	$t(49) = -20.60, p < .001$	-4.54
2. Rice	5.80	.81		
3. Bastogne cookies	1.90	.76	$t(49) = -22.43, p < .001$	-4.74
3. Apples	6.22	1.04		
4. Sweets	1.24	.43	$t(49) = -43.94, p < .001$	-8.76
4. Tomatoes	6.46	.73		
5. Apple pie	2.14	.90	$t(49) = -22.62, p < .001$	-4.90
5. Grapes	6.22	.76		

Table 6

Scores on Familiarity for Food Related Filler Pairs

Familiarity				
Pair	*M*	*SD*	*t*-test, *p*	Cohen's *d*
1. Donuts	4.54	1.84	$t(49) = -7.18$, $p < .001$	-1.22
1. Oranges	6.34	1.00		
2. Fries	4.48	2.10	$t(49) = -3.01$, $p = .004$	-.44
2. Rice	5.32	1.65		
3. Bastogne cookies	5.30	1.92	$t(49) = -5.05$, $p < .001$	-1.00
3. Apples	6.70	.51		
4. Sweets	4.56	2.10	$t(49) = -6.23$, $p < .001$	-.74
4. Tomatoes	5.90	1.47		
5. Apple pie	5.12	1.89	$t(49) = -3.98$, $p < .001$	-.64
5. Grapes	6.14	1.21		