Cover page

Official title: Effects of Just-In-Time Food Swap Recommendations

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Study protocol (as shown in the preregistration on https://osf.io/y29ha)

Hypotheses

Model 1: The Nudge Presence Mediation Model (see Appendix A) H.1: Healthiness of Food Choices and Nudge Presence: Participants in the JIT-visibility nudge condition choose healthier foods than those in the no-nudge condition. H.2: Reactance and Nudge Presence (mediation): The effect of nudge presence on the healthiness of foods chosen will be mediated by reactance, such that nudge presence results in higher levels of reactance and, in turn, higher reactance leads to less healthier food choices. H.3: Ease of Identifying Healthier Options (mediation): The effect of nudge presence on healthiness of food choices will be mediated by ease of identifying healthier options, such that nudge presence results in a greater ease of identifying healthier options, and ease of identifying healthier options, in turn, leads to healthier food choices. RQ1: Education and Nudge Presence (moderation): Does educational level moderate the effect of nudge presence on the healthiness of food choices? If so, in what direction? RQ2: Education and Nudge Presence and Reactance (moderation): Does educational level moderate the pathway from nudge presence to reactance? If so, in what direction? RQ3: Subjective socioeconomic position (SEP) and Nudge Presence (moderation): Does subjective SEP moderate the effect of nudge presence on the healthiness of food choices? If so, in what direction? RQ4: Subjective SEP, Nudge Presence and Reactance (moderation): Does subjective SEP moderate the effect of nudge presence on reactance? If so, in what direction? H.4: GDMS and Nudge Presence (moderation): GDMS will moderate the effect of nudge presence on the healthiness of food choices. • H.4.a: A JIT visibility only nudge (vs. no nudge) will lead to healthier food choices for participants who score higher on the Rational decision-making style compared to participants who score lower. • H.4.b: A JIT visibility only nudge (vs. no nudge) will lead to healthier food choices for participants who score higher on Dependent decision-making style compared to participants who score lower. RQ5: GDMS and Nudge Presence (moderation): Do Avoidant, Intuitive or Spontaneous decision-making styles moderate the effect of nudge presence on the healthiness of food choices? If so, in what way? RQ6: GDMS, Nudge Presence and Reactance (moderation): Do different GDMS moderate the effect of nudge presence on reactance? If so, in what way? H.5: Food Choice Motives (FCM) and Nudge Presence (moderation): FCM will moderate the effect of nudge presence on the healthiness of food choices. Specifically, the effects of the JIT visibility only nudge vs. no nudge on food choice healthiness will be greater for: • H.5.a: Participants who score higher on health as a food choice motive, as compared to those who score lower on health. • H.5.b: Participants who score lower on familiarity as a food choice motive, as compared to those who score higher on familiarity. RQ7: Food Choice Motives (FCM) and Nudge Presence (moderation): Does FCM (i.e., taste, convenience, and price) moderate the effect of nudge presence on healthiness of food choices? If so, in what way? H.6: Ease of Identifying Healthier Options and FCM

(moderated mediation): Health as a FCM will moderate the effect of nudge presence on the ease of identifying healthier options. Specifically, the JIT visibility only nudge (vs. no nudge) will result in greater ease of identifying healthier options for participants who score higher on health as a FCM than for those who score lower, which, in turn, results in healthier food choices. H.7: Ease of Identifying Healthier Options and Education (moderated mediation): Education level will moderate the effect of nudge presence on ease of identifying healthier options. Specifically, the JIT visibility only nudge (vs. no nudge) will result in greater ease of identifying the healthier alternative for participants with lower educational attainment than for those with higher educational attainment, and this in turn leads to healthier food choices. Model 2: The Nudge Type Moderation Model (see Appendix A) All the following nudges are implemented in addition to the JIT visibility only nudge. Therefore, the JIT visibility only nudge functions as the study's control condition in the second conceptual model. H.8.a: Nudge Effectiveness and Nudge Type: Descriptive nutritional label (DNL), hedonic enhancement, and social norm nudges will lead to higher nudge effectiveness compared to the JIT visibility only nudge (control). H.8.b: Nudge Effectiveness and Nudge Type: Hedonic enhancement and social norm nudges will lead to higher nudge effectiveness compared to DNL nudges. H.9: Reactance and Nudge Type (mediation): The effect of DNL, hedonic enhancement, and social norm nudge vs. JIT visibility only nudge on nudge effectiveness will be mediated by reactance, such that higher reactance will reduce nudge effectiveness. H.10: SEP Measures and Nudge Type (moderation): • H.10.a: A DNL nudge (vs. JIT visibility only nudge) will be more effective for participants with higher education as compared to those with lower education. • H.10.b: A DNL nudge (vs. JIT visibility only nudge) will be more effective for participants with higher subjective SEP compared with those with lower subjective SEP. • H.10.c: A social norm nudge (vs. JIT visibility only nudge) will be more effective for participants with lower subjective SEP compared with those with higher subjective SEP. H.11: SEP Measures, Nudge Type and Reactance (moderation): • H.11. a: A social norm nudge (vs. JIT visibility nudge) will evoke less reactance among participants with lower subjective SEP than for those with higher subjective SEP. • H.11.b: A DNL nudge (vs. JIT visibility only nudge) will evoke less reactance among participants with higher education than for those with lower education. H.12: FCM and Nudge Type (moderation): The effect of nudge type on nudge effectiveness will be moderated by FCM. • H.12. a: A DNL nudge (vs. JIT visibility only nudge) will be more effective for participants who score higher (compared to lower) on food choice motive health. • H.12.b: A Hedonic-enhancement nudge (vs. JIT visibility only nudge) will be more effective for participants who score higher (compared to lower) on food choice motive taste. • H.12.c: A social norm nudge (vs. JIT visibility only nudge) will be more effective for participants who score higher (compared to lower) on familiarity or price as a food choice motive. H.13: FCM, Nudge Type and Reactance (moderation): FCM will moderate the effect of nudge type on reactance. Specifically: • H.13.a: A DNL nudge (vs. JIT visibility only nudge) will evoke less reactance among

participants who score higher (compared to lower) on food choice motive health. • H.13.b: A hedonic nudge (vs. JIT visibility only nudge) will evoke less reactance among participants who score higher (compared to lower) on food choice motive taste. • H.13.c: A social norm nudge (vs. JIT visibility only nudge) will evoke less reactance among participants who score higher (compared to lower) on food choice motive familiarity or price. H.14: GDMS and Nudge Type (moderation): GDMS will moderate the effect of nudge type on nudge effectiveness. Specifically: • H.14.a: A DNL nudge (vs. JIT visibility only nudge) will be more effective for participants who score higher (compared to lower) on the Rational decision-making style. • H.14.b: A hedonic-enhancement nudge (vs. JIT visibility only nudge) will be more effective for participants who score higher (compared to lower) on Intuitive or Spontaneous decision-making styles • H.14.c: A social norm nudge and a DNL nudge (vs. JIT visibility only nudge) will be more effective for participants who score higher (compared to lower) on the Dependent decision-making style. H.15: GDMS, Nudge Type and Reactance (moderation): GDMS will moderate the effect of nudge type on reactance. Specifically: • H.15.a: A DNL nudge (vs. JIT visibility only nudge) will evoke less reactance among participants who score higher (compared to lower) on the Rational decision-making style. • H.15.b: A hedonic-enhancement nudge (vs. JIT visibility only nudge) will evoke less reactance among participants who score higher (compared to lower) on Intuitive or Spontaneous decision-making styles. • H.15.c: A social norm nudge (vs. JIT visibility only nudge) will evoke less reactance among participants who score higher (compared to lower) on the Dependent decision-making style. RQ8: Ease of Identifying Healthier Options: Does ease of identifying the healthier option mediate the effect of hedonic-enhancement or social norm nudges (vs. JIT-visibility only nudge) on nudge effectiveness, thereby improving healthy food choices? H.16: Ease of Identifying Healthier Options and FCM (moderated mediation): FCM, specifically, health, will moderate the effect of nudge type on ease of identifying healthier options. Specifically, DNL nudges (vs. the JIT visibility only nudge) will lead to greater ease of identifying a healthier alternative for participants who score higher (compared to lower) on food choice motive health, and this increased ease will, in turn, lead to healthier food choices. H.17: Ease of Identifying Healthier Options and DNL nudge (mediation): Participants exposed to a DNL nudge (vs. JIT visibility only nudge) will identify the healthier option more easily. RQ9: Ease of Identifying Healthier Options and Education (moderated mediation): Does education level moderate the indirect effect of nudge type on healthy food choices through ease of identifying a healthier alternative?

Design Plan

Study type

Experiment - A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

Blinding

For studies that involve human subjects, they will not know the treatment group to which they have been assigned.

Is there any additional blinding in this study?

No data

Study design

This study will use an online one-factor, five-level between-subjects design (No nudges vs. JIT visibility nudge only vs. descriptive nutritional label (DNL) nudge vs. social norm nudge vs. hedonic enhancement nudge) with nudge effectiveness and food choice healthiness as the main dependent variables and nudge presence and nudge type as the main independent variables. We have divided the analyses conceptually into Model 1 (The Nudge Presence Mediation Model) where we focus on the effects of the JIT visibility only nudge (versus no nudges) and Model 2 (The Nudge Type Moderation Model), where the focus is on the effects of additional nudges (DNL, hedonic enhancement, social norms) compared to a JIT visibility only nudge without additional nudges. The study is structured in this two-stage way for theoretical clarity. Participants will complete a hypothetical grocery-shopping task using MAND, a mock supermarket app developed by NAKKO. This study was approved by the Ethical Review Board of the Tilburg School of Humanities and Digital Sciences (Identification code: REDC2023.34abc).

No files selected

Randomization

Participants will be randomly assigned to one of five conditions. Participants will access the study via an anonymous Qualtrics link provided by PanelClix. After completing the first questionnaire, Qualtrics will randomly assign each participant a condition code, which determines their experimental condition.

Sampling Plan

Existing Data

Registration prior to creation of data

Explanation of existing data

N/A

Data collection procedures

Participants will be recruited via PanelClix (a company that builds and manages a large online respondent panel) to ensure we reach the desired sample size and a representative distribution across educational levels, sex and age. Inclusion and exclusion Criteria The inclusion criteria for participation are being fluent in the Dutch language, being 18 years or older, and having access to a smartphone. Participants should not have dietary restrictions that make it difficult to take part in the grocery shopping task (i.e., celiac disease, veganism, or lactose intolerance). Participants who do not complete the shopping task or final questionnaire will be excluded from the study. Participants will also be excluded from the study if they have very short or long completion times, as this can indicate inattentive participation. Two attention check items will also be included in the questionnaire. Participants must pass at least one, otherwise they will be excluded from the analysis.

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Sample size

We will recruit a total of 600 individuals.

Sample size rationale

Assuming a small-to-medium effect ($f = 0.15$, equivalent to Cohen's $d = 0.30$), $\alpha = 0.05$, and 80% power, G*Power (for a one-factor, five-level between-subjects ANOVA design) indicates a minimum of 536 participants (107 per condition) to detect differences among the five nudge conditions. To account for exclusions, we will recruit a total of 600 individuals.

Stopping rule

Recruitment will end once the target sample size is reached.

Variables

Manipulated variables

There are five conditions (IV) that participants can be randomly assigned to: no nudge, JIT visibility only nudge, descriptive nutritional labelling (DNL) nudge, hedonic enhancement nudge, and social norms nudge (more details can be found in the shared Preregistration file). Choice Trials Structure • Experimental Trials. Six product categories will be split into three "Fixed" and three "Mixed" trials. The fixed trials will only show unhealthy products, while mixed trials will combine an equal number of healthier and unhealthy products, with nudges triggered by participants choosing an unhealthy product. This choice trial structure ensures that participants are exposed to enough nudges (minimum three nudges). The table below indicates the category to which each trial belongs. • Filler Trials. Two product categories (i.e., vegetables and meat) will

feature no nudges or nudges triggered by healthy product selections (as opposed to unhealthy ones). These conditions were intended to cover up the actual goal of the study. The data from the filler trials is not used. Experimental Manipulation In experimental trials, nudges are delivered in a just-in-time manner, meaning they appear when a participant adds an unhealthy product to their shopping basket. Each nudge pops up as a sliding recommendation covering about 25% of the screen with a header saying “Alternative”. This recommendation shows a healthier substitute, including its image, product name and price. In the no nudge (control condition), no such recommendation is shown. The same products and their corresponding healthier recommendations are shown across all the different nudge conditions, but the design of the pop-up differs depending on the nudge condition (described below). • No Nudge. Participants are not presented with a pop-up showing a suggested alternative. After making their selection, they are immediately routed back to the start screen, where they can click on the next product category. • JIT Visibility Only Nudge. An alternative product (image, product name, and price) is suggested in the pop-up, accompanied by a header that reads “Alternative”. • Descriptive Nutritional Labelling Nudge. This nudge is the same as the JIT visibility only nudge condition, but with an additional text providing health information on the alternative compared to the original choice (e.g., “This product contains less salt”). • Hedonic Enhancement Nudge. This nudge is the same as the JIT visibility only nudge condition, but with an additional descriptive text (e.g., “Delicious and refreshing”). Furthermore, the product image is replaced with an enhanced version that highlights the product’s taste and visual appeal. • Social Norm Nudge. This nudge is the same as the JIT visibility only nudge condition, but with an additional descriptive prompt (e.g., “4 out of 5 people chose this”) and a visual representation.

Preregistration for Individual traits and Food Choice Nudge Study copy.pdf

Measured variables

We will measure four dependent variables: nudge effectiveness, healthiness of food choices, psychological reactance (mediating variable), ease of identifying healthier options (mediating variable). We will also include four potential moderators: General Decision-Making Styles (GDMS), Food Choice Motives, and the socioeconomic indicators: education level and subjective socioeconomic position (SEP). We will look at the changes (“swap”) to the final basket as another exploratory dependent variable. Thus, we will examine whether participants choose to replace any products from their basket before final checkout, thus the number of swaps to healthy or unhealthy products (a clearer description of this measure can be found under the headings Grocery Shopping Task and Measures in the shared Preregistration file). Choice satisfaction and perceived personalisation will also serve as exploratory variables. Control Measures and Process Indicators The total time (in minutes) taken to complete

the phases of the mock shopping task, along with timestamps for individual product selections, will be recorded. Hunger levels will be assessed at the start of testing using a 100mm VAS scale, ranging from “Not at All” to “Very Much” Participants will also indicate how frequently they shopped for groceries via an online supermarket (e.g., AH.nl, Picnic, the Jumbo app) using a seven-point scale (1 = never; 7 = multiple times per week). Participants’ demographic information, including sex and age, will also be collected to describe the sample and test for potential sex and age differences. Lastly, as an awareness check, participants will be asked whether they recall seeing an alternative suggestion (i.e., whether they noticed the nudges).

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Indices

• Nudge Effectiveness. Nudge effectiveness will be measured by the proportion of recommendations accepted by participants in experimental trials, thus the number of accepted nudges divided by the total nudges shown. As participants are exposed to between three and six nudges, the overall nudge effectiveness will be measured by weighting each participant’s acceptance proportion by the number of nudges they encounter, thus ensuring that every individual nudge will contribute equally to the total nudge effectiveness. • Healthiness of Food Choices. The healthiness of each participant’s final basket (i.e., after phase 2, after the possibility to swap) will be measured by using the FNS score of each product and calculating the average score of the six products they selected for experimental product categories. The FNS score ranges from -15 to +40. A smaller average FNS score means healthier food choices. • Ease of Identifying Healthier Options. The ease of identifying healthier food options will be assessed by asking participants to indicate how easy it was to identify the healthy products during grocery shopping, with responses being recorded on a seven-point Likert scale (1 = “not easy at all”; 7 = “very easy”) (Jansen et al., 2021). • Psychological Reactance. Psychological reactance will be measured using a scale that includes items measuring anger (e.g., “This app made me feel irritated.”) and perceived threat to freedom (e.g., “I felt like my choices were being restricted.”). Participants will respond using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree), which will be measured by averaging individual scores across the items (Dillard & Shen, 2005; Bruns et al., 2018). • Perceived Personalisation. Perceived personalisation will be assessed using two items. Participants will rate their agreement with each statement on a seven-point Likert scale (1 = “Strongly Disagree”; 7 = “Strongly Agree”): “The MAND app was aimed at me as a unique individual”, “The MAND app provided personalised recommendations based on information about me as a person.” Choice Satisfaction. Choice satisfaction will be measured on a 0-100 scale (with anchors 0 = “Not satisfied at all” to 100 = “Very satisfied”), by asking participants to rate their level of satisfaction with the products they selected (Lustria et al., 2016). • Food Choice Motives.

Participants' food choice motives, i.e., health, taste, convenience, familiarity, and price, will be measured using a validated scale (Onwezen et al., 2019). Each food choice motive will be assessed using a 7-point Likert scale (1 = "Not important at all" to 7 = "Very important"). Participants will rate the importance of each motive in selecting food for their daily diet, with a score ranging from 1 to 7. These motives will be assessed to understand individual preferences and their potential impact on responses to the presented nudges. • General Decision-Making Style (GDMS). Decision-making style, which may influence how individuals respond to nudges, will be assessed using the validated General Decision-Making Style (GDMS) scale (Scott & Bruce, 1995). A 25-item scale with 5-point Likert ratings (1 = strongly disagree to 5 = strongly agree) will measure five subscales: Rational, Avoidant, Dependent, Intuitive, and Spontaneous styles. Participants can receive a score on each decision-making subscale ranging from 5 to 25. Participants can score high across multiple subscales, with a higher score indicating a stronger preference for a particular decision-making style. • Education Level. Education level will be assessed by asking participants to report the highest level of education they have completed, with 11 response options. For analysis, we will recode these 11 options into a three-level scale and then treat that scale as a categorical moderator (see Appendix B for all response options and the coding; de Vries et al., 2022). • Subjective Socioeconomic Position (SEP). Subjective SEP will be measured using the single-item MacArthur Subjective Social Status Scale (Adler et al., 2000). Participants are shown a picture of a ladder where the top (10) represents people in the Netherlands with the most money, highest education, and most respected jobs, and the bottom (1) represents people with the least money, least education, and least respected or no jobs. Participants are asked to place themselves on the ladder (1–10) to indicate where they think they currently stand relative to others in the Netherlands. • Number of Swaps. To explore the possible effects of the nudges on final food choices, we will compare the percentage of healthier items in the final basket at checkout with the percentage chosen during the trials (i.e., Checkout% - Trials%; De Bauw et al., 2022).

Analysis Plan

Statistical models

Randomisation Checks For each condition, we will tabulate control variables (age, sex, hunger level, education, subjective SEP) and compare them across the five groups. We will use one-way ANOVA for continuous variables (i.e., age, hunger, subjective SEP) and chi-square tests for categorical variables (i.e., sex and education). If any significant differences ($p < .05$) are detected, the identified variable will be included as covariates in all main models. In the case of education and subjective SEP, they will only be included as covariates in the models that they are not already serving as moderators. If

adding the covariate does not change the conclusion, we will consider the conclusion to be robust. Conceptual Models All analyses will be conducted in R (version 4.5.0) using the processR package and the glmmTMB package. Conceptual models will be tested through several statistical models. All tests are two-tailed, $\alpha = .05$. To account for multiple testing, appropriate adjustments will be applied to the hypotheses to control the Type I error rate. For Conceptual Model 1, the total, direct, and indirect effects of nudge presence on the mean healthiness of food choices will be estimated using PROCESS Model 4 (with 5,000 bootstrap samples and bias-corrected 95% CIs) (H1–H3). Moderation tests for H4-H5, and RQ1, RQ3, RQ5, RQ7 will use PROCESS Model 1, probing interactions at ±1 SD or by category (e.g., education). This will test the moderating effects of subjective SEP, educational level, FCM and GDMS on the main pathways between nudge presence and healthiness of food choices. Separate tests will be run for each moderator. For RQ2, RQ4, and RQ6, PROCESS Model 1 will be used to test the mediation of subjective SEP, educational level, and GDMS on the pathway from nudge presence to reactance. PROCESS Model 7 will also be applied to H6 and H7 to test the moderated mediation of FCM and educational level on the pathway from nudge presence to the healthiness of food choices, through the ease of identifying healthier options. For Conceptual Model 2, nudge effectiveness will be analysed as the proportion of accepted nudges using a GLMM, with three contrasts to test H8a (DNL vs JIT visibility only; Hedonic vs IT visibility only; Social vs IT visibility only) and two contrasts to test H8b (Hedonic vs DNL; Social vs DNL.). The mediation of ease of identifying healthier options and reactance on the path from nudge type to nudge effectiveness will be tested using PROCESS Model 4 (H9 and RQ8). We will test whether participants exposed to the DNL nudge report higher ease of identifying healthier options than those exposed to the JIT-visibility nudge (H17) using an independent-samples t-test. The moderation of subjective SEP, education, FCM, and GDMS on the path between nudge type and nudge effectiveness will be tested using PROCESS Model 1 (H10, H12, H14). Hypotheses 11, 13, and 15 will also use PROCESS Model 1 to examine the moderating effects of these variables on the relationship between nudge type and reactance. Finally, the moderated mediation effects of education (RQ9) and FCM (H16) on the path between nudge type and the healthiness of food choices, mediated by the ease of identifying healthier options, will be tested using PROCESS Model 7.

No files selected

Transformations

The experimental condition will be dummy-coded (no-nudge = 0, JIT-visibility, DNL, hedonic, social = 1-4), and subjective SEP, GDMS, FCM will be treated as continuous variables and mean-centred to make interpretation of interaction terms easier. Education will be recoded as a categorical variable using dummy coding (high; 3,

medium; 2 and low; 1. The coding scheme will be clearly documented in data files and these files will be uploaded to the OSF project repository before publication.

Inference criteria

No data

Data exclusion

As an awareness check, participants will be asked whether they recall seeing an alternative suggestion (i.e., whether they noticed the nudges).

Missing data

All questionnaires will be administered online (via Qualtrics) and programmed to be mandatory. Therefore, no missing values should remain after testing.

Exploratory analysis

In addition to the preregistered analyses, we will conduct other exploratory analyses on the data, which will be clearly labeled as such in reporting.