Master's thesis

Supporting Plant-based Dietary Behaviour Change:

The Effect of Action and Goal Implementation Intentions, and Self-efficacy

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Abstract

Individuals can reduce environmental problems by consuming less animal-based products. Evidence suggests that implementation intentions (if-then plans) facilitate desired behaviour change. We proposed that both action and goal if-then plans, related to the intention to eat more plant-based, would decrease animal-based consumption up to 2.5 weeks. Given the unclear mechanism of self-efficacy to decrease one's animal-based consumption, we tested its main, moderating and mediating effects. We conducted an online experiment in the Netherlands on a convenience sample, $N = 287$. After three baseline measurements, participants were randomly assigned to the if-then goal group, the if-then action group, and the no-intervention controls; six post-manipulation measurements followed. The results show that compared to controls, and accounting for the effects of time and self-efficacy, the action group significantly reduced their animal-based consumption. The reduction in consumption for the goal group compared to controls was not significant but indicated a short-term effect requiring further research. We found that self-efficacy significantly decreased animal-based consumption. No evidence of moderating or mediating effects was found. The limitations include insufficiently strong manipulation, low statistical power, and more missing data for controls. Our study contributes to the field of environmental psychology with an experimental and longitudinal design, and the introduction of a promising instrument measuring animal-based consumption. We provide recommendations for research and suggest practical implications. Our research endorses action implementation intentions as a cost-effective strategy to increase plant-based consumption.

Keywords: implementation intentions, plant-based diet, self-efficacy, experimental manipulation, longitudinal design

Contents

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Over the last three centuries, the human impact on the environment has intensified. Humanity has become dangerously exploitative of the natural environment, with minimal restorative efforts. To exemplify, agricultural practices often employ deforestation, monocultural and intensive agriculture, use of chemical products, inefficient resource use and industrial livestock production (Goldman et al., 2020). Such practices are oriented towards immediate gains while ignoring long-term sustainability and may enable dangerous climate changes. The commonly discussed change is global warming due to greenhouse gasses (e.g., CO_2, methane), which has repercussions for the livability of Earth (IPCC, 2019). It is estimated that 21-37% of the global greenhouse gas emissions originate from the food sector (IPCC, 2019). Intensive animal farming is a large part of this problem area for reasons described next (Poore & Nemecek, 2018; Thelen, 2021; Sherman, 2015; Jackson et al., 2001).

Firstly, livestock animals (e.g., cows and sheep) emit copious quantities of CO_2 and methane. Second, livestock animals require substantial quantities of feed often grown on soil with reduced carbon-storage properties (often obtained through deforestation and destruction of species' habitats). Third, industrial fishing and waste runoff from animal farms negatively impacts water quality and enables the overgrowth of algae which annihilate local life (e.g., the "dead zone" in the Gulf of Mexico), causing the destabilization of important ecosystems. Accordingly, an important climate change mitigation action suggested by the Intergovernmental Panel on Climate Change is the adoption of an increasingly plant-based diet (IPCC, 2019). Therefore, the focus of this study is supporting people's intention to adopt an increasingly plant-based diet.

There are barriers to acting in line one's goals and intentions, and changing dietary behavior. The literature on behaviour change highlights a discrepancy between intentions and

actual behaviour – the intention-behaviour gap (Nielsen, 2017). Intentions, despite being one of the strongest predictors of future behaviour, account for only 20-30 percent of the variance in future behaviour (Sheeran, 2002). What are the factors that inhibit translating intention into action? Firstly, counterintentional habits are strong predictors of behaviour (Verplanken & Faes, 1999; Ouellette & Wood, 1998). Habits are repeated, automatic patterns of behaviour elicited by cues, requiring time and effort to weaken and be replaced with desired behaviour. An example of a counterintentional habit is automatically buying flavored potato chips while one's intention is to avoid highly processed snacks. Second, people often have conflicting values and goals (Steg et al., 2014). For example, one might strive to maintain a plant-based diet and still enjoys eating cheese; in different circumstances, they could prioritize one over the other. Specifically, habits and hedonic priorities are more likely in conditions of low cognitive resources (Hall et al., 2012). Third, low confidence in one's ability to engage in the desired behaviour (low self-efficacy) interferes with translating intention into action (Hamilton et al., 2017). Finally, a common reason for not performing intentional behaviour is simply forgetting (Milne et al., 2002). Addressing these barriers is important to support intentional behaviour.

Among the behavioural change strategies and interventions aimed at supporting intentional behaviour, one stands out in terms of elegance, ease of implementation, and scientific support: implementation intentions (IIs). This strategy consists of creating an if-then statement by linking a goal-directed behavioural plan Y to a situational cue X (Gollwitzer, 1999); an example of a dietary II is "If I am hungry after 8pm, I will eat a small fruit instead of a full meal". Implementation intentions have been suggested to address the barriers to behaviour change highlighted above: they are a self-regulation tool that support the memory retrieval of the desired behaviour, provide a behavioural plan useful in situations of low cognitive resources, improve self-efficacy, replace of

counterintentional behaviour with intentional alternatives and ultimately benefit goal-striving (Gollwitzer & Sheeran, 2006).

The mechanism of self-efficacy for implementation intentions, however, has received mixed evidence. Self-efficacy has been proposed as both a moderator of IIs and a mediator. Evidence for the moderating effect of IIs was reported by Wieber et al. (2010) in a cognitive task experiment, such that IIs had a positive effect on solving difficult task items only for the high self-efficacy group.[1] In a meta-analysis of 66 studies, Webb & Sheeran (2008) tested the extent to which IIs strengthened the confidence in one's ability to perform the desired behaviour (self-efficacy), which in turn would promote such behaviour. They reported an overall negligible and statistically non-significant mediation effect in the relationship between IIs and goal attainment. Small effect sizes for mediation were reported for both junk food consumption (Orbell & Sheeran, 1999) and healthy eating behaviours (Jackson et al., 2005). In regards to exercise and health behaviours, some reported that IIs increased feelings of self-efficacy (Murray et al., 2005), while others reported no significant effect (Milne et al., 2002). To address the uncertain role of self-efficacy in the relationship between IIs and behavior change, this study will investigate the main, mediator and moderator effects of self-efficacy.

Overall, there is clear scientific support for the effect of IIs in promoting intentional behaviour in variety of domains of goal attainment: in a meta-analysis of 94 studies, Gollwitzer and Sheeran (2006) reported an overall medium-to-large effect size.[2] The effect was large for the environmental domain, and medium for the personal and health domains. Moreover, IIs suppressed undesired behavioural responses (medium effect size), supported goal-striving when in a detrimental self-state (large effect size), and facilitated overcoming the activation of conflicting

[1] Critically, self-efficacy was experimentally manipulated, leaving open the question of how self-efficacy would function "naturally" in an II intervention context.
[2] There was no difference in effects between experimental designs and correlational designs.

goals (large effect size). The authors further confirmed that IIs significantly impacted the memory for, attention to, detection and processing of relevant cues. Finally, IIs were found to be cognitively efficient and to not rely on conscious intention in the cued situation (automatic action initiation), supporting Gollwitzer's claim (1999) that IIs mimic and replace habits. Similarly, in a study on breast self-examinations, Orbell et al. (1997) reported that previous behaviour significantly predicted behaviour for the control group, but not for the implementation intentions group, indicating that IIs contribute to overcoming habits.

Implementation intentions have further been found to be effective in changing dietary behaviour. Nooijer et al. (2006) reported that while IIs did not significantly increase fruit intake after 10 days, they increased the number of days in which an additional serving of fruit was eaten. In a randomized control trial, a moderate effect of IIs (created collaboratively with an interviewer) on reducing fat intake at a six-month follow-up was reported (Luszczynska et al., 2007). Moreover, in a meta-analysis of 70 studies, IIs were found to support healthy eating behaviours (medium effect size) and to reduce (small effect size) unhealthy eating behaviours (Carrero et al., 2019). Importantly, Rees et al. (2018) found an effect of implementation intentions in reducing meat consumption after 1 week (medium-to-large magnitude). However, they report concern with their measurement of meat consumption (self-reporting consumption in grams), which may have systematically underestimated meat consumption. We propose that reporting consumption in grams for up to a week prior involves calculation steps that render difficult and often inaccurate estimations. Nevertheless, the results of the study suggest a strong effect of IIs on reducing meat consumption, which the current study will extend by including all animal-based consumption, more frequent measurements, and longer timeline.

While many studies investigated the effects of specific action IIs (e.g., buy apples instead of chocolate), research on higher-order goal IIs (linking the reminder of a higher-order goal to a

situation) is sparse. Van Koningsbruggen et al. (2011) conducted a study in which participants received the following instructions: "Please tell yourself: The next time that I am tempted to eat [high caloric food][3], then I will think of dieting". They hypothesized that the goal IIs supports intentional dietary behaviour; their reasoning fits the proposal that the activation of superordinate goal intention contributes to the effectiveness of IIs (Cohen et al., 2008). According to Van Koningsbruggen et al. (2011), this goal activation is particularly useful under conditions of temptation and enhances self-control. Indeed, they found that the goal IIs reduced high caloric food intake for dieters, who often inhibit their higher-order goal to diet and prioritize hedonic goals when exposed to attractive food (Stroebe et al., 2008). This study provides initial evidence of the efficacy of goal IIs on intentional dietary behaviour. We will extend this finding by testing the effect of goal IIs on reducing animal-based consumption.

Our study addresses knowledge and methodological gaps in the research on the effect of implementation intentions on intentional dietary behaviour. Specifically, we investigate the effectiveness of IIs on reducing animal-based consumption. Furthermore, we will explore, without a prediction, which type of II has a stronger effect.[4] We expect a marginal advantage of action IIs over goal IIs due to habit substitution, since the former provide a specific behavioural alternative. We expect a marginal advantage of goal IIs over the action IIs due to the activation of the higher-order goal (e.g., remembering one's goal to change one's diet). Moreover, the two types of IIs might function differently in terms of self-efficacy. We expect that plant-based self-efficacy has a stronger mediation effect for action implementation intentions, as they incorporate a specific

[3] Participants received this instruction 5 times for : [chocolate], [cookies], [pizza], [fries] and [chips].
[4] The literature does not enable a strong expectation of the differences between these types of IIs, showcasing predominantly medium effect sizes of action IIs on dietary behaviour (based on multiple studies), and only one low-to-medium effect size of goal IIs on dietary behaviour.

behavioural plan. Overall, we expect that self-efficacy is a predictor of consumption, such that higher plant-based self-efficacy leads to a decrease in consumption.

This study involves an experimental manipulation and applies a longitudinal design. Our aim is to assess whether IIs support intentional behaviour (eating less animal-based foods) for up to 2.5 weeks. Importantly, this study employs the first use of the measurement tool we developed for animal-based consumption. Developing this measurement tool was necessary due to limitations of existing instruments measuring food consumption (i.e., measuring frequency instead of quantity, operationalizations of serving sizes that are vague or difficult to understand, the timescale of the instrument that enables poor recall). This study has practical implications for supporting people to act in line with their plant-based dietary intentions.

Hypotheses

1(a) The implementation manipulation groups (creating if-then plans related to reducing animal-based consumption) will reduce their animal-based consumption more than the control group (up to 18 days post-manipulation).

1(b) *Exploratory:* Which type of implementation intention has a stronger effect in reducing animal-based consumption?

2 (a) Plant-based self-efficacy has a negative effect on animal-based consumption.

2(b) Plant-based self-efficacy moderates the relationship between implementation intentions and animal-based consumption. We offer no specific prediction for this effect.

2 (c) Plant-based self-efficacy mediates the relationship between implementation intentions and animal-based consumption. We expect a stronger mediation effect for the action implementation intentions.

Methods

Participants

A total of 353 participants, recruited through convenience and snowball sampling methods, consented to take part in this research. We excluded 66 participants whose total reported consumption of animal products was zero (exclusion criteria), resulting in a final sample of $N = 287$ in the first survey. A key characteristic of the target population was having an interest in eating more plant-based. First-year psychology students ($n = 210$) at the University of Groningen were remunerated with course credit, and participants outside the university($n = 77$) had the chance to win one of five vouchers for a vegan shop.

The sample ranged in age from 17 to 70 with mean age $M = 23.9$ ($SD = 10.4$). Most participants ($n = 219$) identified as "female", $n = 60$ identified as "male", and $n = 4$ identified as "other". The most frequent nationalities of the participants were Dutch ($n = 173$), German ($n = 51$) and Romanian ($n = 8$). In the first survey, 171 respondents participated in the Dutch version, and 116 respondents chose the English version. Participants initially reported their diet as omnivore ($n = 113$), vegetarian ($n = 42$), flexitarian ($n = 75$), pescatarian ($n = 16$), and vegan ($n = 31$, whose animal-based consumption was not zero). The final sample, after exclusion, involved 65 participants in the control group, 57 in the goal group, and 73 in the action group.

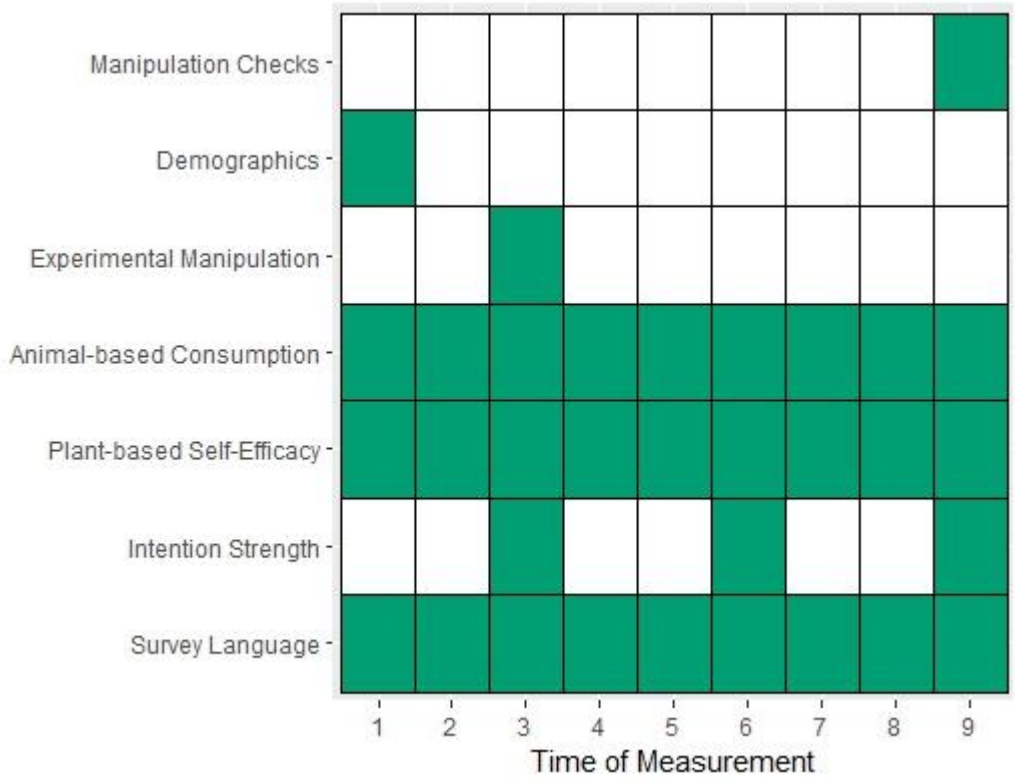
This study was approved by the Ethics Committee at the University of Groningen. The data collection took place from May 3rd until December 23rd 2022, and was carried out by Cristian Buruiana under the supervision of Maddeline Judge and Ellen van der Werff.

Procedure

The surveys were implemented in Qualtrics for computer and phone screens. See figure 1 below for a visualization of the timeline of recorded measurements.

Figure 1

Timeline of the Recorded (in Green) Types of Measurements



Note: The order of the Measurements on the Y-axis is chronological from bottom to the top.

Pre-manipulation

For participant recruitment, VeganChallenge, WeekZonderVlees, Green Office and Vegan Study Association advertised our study through their newsletters. We advertised our research on Facebook communities related to sustainable diets (e.g., Vegan for Beginners). Lastly, we recruited first-year psychology students at the University of Groningen.

This study employed a repeated measures, fixed occasion (nine) design, with an experimental manipulation at the end of survey three. For the first survey, participants clicked on the link (available in all study advertisements) and were directed to Qualtrics. They were asked (in Dutch and English) to select in which of the two languages they prefer seeing the survey (always the first question). Then, they read the information form, followed by the informed consent form.

Participation was possible only if they selected "Yes, I consent to participate". We then collected the participants' email addresses. Afterwards, the participants' plant-based self-efficacy was assessed. Next, they received the instruction on using the animal-consumption measurement instrument and were asked to report their consumption of specific animal products for yesterday. At the end of the first survey, participants reported their demographic information – age, gender, nationality and current diet.

The next surveys (links with a short message, in the preferred language) were automatically sent to the participant's email after the first survey,[5] using the workflow feature in Qualtrics. Starting with the first participation time, participants received a link to the next survey every three days, with the polite request to participate within a day. The second survey assessed their plant-based self-efficacy and consumption of animal products. The third survey assessed their intention strength, plant-based self-efficacy, consumption of animal products, and ended with the experimental manipulation.

Experimental Manipulation

Participants were randomly assigned with equal quotas to the control group, goal group, or action group; they were not informed of the experimental manipulation. The control group was directed to the end of the survey with no additional task or information. The experimental groups (goal and action) were asked to create one or two if-then plans for food purchasing situations, which fit their plant-based dietary intentions (see table C1 of Appendix C for the implementation intention instructions). Firstly, the experimental groups were asked to think of some relevant shopping situations in which they can change their behaviour in order to eat more plant-based foods. Then, they were guided in the process of creating these implementation intentions, with

[5] To ease the implementation of the study design in the SONA platform (the platform through which first-year students joined our research), surveys 3, 6 and 9 were also accessible via the SONA platform. SONA participants also received and email with reminder to participate.

notable group differences. The goal group was asked to link the shopping situation to a relevant broader goal:[6] "If I am in shopping situation X..., then I remind myself of my goal Y...". The action group was asked to link the shopping situation to a specific action:[7] "If I am in shopping situation X..., then I will do the specific action Y...". For examples of the if-then plans created by participants, see table C2 in Appendix C. Most participants followed the instructions, and some deviated from them (e.g., specifying both an action and a goal in the plan, choosing "more ethical" animal products instead of reducing consumption, or replacing meat with dairy products). After writing, participants were asked to imagine what it will be like to implement these if-then plans. Lastly, their plans were shown on the screen and they were asked to remember and to implement them in the next days.

Post-manipulation

The fourth, fifth, seventh and eighth surveys had the same setup as survey two: reporting plant-based self-efficacy, then animal-based consumption. Additionally, the sixth and ninth surveys assessed intention strength before assessing self-efficacy and consumption. In the ninth survey, participants reported their perceived diet change in the last month, the ease of using the measurement instrument, the if-then plans they created (if applicable), followed by the assessment of the plans' personal relevance, usefulness, implementation recall of the plans in the situation, and their impact on shopping choices. Finally, the participants were debriefed (see table C3 of Appendix C) by receiving information on the study's aims, the experimental manipulation, remuneration, contact for further inquiries, and finally the suggestion to use if-then plans in the future.

[6] With some examples of goals being "to have a small environmental footprint", "to reduce animal suffering", "to have a healthy diet".
[7] With some examples of specific actions being "choose soy products/mushrooms instead", "choose the food with the least animal products", "walk to the vegan section".

Materials

Intention Strength

We measured plant-based diet *intention strength* as the answer to the question "How strong is your intention to have a more plant-based diet?" (on a 7-point Likert Scale: 1 = Not at all strong, 4 = Somewhat strong, 7 = Very strong). The question was adapted from Ajzen & Madden (1986). Further, we computed the *mean intention strength* (total of all valid observations, divided by number of valid observations) for each participant, then the *sample mean intention strength* across participants.

Self-Efficacy

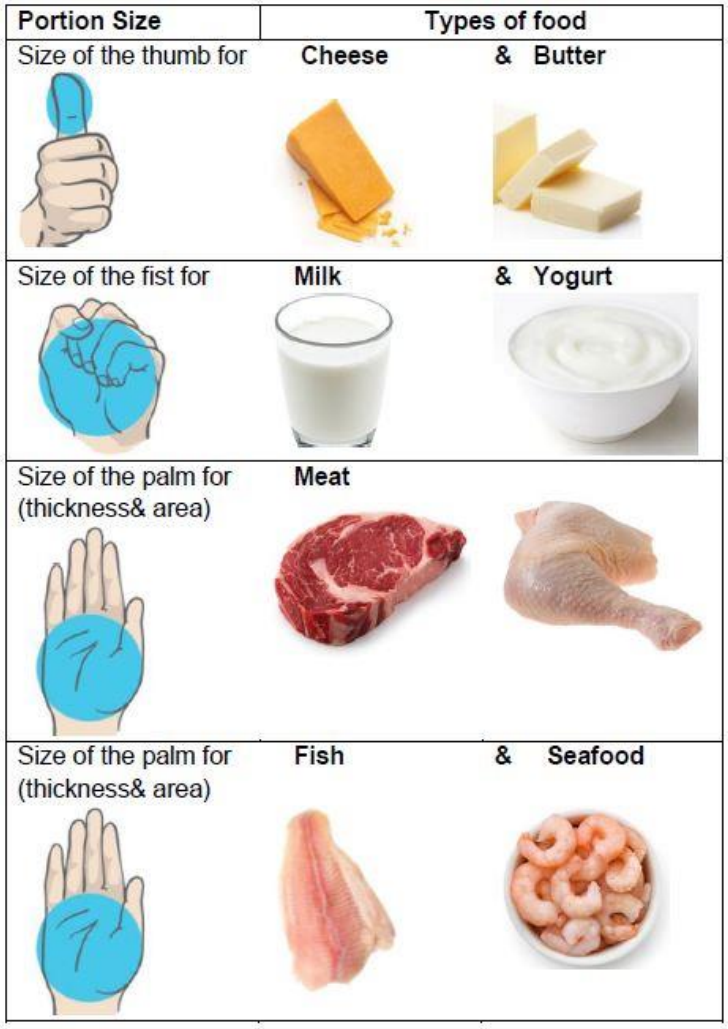
Plant-based diet *self-efficacy* was assessed as the answer to "Please think about your intention to have a more plant-based diet. How confident are you that you can act in line with this intention?" on a 7-point Likert scale (1 = Not at all confident, 4 = Somewhat confident, 7 = Very confident). The question was adapted from Bandura (1997). Similar to intention, we computed the *mean reported self-efficacy* (total of all valid observations, divided by number of valid observations) for each participant, then the *sample mean self-efficacy* across participants.

Animal-based Consumption Measurement Instrument

We opted to develop an effective, reliable and convenient tool for measuring animal-based consumption. A crucial feature was the definition of serving/portion size, which is often left undisclosed, and may be culture-specific. We implemented hand measurements as a convenient guide to assess serving size, according to the research of Brown et. al (2021), who found that a "handful" is a good reference for servings of nuts. The measurement instrument we created (see figure 2) quantifies one portion of cheese or butter as the size of one's thumb (dairy type 1), one portion of milk or yogurt as the size of one's fist (dairy type 2), and one portion of meat or fish/seafood as the size of one's palm; reporting half portions is possible.

Figure 2

Measurement Instrument[8] *for Animal-based Consumption*



Reports of each type of consumption (dairy type 1 and 2, meat, seafood) for one day with values of 15 and 25 were considered a self-report error (investigated after data collection). These units indicate a highly extreme daily intake.[9] We checked the distribution for types of consumption and consistently found no values between 15 and 25 (see Appendix B for examples of this distribution pattern). We consider that this pattern suggests a reporting error relating to the decimal.

[8] See figure C1 of Appendix C for the Dutch version. The Dutch version was translated from the original English survey with the help of two native Dutch speakers.

[9] For reference, 15 units approximate these values: (a) for type 1 dairy - 150g cheese, (b) for type 2 dairy – 1 liter of milk, (c) for meat -750 g chicken, (d) for seafood - 750 g fish.

Accordingly, we changed the decimal point of these extreme values (e.g., 15 = 1.5; 25 = 2.5). These changed scores represent 0.54% of the total of 9030 available reports of consumption types.

We summed the consumption of the 5 types of animal products for each survey, resulting in nine *individual consumption scores,* each reflecting yesterday's total consumption of animal products. Further, per participant, we computed the *mean reported consumption* (total of all valid observations, divided by their number).[10] Finally, we computed the *sample mean of reported consumption* across participants.

In the last survey, we assessed the participants' experiences with the animal-based consumption measurement instrument. Participants reported their agreement to the statement "Calculating my consumption of animal products using the hand measurements guide was easy" (on a scale from 1 = Strongly disagree, to 7 = Strongly agree).

Manipulation Checks

In the last survey, we asked participants to write the if-then plans they created (if applicable). Further, their rated their agreement (1 = Strongly disagree, to 7 = Strongly agree; with Non-applicable as an option) with the following statements. For the if-then plans' *relevance*, participants rated "The if-then plans I wrote were relevant for my dietary intention". For the if-then plans' *implementation recall*, participants rated "I remembered the plan(s) in those shopping situations". For the if-then plans' *impact on shopping choices*, they rated "The if-then plan(s) changed my shopping choices". For the if-then plans' *implementation usefulness*, participants rated "Writing and implementing those if-then plans is useful for my dietary intentions". For their perceived *dietary change*, participants rated "My consumption of animal products is lower than a month ago".

[10] For a participant who answered 7 out of the 9 surveys, a mean of 2 units reflects a total of 14 units of consumed animal products, for 7 days (e.g., days 0, 3, 6, 12, 15, 18, and 27).

Results

The nine repeated measures datasets were merged using SPSS. The data manipulation and analyses were performed using R Statistical Software v4.2.0. The data visualization employed a colorblind-friendly color palette.

Descriptive Statistics

The overall mean of consumption of animal products (for 4 weeks) for the final sample was equal to 20.9 units (*SD* = 17.2); the mean of consumption per day was equal to 3.6 units (*SD* = 2.8);. The mean of self-efficacy for the final sample was equal to *M* = 4.7 (*SD* = 1.4). The mean of intention strength for the final sample was equal to *M* = 4.6 (*SD* = 1.5). See table 1 for the descriptive statistics of consumption, self-efficacy and intention strength for the nine measurement times, and the number of valid cases *N*.

Table 1

Descriptive Statistics of Consumption, Self-efficacy and Intention, per Measurement Time

	T1	T2	T3	T4	T5	T6	T7	T8	T9
N	287	235	199	203	199	162	195	186	147
Consumption *M*	3.9	3.6	3.1	3.2	3.2	2.9	3.5	3.1	2.8
SD	3.2	3.2	2.8	2.8	3.1	2.9	3.7	3.0	3.0
Self-efficacy *M*	4.7	4.7	4.8	4.7	4.7	4.8	4.6	4.7	4.9
SD	1.6	1.4	1.5	1.5	1.5	1.6	1.6	1.5	1.5
Intention Strength *M*			4.6			4.6			4.7
SD			1.6			1.6			1.7

Note: The columns (T) represent the Measurement Times.

In the last survey, participants reported a mean score of $M = 5.2$ ($SD = 1.6$) for the ease of using the handguide for reporting animal-based consumption. Self-reported dietary change had a mean score of 3.3 ($SD = 1.9$).

Random Assignment and Manipulation

We found that the three groups were significantly different in terms of age, $F(2, 188) = 3.52$, $p = .031$: the control group had the lowest mean of 21, the goal and action groups both had a mean of 25. Moreover, the three groups were significantly different in terms of baseline intention strength, $F(2, 190) = 3.91$, $p = .021$: the goal group had the lowest mean of 4.3, the control group had a mean of 4.4, and the action group had a mean of 4.9. The three groups were not significantly different in terms of gender, $X^2(4) = 5.22$, $p = .265$, nor in terms of diet, $X^2(10) = 8.63$, $p = .567$. Lastly, the three groups were not significantly different in terms of baseline consumption, $F(2, 192) = 2.19$, $p = .114$, in terms of baseline self-efficacy, $F(2, 192) = 2.07$, $p = .128$, nor in how easy they experienced using the handguide for reporting consumption, $F(2, 135) = 0.65$, $p = .521$.

Overall, the experimental manipulation participations (goal and action) reported a mean score of 4.4 ($SD = 1.9$) for the relevance of their if-then plans, $M = 3.6$ ($SD = 2.1$) for implementation recall, $M = 4.7$ ($SD = 4.6$) for the impact on shopping, and $M = 3.8$ ($SD = 1.8$) for the usefulness of their if-then plans. The action group reported higher relevance of the if-then plans compared to the goal group, $t(85) = 3.34$, $p = .001$, Cohen's $d = 0.70$. Moreover, the action group reported a stronger impact of the if-then plans on shopping choices as compared to the goal group, $t(88) = 2.42$, $p = .017$, Cohen's $d = 0.51$. The action group also reported better implementation recall of their plans as compared to the goal group, $t(82) = 2.53$, $p = .013$, Cohen's $d = 0.53$. Lastly, the action group reported higher perceived usefulness of if-then plans compared to the goal group, $t(84) = 2.54$, $p = .012$, Cohen's $d = 0.53$.

Dropout and Missing Data

Participant dropout and missing data were expected given the study setup. A large contribution to the dropout was the fixed participation schedule with deadlines. From a total of 2583 possible measurements (287 participants multiplied by nine occasions), 29% were missed. After the assignment to groups, the missed surveys percentage was 29% for the control group, 19% for the goal group, and 19% for the action group. See Appendix A for a visualization of missing data across the surveys, and its relation to the experimental groups. The lower dropout in the two implementation manipulation groups might suggest that they were more invested in the experiment than the control group.

Hypothesis Testing

Multilevel Models Predicting Consumption

Given the data structure (level 1 repeated measures nested within level 2 subjects) and the properties of our research questions (macro-micro, micro-micro, and cross-over interactions), a multilevel approach is most fitting. Firstly, given the nested structure, there is unexplained variability at the level of repeated measurements, and at the level of individuals. A hierarchical multilevel model is equipped to address this, unlike a multiple linear regression model. If the dependency of observations is not accounted for, type 1 errors can be inflated (Snijders & Bosker, 2012). Importantly, multilevel analysis is an excellent tool for unbalanced data structures (Snijders & Bosker, 2012). Instead of discarding participants with some missing data (listwise deletion), multilevel analysis uses any existing observations to explain variance, rendering this a more fitting approach as compared to repeated measures analysis of (co)variance. For our models, we use the multiple likelihood estimation method to compare full models in deviance test and assess changes in model fit (Finch et al., 2019). In our models, the variables are defined as follows: time of measurement is the time variable (first measurement = 0, last measurement = 8). Group is a level 2 predictor coded as dummy variables action (compared to the control group) and goal (compared to

the control group). Self-efficacy is a level 1 predictor that varies with time. The dependent variable is consumption, which is also a time-varying, level 1 predictor.

Baseline Variance Components Model. To test the hypotheses 1a and 1b, we fit hierarchical multilevel models predicting consumption. The first model,[11] which split the variance into between-occasions variance and the variance between occasions within participants, had a random intercept (participants vary in their means). The overall weighted consumption (over time over participants) had a mean of $M = 3.6$ ($SE = 0.2$). The likelihood statistic of this model was -*2*loglikelihood*(3*)* = 8167. A decrease in the *-2*loglikelihood* of the subsequent model suggests improvement in model fit. We computed an intraclass correlation (*ICC*) value of .65. To elaborate, 65% of the variance in consumption is between people, and 35% of the variance is within participants.[12]

Unconditional Growth Model. Next, we created the unconditional growth model[13] by adding the time variable (with fixed slope) to the model with the random intercept. Adding time resulted in a good fit (the likelihood statistic of this model, *-2*loglikelihood*(4) = 8160, was a significant decrease from the baseline model, as the deviance test showed $p < .006$). This uncoditional growth model with fixed slope for time had an *ICC* of .65.[14] This model suggests that with each measurement time, consumption decreases on average by 0.05 units ($b = -0.05$, $t(1518) = -2.76$, $p = .006$; 95% *CI* [-0.09, -0.02]).

Conditional Growth Models. Before incorporating level 2 predictors, we saturated the model with level 1 predictors by adding the effect of plant-based self-efficacy to the model in order

[11] Run on 1806 measurements and 287 participants.
[12] The within variation (also known as residual variation, level 1 variation) was equal to 3.67. The between variation (also known as level 2 variation) was equal to 6.73.
[13] Run on 1806 measurements and 287 participants, like the previous model.
[14] Compared to the baseline model, this model had a lower between variability (variance at level 2 = 6.68) and the same within variability (level 1 variance = 3.67).

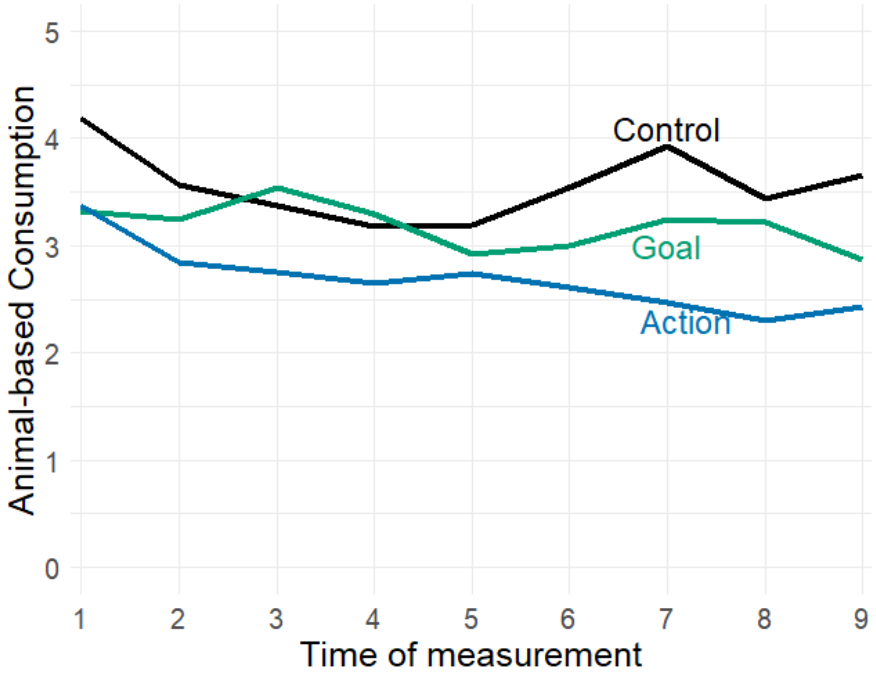
to test hypothesis 2a. This allows us to test the effect of our manipulation while controlling for self-efficacy. Adding self-efficacy led to an improvement in model fit compared to previous models, *-2*loglikelihood* (5) = 8144, $p < 0.001$. This model[15] with fixed slopes for time and for self-efficacy had an *ICC* of .61. The higher ICC (compared to previous models) when adding the fixed effect of self-efficacy suggests we have accounted for more variability in clustering.[16] The fixed effect of self-efficacy was significant (b= -0.39, t(1517) = -7.05, $p < 0.001$, 95% CI [-0.49, -0.28]), suggesting that for a one unit increase in self-efficacy scores, consumption decreases with 0.39 serving sizes.

The subsequent model[17] incorporated the level 2 predictor of group (experimental manipulation) as fixed slopes for the dummy variables goal group (goal vs control) and action group (action vs control). Adding the group predictors improved the model fit (the likelihood statistic *-2*loglikelihood*(7)[18] = 6294, was an improvement over the last model: X^2 (2) = -1832.42, $p < .001$). The *ICC* of this model was equal to .61.[19] The fixed slope for goal was not significant (b = -0.47, t(192) = -1.14, p = .260, 95% CI [-1.29, 0.34]), indicating that the goal IIs might not have had an significant effect on animal-based consumption. However, the fixed slope for action was significant (b = -0.82, t(192) = -2.10, p = .040, 95% CI [-1.59, -0.05]). The model suggests that accounting for self-efficacy, setting action IIs led to a reduction of 0.82 portions of animal-based consumption, compared to not setting if-then plans. See Figure 3 for a display of temporal changes in animal-based consumption per group.

[15] Run on 1806 measurements and 287 participants.
[16] Compared to the baseline model, this model had a lower between variability (variance at level 2= 5.74) and a lower within variability (level 1 variance = 3.64).
[17] This Conditional growth model was run on 1466 measurements and 195 participants (some participants missed the survey containing the manipulation).
[18] The deviance test could not be performed as this model has a different number of observations (due to more missing Group values), hence we performed a X^2 for nested models.
[19] The level 2 variance (4.73) decreased compared to the baseline model, as did the level 1 variance (3.04).

Figure 3

Timeline of Animal-based Consumption Means per Group



To test for hypothesis 2b (self-efficacy as a moderator), we added the cross-level interactions Self-efficacy*Group to the model. However, this did not significantly improve the model fit, nor yield significant betas (the slope for action remained significant), providing no evidence of a moderating effect of self-efficacy. The outcomes were similar when adding the cross-level interactions Self-efficacy*Time*Group. From a model building perspective, the growth model with the predictors time, self-efficacy and groups had the best model fit.

In this best-fitting model, the intercept was 5.39, representing the predicted consumption score at the first measurement, for a participant with no self-efficacy in the control group. With every measurement time, this consumption is predicted to decrease with 0.05 serving sizes. With every one unit increase in self-efficacy, consumption is predicted to decrease with 0.32 serving sizes. If the participant is in the goal group compared to the control group, consumption is predicted to decrease with 0.47 serving sizes, although this slope was not significant. If the participant is in

the action group compared to the control group, consumption is predicted to decrease with 0.82 serving sizes.

A power calculation (experiment with 2 treatments and 1 control, *ICC* = 0.61, small effect size of 0.2, 190 subjects in the manipulation, and the potential maximum of participation occassions *n* = 1710) revealed a low power equal to .30. To achieve a power of 65% for finding this effect, an approximate sample of *n* = 500 needs to be assigned to the three groups.

For visualizations of this model's assumptions, see Appendix D. The assumption of linearity is met (see figure D1). The assumption of homogeneity of variance is violated, indicated by a shotgun pattern in the fitted versus residual plot (see figure D2). This deviation from the assumption was not improved by a logarithmic transformation. The assumption of normality of residuals does not show violation as indicated by the distribution of residuals (see figure D3).

Multilevel Models Predicting Self-efficacy

We further built a line of models to investigate if the manipulation had an effect on self-efficacy, as a starting point for testing self-efficacy as a mediator (hypothesis 2b). With self-efficacy as the dependent variable, we created the baseline model.[20] The overall weighted self-efficacy (over time over participants) had a mean of *M* = 4.7 (*SE* = 0.1). The likelihood statistic of this model *-2*loglikelihood*(3) was equal to 5058. We computed an *ICC* of .73, so 73% of the variance in self-efficacy is between participants, and 27% of the variance is within participants.[21] A comparison of this model's *ICC* with that of the consumption model suggests that in our data, self-efficacy is much more stable within individuals than consumption.

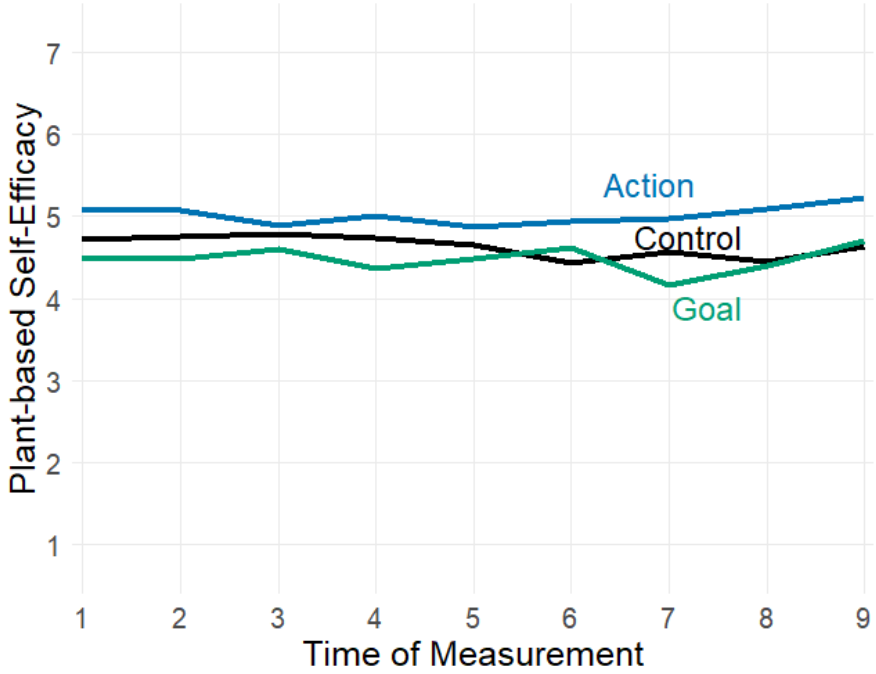
The second step was adding the time variable (fixed slope) to the model with the random intercept, which led to a better model fit (the likelihood statistic of this model,

[20] Run on 1812 measurements and 287 participants.
[21] The variation within participants (0.61) was smaller than the variation between participants (1.69).

*-2*loglikelihood*(4) = 5054, was a decrease from the baseline model, p = .040). This model had an *ICC* of 0.74; both the within and between variability decreased slightly. This unconditional growth model suggests that with each measurement time, self-efficacy decreases by 0.02 units (b = -0.02, t(1524) = -2.04, p = .040).

Figure 4

Timeline of Plant-based Self-efficacy Means per Group.



The third step was adding the fixed effect of group, which led to a better model[22] fit, *-2*loglikelihood* (6) = 4027, X^2 (2) = -1027.20, p < .001. We computed an *ICC* of 0.73; the within variability and the between variability decreased slightly. The fixed slope for the goal group was not significant (b = -0.09, t(192) = -0.39, p = .690, 95% CI [-0.56, 0.38]), and neither was the slope for the action group (b = 0.39, t(192) = 1.72, p = .09, 95% CI [-0.06, 0.83]). Because setting implementation intentions did not significantly impact plant-based self-efficacy, the mediating role

[22] This model was run on 1468 measurements and 195 participants.

of self-efficacy could not be established. See figure 4 for a display display of temporal changes in plant-based consumption per group.

Discussion

Main Findings

The purposes of this study were to test the effect of implementation intentions on reducing animal-based consumption with a focus on differences between specific action and higher-order goal implementation intentions, and to investigate the role of plant-based self-efficacy in this relationship. Our results partially support hypothesis 1a, as we discovered that setting action implementation intentions (but not goal implementation intentions) leads to a significant reduction in animal-based consumption compared to the control group (when controlling for the effects of time and self-efficacy); this informs the direction for the exploratory hypothesis 1b. This corresponds with the groups' self-perceptions, as the action implementation intentions group perceived their if-then plans to be more relevant, more useful, with a better implementation recall, and as having more impact on their shopping choices. These results represent the first direct demonstration that setting action implementation intentions may function better than goal implementations intentions in reducing animal-based consumption.

Further, we found that animal-based consumption significantly decreases when plant-based self-efficacy increases, thus supporting hypthesis 2a. However, there was no support that plant-based self-efficacy changes the effect of implementation intentions on animal-based consumption posited in hypothesis 2b. Similarly, we did not find that setting implementation intentions significantly strengthens plant-based self-efficacy; therefore, we did not find evidence for the mediating role of plant-based self-efficacy in the effect of implementation intentions on animal-based consumption (hypothesis 2c). As expected, the action group had a higher confidence to eat

more plant-based (in reference to the control group) than the goal group (in reference to the control group), although these effects were non-significant.

Contextualizing the Results

Our results are consistent with previous literature with regards to the effect of action implementation intentions on dietary behaviour (Carrero et al., 2019; Rees et. al, 2018). We add value to this line of evidence by extending it to all animal-based food consumption, and testing the effect of the experimental manipulation more frequently and for a longer interval than previous studies. We consider the effect of action implementation intentions in reducing animal-based consumption to be practically significant. Our study shows that for people who intend to eat more plant-based, linking a shopping situation (that often elicits an undesirable habit) to a specific action would on average decrease their consumption of animal products by almost a serving size, for a period of up to 2.5 weeks. In the context of a dietary intention, setting action implementation intentions shopping situations is effective, as action IIs may support the recall of one's intention even in states of potentially low cognitive resources (e.g., evening tiredness), provide behavioural alternatives to undesirable habits and ultimately enable automatic initiation of action (Gollwitzer, 1999).

While it has been reported that goal implementation intentions also reduced consumption of undesired foods (Van Koningsbruggen et al., 2011), the present study did not find that goal IIs reduced animal-based consumption; nevertheless, our findings are in the same direction. Firstly, a possible explanation for this trend is that while action IIs enable automatic action initiation (Gollwitzer & Sheeran, 2006), goal IIs might not. To explain, goal IIs might not have the effects of mimicking and replacing habits reported for action IIs, because they do not specify a specific behavioural alternative. Accordingly, goal IIs require choosing an intentional behaviour, repeatedly, in the specified situations. This cognitive step involving mental effort might reduce the efficacy of

goal IIs compared to action IIs. We propose that future research investigate this mechanism in situations of low cognitive resources. Second, the goal IIs may not support memory retrieval as well as the action IIs, and the lower specificity of the goal plan may limit recall. Accordingly, we found that the goal group reported lower implementation recall than the action group. To further test this assumption, future research should assess the memory retrieval of IIs (during retrieval time) in both laboratory and field settings. Furthermore, it is plausible that the lower sample size for the goal group enabled a more biased group (law of large numbers). To exemplify, in our study, the goal group had the lowest baseline intention strength; accordingly, they later reported lower relevance of their IIs compared to the action group. Our goal IIs manipulation might have been largely innefective for many participants due to difficulty in finding a relevant plant-based goal. Lastly, it is possible that an immediate behavioural effect of setting goal implementation intentions (up to a week) was followed by a rebound effect, and they cancelled each other out. Interestingly, this was a trend we found (see figure 3): after the manipulation, the goal group's consumption decreased in the next six days and increased from day six to day fifteen. We found a different trend for the action group – stable consumption in the six days post-manipulation, and a decrease from day six to day fifteen. For a better understanding of the effect of goal implementation intentions over time, we recommend that future research investigate these trends by measuring consumption daily, by including the complimenting perspective of complex dynamic systems (Kunnen, 2012) to our traditional statistical framework, and by modelling non-linear effects of time.

Lastly, our results are consistent with studies reporting an independent main effect of self-efficacy on dietary behaviour (Bouwman et al., 2020). Indeed, the confidence in one's ability to perform a desired behaviour makes behaviour initiation more likely. Our results are also in line with research reporting that the effect of IIs on goal-directed behaviour is not partly explained by changes in self-efficacy (Milne et al., 2002), and we offer several explanations for this. To begin

with, it has been suggested in the environmental psychology literature that successful behaviour can improve self-efficacy to only a limited extent (Van der Werff & Lee, 2021); we find it reasonable that creating a simple plan has an even more limited effect on self-efficacy. Arguably, setting action IIs might reduce situational uncertainty for some participants (more so for action IIs, which offer a specific behavioural alternative), but not enough to enable a significant effect. Moreover, an interval of three to four weeks may be too short for significant changes in self-efficacy to manifest. Indeed, we found that plant-based self-efficacy increased only slightly post-manipulation, and that it was a very stable construct (only slight fluctuations as seen in figure 4, and high intraclass correlation). Future research could test the possible role of self-efficacy on a longer timeline, and should operationalize self-efficacy on a more specific level (e.g., confidence in one's ability to implement the if-then plan).

Limitations

There are at least three limitations in our study. A potential first limitation concerns the effectiveness of our manipulation, particularly in relation to the representativeness of our sample (our population of interest is characterized by the intention to eat more plant-based, without currently being vegan). To elaborate, the perceived relevance of the if-then plans was not very strong, suggesting that our manipulation might not have been sufficiently relevant for some participants. Thus, it is possible that our manipulation was not effective as expected; to exemplify, the perceived recall of the if-then plans in shopping situations was quite low. Moreover, some participants deviated from the instructions for setting if-then plans. However, finding that the action IIs had an effect on animal-based consumption despite this limitation indicates more confidence in our findings, and a potential for finding both a larger effect of action IIs and significant effect of goal IIs in future research. To improve on this limitation, we suggest that in future research,

participants undergo a stricter screening criterea that defines our population of interest, and that participants receive occassional reminders of their if-then plans.

A second potential limitation is that participant dropout and missed surveys were more prevalent in the control group. Due to the repetitive and perhaps demanding nature of our study design, it is possible that the control group was less motivated to stay engaged in absence of the manipulation. This may add some uncertainty about the actual strength of effect of implementation intentions. Future research may benefit from a proposal on keeping control participants more engaged in the study.

A third potential limitation is related to the overall low statistical power of our study. Given the constraints of this project, our sample size was reasonable. However, considering our study design and missing data percentage, a larger sample size might be needed to find evidence of the effect of goal IIs. Despite these limitations, this study can be seen as a first step towards integrating goal frames in implementation intentions and dietary behaviour research into more appropriate study designs (longitudinal) and statistical methods (multilevel analysis).

Contribution of this Research

Our study has strengths that add value to the topic of dietary change and to the field of environmental psychology. First of all, we employed a longitudinal design spanning 27 days (with a baseline period of nine days and a post-intervention period of 18 days), with a three-day span between measurements. This setup allows (a) capturing both workweek and weekend fluctuations in consumption, (b) capturing instances of shopping and manipulation-induced changes in shopping patterns, (c) testing the effect longer than most previously discussed studies, and (c) a participant experience that is not overly demanding or intrusive for a longitudinal design. Second, we employed a random assignment experimental design which allows us to draw causational conclusions regarding our manipulation. Third, we employed a multilevel analysis framework,

which is a better statistical choice for this design than a repeated measures analysis of (co)variance in regards to unbalanced data structures and missing data. Certainly, future research is needed to replicate the findings of this study.

Lastly, we designed a measurement instrument that improves on limitation of existing instruments measuring food intake. Our measurement instrument was perceived favorably by participants, who reported a lot of ease in calculating their animal-based consumption with it. This was our aim, and to this end we quantified serving sizes in a visual way (hand measurements) that can be culture-independent, easily accesible and understood. Furthermore, we designed the instrument specifically for animal-based consumption using subcategories of foods. Importantly, this instrument captures a full day of consumption (hence the choice to measure yesterday's consumption) while still ensuring good recall (compared to instruments assessing last week's or last month's consumption). Our measurement instrument (created by Cristian Buruiana, Maddeline Judge and Ellen van der Werff) is available in both English and Dutch (translated by Alynda Kok and Maddeline Langley), and is promising to use in future studies involving animal-based food consumption.

Practical Implications

Our study emphasizes that action implementation intention is a supportive and cost-effective behaviour change strategy to increase plant-based consumption. This strategy could increase the effectiveness and efficiency of campaigns aiming to increase plant-based consumption (e.g., Veganuary, Vegan Challenge, WeekZonderVlees), whose predominant strategies are information provision, modelling, commitment and prompting. The combination of several of these strategies with action implementations would increase the conduciveness of the intervention to behaviour change (Steg & De Groot, 2019, pp. 265–268). Lastly, the animal-based consumption measurement

instrument can be integrated in both applied research and personal use (e.g., mobile applications) for convenient reporting.

Concluding Remarks

Our project addresses a topic of high societal relevance: how can individuals be supported to implement their intention to have an increasingly plant-based diet? The results of our study reinforce the body of evidence supporting implementation intentions as an effective dietary behaviour change strategy, specifically for animal-based consumption reduction. In this regard, we provide evidence of a stronger effect of action implementation intentions. We emphasize the potential for finding an effect of goal implementation intentions given a stronger experimental manipulation (reminders of created if-then plans). Furthermore, we report that plant-based self-efficacy is an important factor explaining changes in animal-based consumption. We suggest that future research implement our recommendations and further investigate our findings. Importantly, we encourage the use of our intuitive and convenient instrument measuring animal-based consumption, which is a key contribution of this research to the field of environmental psychology (specifically plant-based diets).

We advise that implementation intentions be integrated in both campaigns facilitating plant-based consumption and individual goal-striving, as IIs constitute a practical strategy to support intentional behaviour. After all, it is as simple as writing a situation that elicits unwanted behaviour, and linking it to a desired behavioral alternative. And ultimately, a more more plant-based diet can bring personal benefits and contribute to a more sustainable society.

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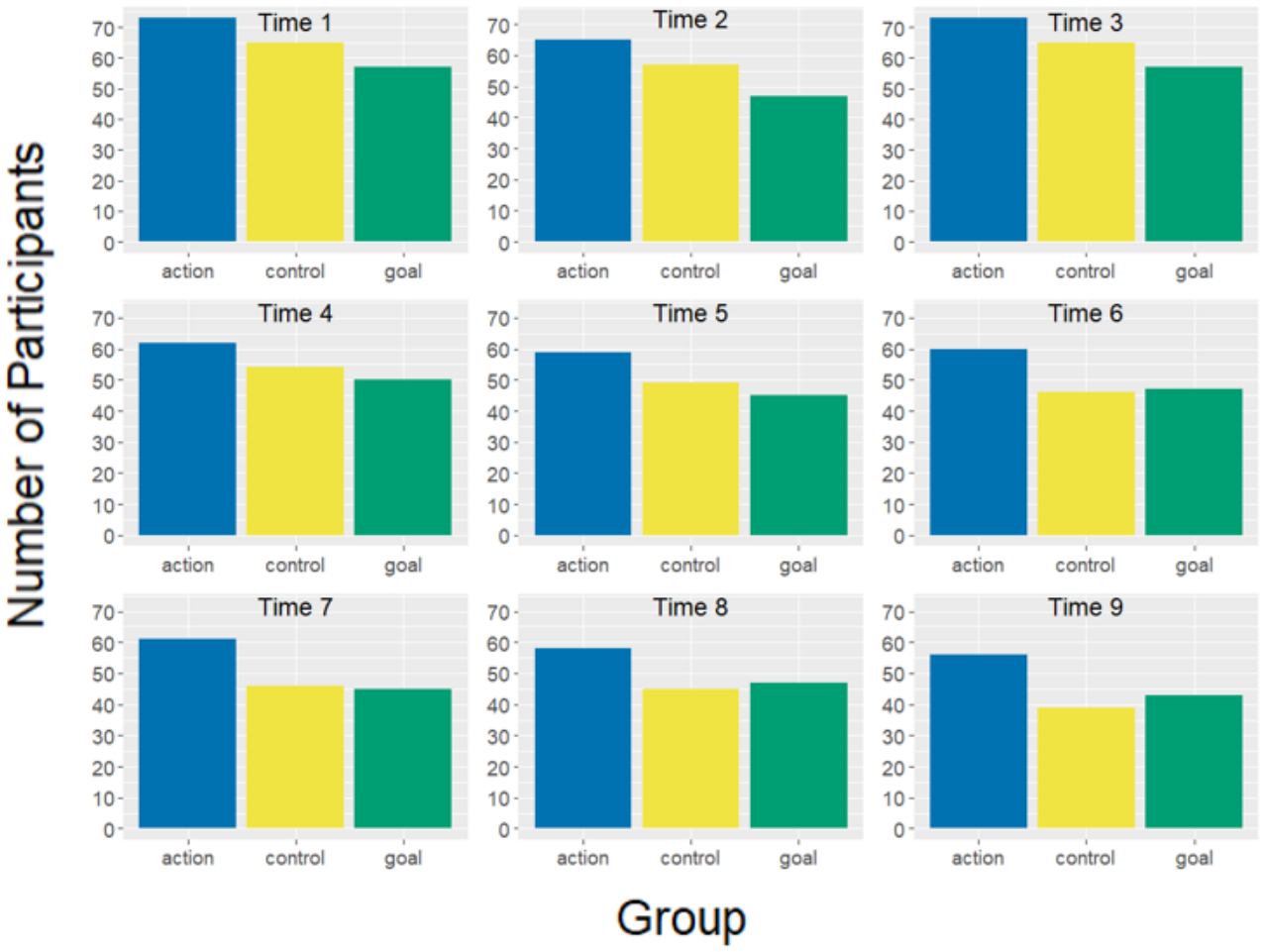
Appendix A

Missing Data

Appendix A

Barplots Indicating the Number of Participants per Groups, for each Measurement Time

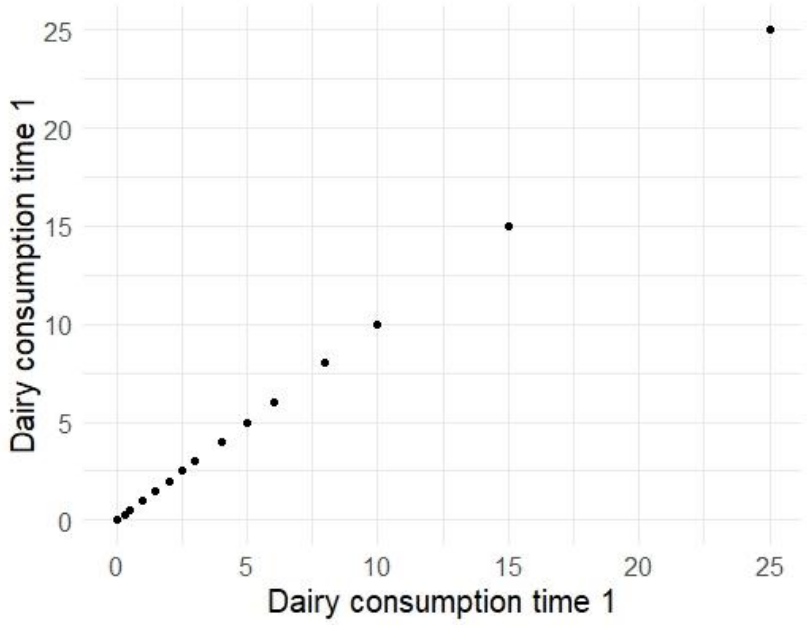

Number of Participants
Time 1
Time 2
Time 3
Time 4
Time 5
Time 6
Time 7
Time 8
Time 9
0
10
20
30
40
50
60
70
action
control
goal
Group

Appendix B

Extreme Consumption Scores

Figure B1

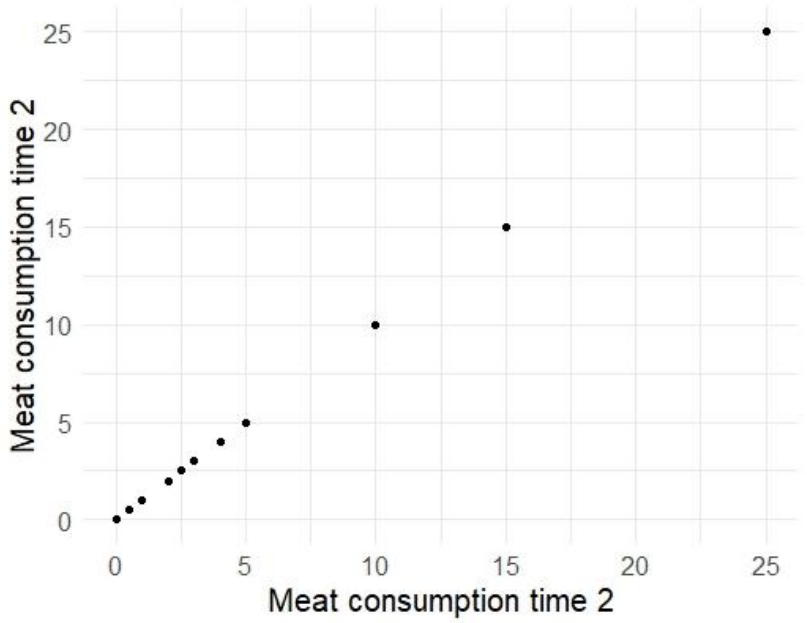
Distribution of Dairy Consumption at Time 1



Note: There are no scores between 10 and 15, and no scores between 15 and 25

Figure B2

Distribution of Meat Consumption at Time 2



Note: There are no scores between 10 and 15, and no scores between 15 and 25

Appendix C

Research Materials

Table C1

Implementation Intention Instructions (English then Dutch), in Order of Presentation (1 to 4)

Page	Action Group	Goal Group
1	In the following part, you will be asked to write some If-then plans [If situation X… happens, then I will …Y…] that fit your plant-based dietary goals and intentions. These statements should refer to any situation in which you are buying food that you will eat (e.g. market, supermarket, take-out/restaurant).	In the following part, you will be asked to write some If-then plans [If situation …X… happens, then I will …Y…] that fit your plant-based dietary goals and intentions. These plans should refer to any situation in which you are buying food that you will eat (e.g. market, supermarket, take-out/restaurant).
2	Think about a few such relevant shopping situations in which you can change your behaviour in order to eat more plant-based foods. For example, there could be an animal-based food section in the shop that is difficult to resist, or a type of animal-based food that you want to consume less.	Think about a few of these relevant shopping situations in which you can change your behaviour in order to eat more plant-based foods. For example, there could be an animal-based food section in the shop that is difficult to resist, or a type of animal-based food that you want to consume less.
3	Please spend as much time as you need to create these plans. Make them personal and relevant to your plant-based dietary intention.	Please spend as much time as you need to create these statements. Make them personal and relevant to your plant-based dietary intention.

	Link the shopping situations you thought of, to (a) specific actions(s). Examples of specific actions could be “choose soy products/mushrooms instead”, “choose the food with the least animal products”, “walk to the vegan section”, etc. An example of a plan could be “If I am craving meat when shopping, then I will buy mushrooms”. When you write one, imagine for a few seconds what it will be like if you will implement this if-then plan in that situation.	Link the shopping situations you thought of, to (a) relevant broader goal(s). Examples of goals could be “to have a small environmental footprint”, “to reduce animal suffering”, “to have a healthy diet”, etc. An example of a plan could be “If I am craving meat when shopping, then I will remind myself of my goal to have a smaller environmental footprint”. When you write one, imagine for a few seconds what it will be like if you will implement this if-then plan in that situation.
4	Write the first if-then plan in the form "If I am in shopping situation X..., then I will do the specific action Y..." Write the second if-then plan in the form "If I am in shopping situation X..., then I will do the specific action Y..."	Write the first if-then plan in the form "If I am in shopping situation X..., then I remind myself of my goal Y..." Write the second if-then plan in the form "If I am in shopping situation X..., then I will remind myself of my goal Y..."
1	In het volgende deel word je gevraagd om enkele Als-dan plannen te maken [Als situatie …X… gebeurt, dan zal ik …Y…] die passen bij je plantaardige	In het volgende deel word je gevraagd om enkele Als-dan plannen te maken [Als situatie …X… gebeurt, dan zal ik …Y…”] die passen bij je plantaardige voedingsdoelen en -intenties.

	voedingsdoelen en -intenties. Deze plannen moeten betrekking hebben op situaties waarin je producten koopt die je gaat eten (bijv. markt, supermarkt, afhaalrestaurant/restaurant).	 Deze plannen moeten betrekking hebben op situaties waarin je producten koopt die je gaat eten (bijv. markt, supermarkt, afhaalrestaurant/restaurant).
2	Bedenk enkele winkelsituaties waarin je je gedrag kunt veranderen om meer plantaardig te eten. Zo kan er in de winkel een afdeling met dierlijke producten zijn waar je moeilijk weerstand aan kunt bieden, of een specifiek dierlijk product dat je minder wilt consumeren.	Bedenk enkele winkelsituaties waarin je je gedrag kunt veranderen om meer plantaardig te eten. Zo kan er in de winkel een afdeling met dierlijke producten zijn waar je moeilijk weerstand aan kunt bieden, of een specifiek dierlijk product dat je minder wilt consumeren.
3	Besteed zoveel tijd als je nodig hebt aan het maken van deze plannen. Maak ze persoonlijk en relevant voor jouw plantaardige voedingsintentie. Koppel de winkelsituaties aan (een) specifieke actie(s). Voorbeelden van specifieke acties zijn “kies in plaats daarvan sojaproducten/champignons”, “kies de producten met de minste dierlijke ingrediënten”, “loop naar het veganistische gedeelte”, etc.	Besteed zoveel tijd als je nodig hebt aan het maken van deze plannen. Maak ze persoonlijk en relevant voor jouw plantaardige voedingsintentie. Koppel de winkelsituaties aan (een) relevante bredere doelstelling(en). Voorbeelden van doelen kunnen zijn “een kleine ecologische voetafdruk hebben”, “dierenleed verminderen”, “gezond eten”, etc. Een voorbeeld van een Als-Dan plan zou kunnen zijn: “Als ik trek heb in

	Een voorbeeld van een Als-Dan plan zou kunnen zijn: “Als ik trek heb in vlees tijdens het winkelen, dan koop ik in plaats daarvan champignons”. Wanneer je zo'n plan opschrijft, stel je dan een paar seconden voor hoe het is als je dit als-dan plan in die situatie zult implementeren.	vlees tijdens het winkelen, dan zal ik mezelf herinneren aan mijn doel om een kleiner ecologische voetafdruk te hebben”. Wanneer je zo'n plan opschrijft, stel je dan een paar seconden voor hoe het is als je dit als-dan plan in die situatie zult implementeren.
4	Schrijf het eerste als-dan plan in de vorm "Als ik in winkelsituatie X ben..., dan zal ik de specifieke actie Y doen..." Schrijf het tweede als-dan plan in de vorm "Als ik in winkelsituatie X ben..., dan zal ik de specifieke actie Y doen..."	Schrijf het eerste als-dan plan in de vorm "Als ik in winkelsituatie X ben..., dan zal ik mezelf herinneren aan mijn doel Y..." Schrijf het tweede als-dan plan in de vorm "Als ik in winkelsituatie X ben..., dan zal ik mezelf herinneren aan mijn doel Y..."

Table C2

Examples of Randomly-sampled If-then Plans Created by Participants, per Group

Action if-then plans	Goal if-then plans
If I am trouble figuring out what protein source I want I go for tofu or beans.	If I am shopping and want to include a source of protein in my meals I can remind myself that in order to avoid animal cruelty I can buy plant based protein sources.
If I am craving cheese when shopping, then I will check out the vegan cheese offer.	If I am habitually opting for dairy products, then I consciously remind myself of my goal to reduce animal cruelty.
If I want a dessert when shopping, I will buy fruits	If I want to eat meat for dinner then I remind myself that I don't want to hurt animals and buy something else
If I am in the shopping situation where I am craving yogurt I will by soy yogurt	If I am buying meat, then I remind myself to make sure the meat comes from acceptable conditions.
If I walk into Lidl to buy something for a meat based meal I will try and find a plant-based alternative.	If I am grabbing for cheese in the supermarket, I remind myself of my goal to reduce cow suffering.
Als ik een gebakje of broodje wil kopen voor mijn werkpauze, dan koop ik in plaats daarvan een smoothie	als ik tijdens winkelen zin heb ik vlees, dan zal ik mezelf herinneren om vegetarisch eten te proberen
Als ik zin heb in een stukje vis, dan bedenk ik mij wat voor lekkere vegetarische recepten er bestaan en ga ik hier iets van uitzoeken	Als ik in de winkel zin in droge worst heb om te snacken, dan zal ik mezelf herinneren aan mijn doel om meer fruit te eten als snack.
Als ik melkproducten wil halen dan zal ik soja halen want ik ben toch lactose intolerant	als ik in een winkelsituatie ben waar eieren gekocht moeten worden, zal ik mezelf er aan herinneren aan mijn doel

	om de biologische variant kopen of zorgen dat ik eieren van mijn ouders krijg.
Als ik zin heb in cake, dan zal ik plantaardige boter kopen in plaats van roomboter	Als ik in een winkelsituatie met yoghurt ben, dan al ik mezelf herinneren aan mijn doel om minder zuivel te eten voor mijn gezondheid.
Als ik trek heb in een frikandelbroodje, koop ik een kaasbroodje	Als ik in de Albert Heijn to go ben wil ik minder snel eten kiezen wat vis bevat, dan zal ik mezelf herinneren aan mijn doel om minder vis te eten.

Note: The if-then plans are reported here unedited, and may contain spelling mistakes.

Table C3

Debriefing Forms (English, then Dutch)

Dear participant, thank you for taking part in this research on plant-based dietary intentions!

Hereby we want to inform you about the purpose of the study.
We investigate the effectiveness and mechanisms of implementation intentions on reducing animal-based food consumption. We further investigate if confidence in implementing your intention (self-efficacy) is a mechanism of implementation intentions.

You were assigned to one of three groups:

-If you were in the higher-order goal group, you set a few implementation intentions in the form of "If I am in the shopping situation X…. , I will think of my goal to ….".

-If you were in the specific action group, you set a few implementation intentions in the form of "If I am in the shopping situation X…. , I will perform this action ….".

-If you were in the control group, you reported your intention to have an increasingly plant-based diet.

We encourage you to set some implementation intentions of your choice, either linked to goal or specific action, to assist you in your goal pursuit.
Examples of implementation intention can be "If I am craving meat while shopping, I will buy mushrooms" or "If I am craving meat while shopping, I will think of my goal to have a smaller ecological footprint".

Beste deelnemer, bedankt voor je deelname aan dit onderzoek naar plantaardige voedingsintenties!

Hierbij willen wij u informeren over het doel van het onderzoek:
We onderzoeken de effectiviteit en mechanismen van implementatie-intenties voor het verminderen van dierlijke voedselconsumptie. We onderzoeken verder of vertrouwen in het uitvoeren van je intentie (zelfeffectiviteit) een mechanisme van implementatie-intenties is.

Je was in een van de drie groepen:

-Als je in de doelgroep was, stel je een paar implementatie-intenties in de vorm van "Als ik in de winkelsituatie X ben .... , zal ik aan mijn doel denken om ….".

-Als je in de specifieke actiegroep was, stel je een paar implementatie-intenties in de vorm van “Als ik in de winkelsituatie X ben…. , ik zal deze actie uitvoeren ...".

-Als je in de controlegroep was, gaf je aan van plan te zijn om steeds meer plantaardig te gaan eten.

We moedigen je aan om implementatie-intenties van je keuze op te stellen, ofwel een doel ofwel een specifieke actie, om jezelf te helpen bij het nastreven van jouw doel. Voorbeelden van implementatie-intentie kunnen zijn: "Als ik trek heb in vlees tijdens het winkelen, dan koop ik champignons" of "Als ik trek heb in vlees tijdens het winkelen, dan denk ik aan mijn doel om een kleinere ecologische voetafdruk te hebben".

Figure C1

Dutch Version of the Measurement Instrument for Animal-based Consumption

Appendix D

Model Assumptions

Figure D1

Scatterplot of Model Residuals versus Observed Consumption

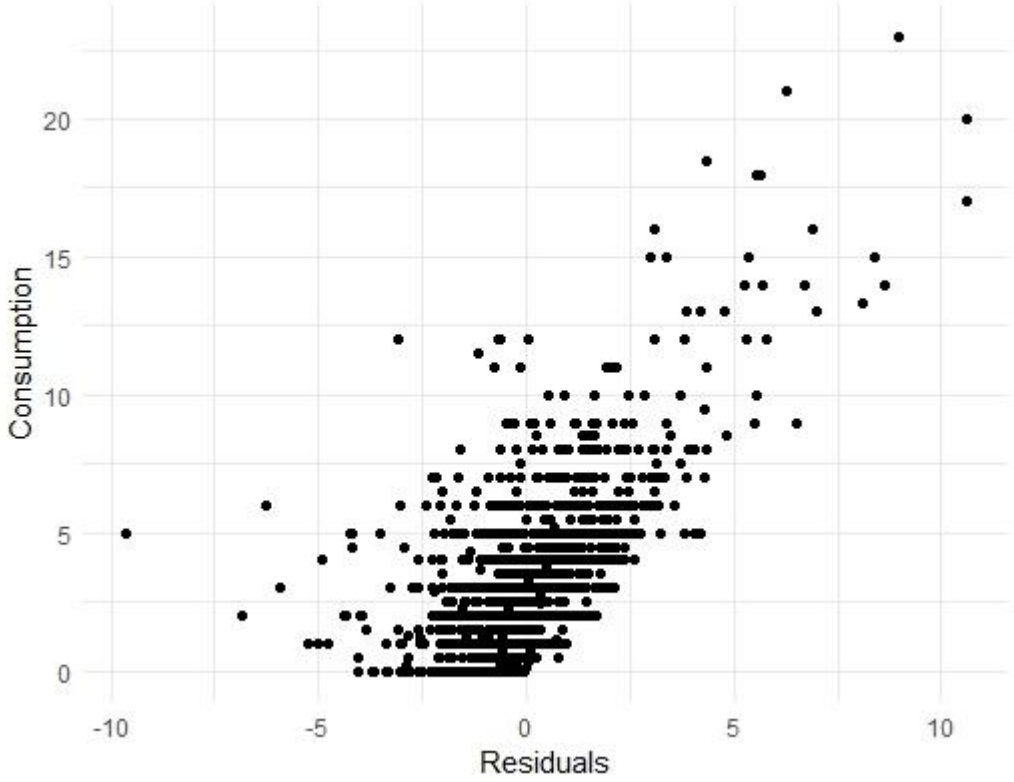


Figure D2

Fitted versus Residuals Plot

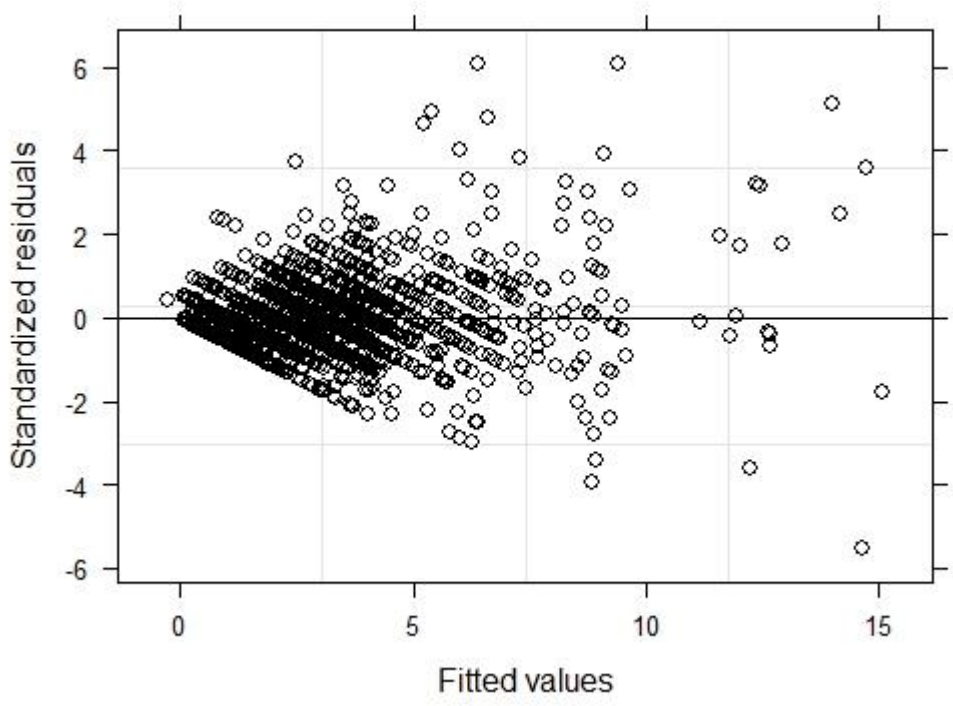


Figure D3

Histogram of Model Residuals