Meat Consumption and Potential Reduction:
Environmental and Public Health Benefits

Garrett Lentz, Dr. Sean Connelly, Dr. Miranda Mirosa

University of Otago, Dunedin

Introduction

Impacts

- ❖ Producing and consuming meat linked to variety of environmental and public health impacts:
  - Globally: Accounts for about **20%** of greenhouse gas (GHG) emissions[1,2], **80%** of land use[3], **33%** of water use[4], and is major contributor to habitat loss[5], species declines[6,7], and pollution[8,9]
  - In New Zealand: **45%** of total GHGs from animal agriculture[10]
  - Linked to major diseases: heart disease, obesity, diabetes, cancer, etc.[11,12,13,14,15,16,17]
- ❖ Projected global meat demand: **72%** higher in 2030 than in 2000[18]
  - Impacts *will* increase
- ❖ Intake reductions would result in both environmental and public health benefits.

Understanding Meat Consumption

- ❖ One recent study[19] based in New Zealand found:

1. Consumer awareness of meat's environmental impacts is **low**.
2. Motivations to reduce meat differ between consumer groups (i.e. non-reducers, reducers, abstainers)
3. Attitudes and meat attachment predict:
   - Willingness and intentions to reduce meat consumption
   - Agreement with proposed policy measures that would promote reduced-meat diets.

- ❖ So meat intake is relatively understood, but in practice, *how* might it be reduced?

Research Questions

This study aimed to understand how different motivational framings (e.g. health, environment, animal welfare) influence consumers' meat consumption, asking three primary research questions:

RQ1 - Does the viewing of a meat-related film have any immediate or long-term impacts on motivations (six in total) to reduce meat consumption?

RQ2 - Does the viewing of a meat-related film have any immediate or long-term impacts on attitudes, meat attachment or agreement with proposed 'meat-reduction policies'? If so, are there differences between the motivational framings?

RQ3 - Does the viewing of a meat-related film have any impacts on willingness and/or intentions to reduce meat in the diet, reduction frequencies, and/or meat intake frequencies?

Methods

Sample

- ❖ 85 university students
- ❖ Ages: 18 to 30
- ❖ Consume meat, but have not seen any films on meat-related issues/impacts

Experimental and Control Group(s)

- ❖ Randomly assorted by gender into four different 'film groups'.

1) Health group (i.e. Group H, n = 22) – Film: What the Health
2) Environmental group (i.e. Group E, n = 21) – Film: Cowspiracy
3) Animal welfare group (i.e. Group A, n = 21) – Film: Earthlings
4) Control group (n = 21) – Film: Jim and Andy (Subject: Acting)

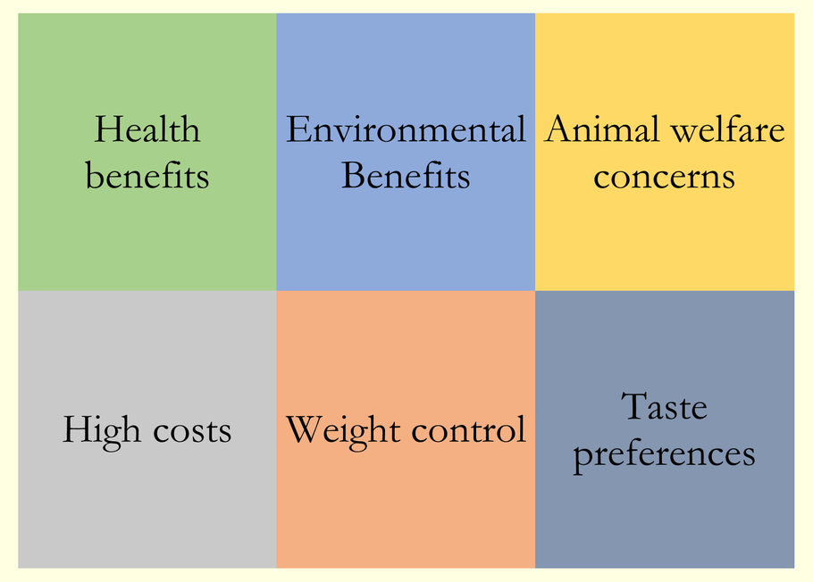
Surveys

- ❖ Three surveys were given:

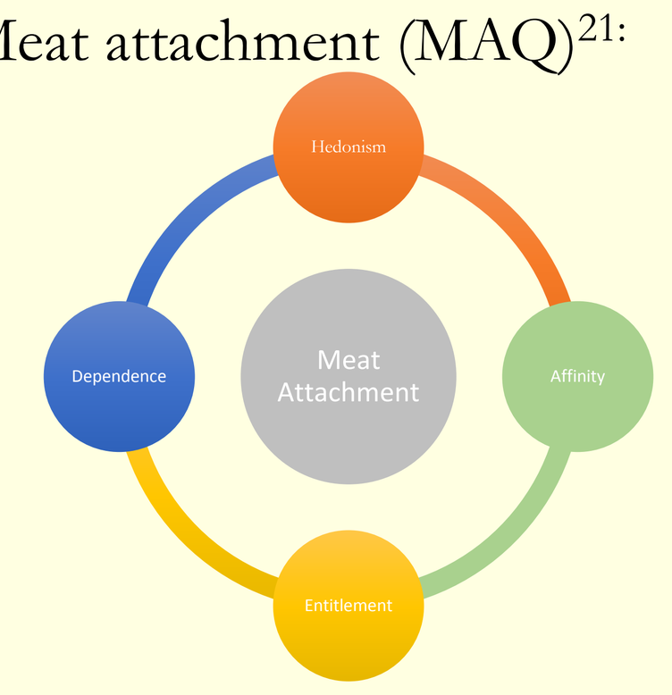
1) Pre-survey (before film)
2) Post-survey (immediately after film)
3) 1 month follow-up

Variables Measured

Six motivations:



Meat attachment (MAQ)[21]:



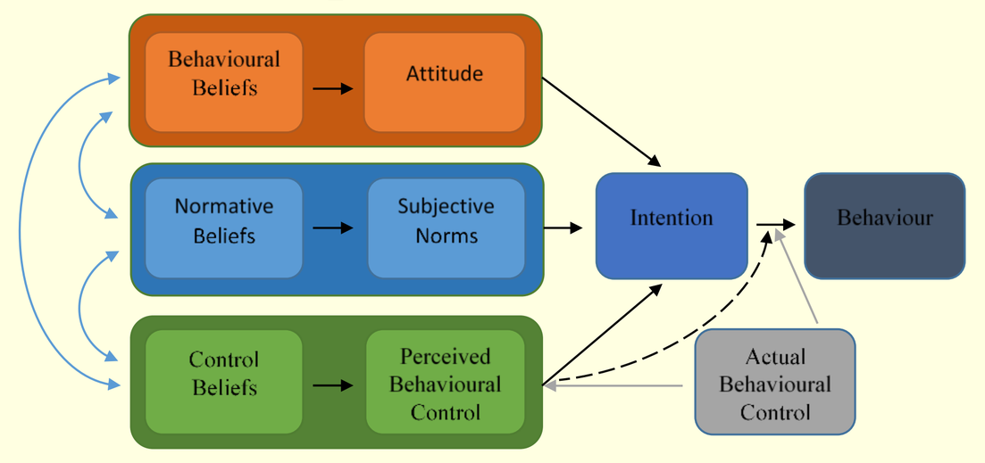
Hedonism: Pleasure from consuming meat

Affinity: Positive attributes of meat

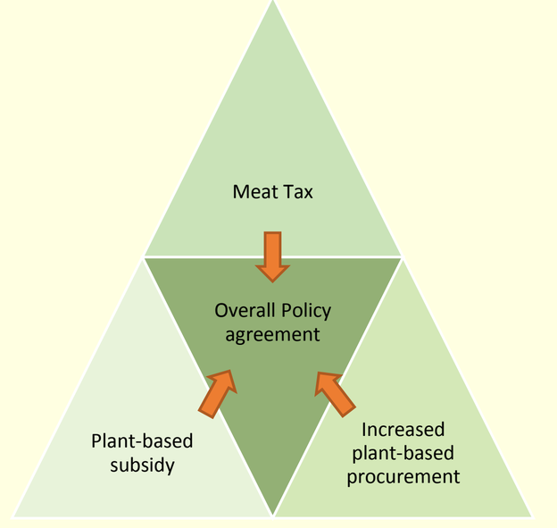
Entitlement: Right to consume meat

Dependence: Necessity of meat in diet

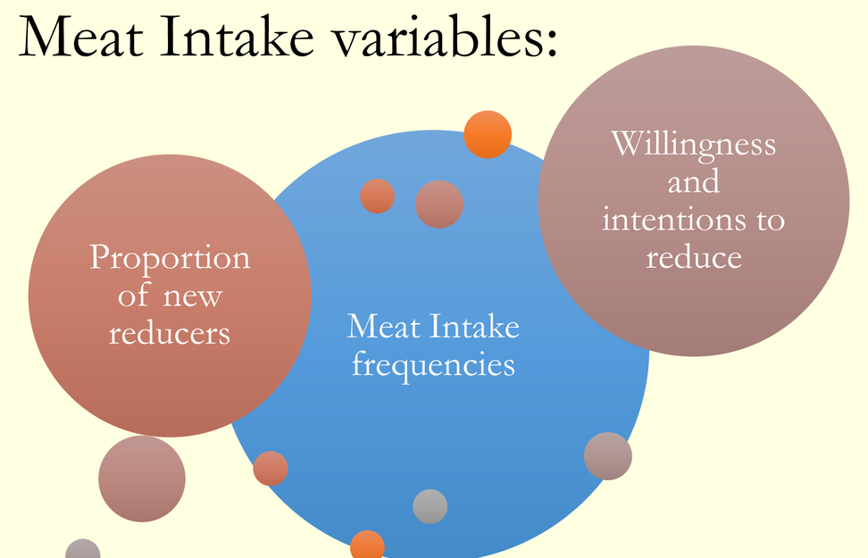
Theory of Planned Behaviour (TPB) components[20]:



Policy Agreement:



Meat Intake variables:



Results

Changes in Meat-related Variables

Changes over time analysed with ANOVA and ANCOVA:

- Post-hoc t-tests performed
- All p-values adjusted for multiple comparisons
- ANCOVA analyses controlled for pre-survey scores.

Significant changes ($p<.05$) in variables over time:

1) **Motivations:** Health and Animal welfare
2) **TPB:** Attitudes and Perceived behavioural control (i.e. PBC)
3) **MAQ:** Meat attachment and subscales (i.e. Hedonism, Affinity, Entitlement, Dependence)
4) **Policy Agreement:** Meat tax and overall policy agreement

Within-group changes:

Paired t-test results for changes in variables over time

	Post			Follow-up		
	Δ Mean	SD	t	Δ Mean	SD	t
Motivations						
Health						
Group H	0.87	1.15	**3.5***	- 0.02	1.14	- 0.09
Group E	-0.62	0.76	**- 3.8***	- 0.40	0.89	- 2.0
Group A	0.76	1.79	1.94	0.45	1.63	1.26
Control	- 0.10	0.23	- 0.46	- 0.13	1.23	- 0.50
Animal Welfare						
Group H	0.66	1.04	**2.99***	0.23	1.42	0.77
Group E	0.18	0.82	1.01	- 0.13	0.97	- 0.61
Group A	1.20	1.06	**5.19***	0.81	1.21	**3.08***
Control	0.07	0.66	0.50	- 0.09	0.82	- 0.48
TPB						
Attitudes						
Group H	- 1.36	1.29	**- 5.0***	- 0.77	0.80	**- 4.5***
Group E	- 0.91	0.95	**- 4.4***	- 0.55	0.78	**- 3.3***
Group A	- 1.36	1.32	**- 4.7***	- 0.88	0.73	**- 5.6***
Control	- 0.12	0.40	- 1.4	0.10	0.66	0.7
PBC						
Group H	0.42	0.57	**3.4***	0.33	0.59	**2.6***
Group E	- 0.09	0.49	- 0.8	- 0.06	0.64	- 0.4
Group A	0.45	0.77	**2.7***	- 0.01	1.02	- 0.1
Control	0.03	0.55	0.25	- 0.30	0.76	- 1.8
MAQ						
Hedonism						
Group H	- 0.81	1.09	**-3.5***	- 0.59	0.64	**- 4.3***
Group E	- 0.63	0.80	**- 3.6***	- 0.40	0.48	**- 3.8***
Group A	- 1.17	1.27	**- 4.2***	-1.14	1.35	**- 3.9***
Control	- 0.05	0.35	- 0.67	-0.03	0.56	-0.3
Affinity						
Group H	- 1.46	1.06	**- 6.4***	- 0.78	0.81	**- 4.5***
Group E	- 0.94	1.09	**- 4.0***	- 0.52	0.65	**- 3.6***
Group A	- 1.90	1.04	**- 8.4***	- 1.33	1.43	**- 4.3***
Control	- 0.12	0.39	- 1.5	- 0.11	0.59	- 0.8
Entitlement						
Group H	- 0.75	1.22	**- 2.9***	- 0.71	0.93	**- 3.6***
Group E	- 1.16	0.97	**- 5.5***	- 0.59	0.94	**- 2.9***
Group A	- 1.16	1.16	**- 4.6***	- 1.14	1.33	**- 3.9***
Control	- 0.13	0.33	- 1.8	- 0.18	0.55	- 1.5
Dependence						
Group H	- 1.19	1.03	**- 5.4***	- 1.04	0.91	**- 5.4***
Group E	- 0.52	0.90	**- 2.7***	- 0.40	1.11	- 1.7
Group A	- 1.20	1.04	**- 5.3***	- 0.79	1.42	**- 2.6***
Control	- 0.24	0.41	**- 2.7***	- 0.10	0.51	- 0.9
Meat Attachment						
Group H	- 1.08	0.84	**- 6.0***	- 0.80	0.46	**- 8.3***
Group E	- 0.78	0.76	**- 4.7***	- 0.47	0.60	**- 3.6***
Group A	- 1.36	0.92	**- 6.8***	- 1.08	1.22	**- 4.1***
Control	- 0.14	0.18	**- 3.7***	- 0.10	0.34	- 1.4
Policy Agreement						
Tax Agreement						
Group H	1.71	1.71	**4.7***	0.97	1.63	**2.8***
Group E	1.86	1.42	**6.0***	0.84	1.31	**2.9***
Group A	1.33	1.60	**3.8***	1.20	1.20	**4.6***
Control	0.22	0.61	1.7	0.10	0.99	0.5
Overall Agreement						
Group H	1.31	0.99	**6.2***	0.71	1.16	**2.9***
Group E	1.22	0.81	**6.9***	0.80	0.78	**4.8***
Group A	1.01	0.96	**4.8***	0.88	0.90	**4.5***
Control	0.34	0.51	**3.1***	0.37	0.78	2.1

Between-group changes:

ANCOVA pairwise comparisons for motivations

	Comparison Group	M Difference	Std. Error
Health			
Group H	E	**0.90***	0.28
	A	0.12	0.29
	Control	0.40	0.28
Group E	A	**- 0.78***	0.29
	Control	- 0.50	0.29
Group A	Control	0.28	0.30
Animal Welfare			
Group H	E	0.33	0.27
	A	**- 0.67***	0.27
	Control	0.38	0.27
Group E	A	**- 1.01***	0.27
	Control	0.04	0.27
Group A	Control	**1.05***	0.27

ANCOVA pairwise comparisons for TPB, MAQ, and Policy Agreement

	M Difference	Std. Error
TPB		
Attitudes		
Group H	**- 1.02***	0.22
Group E	**- 0.84***	0.22
Group A	**- 1.07***	0.22
MAQ		
Hedonism		
Group H	**- 0.64***	0.22
Group E	**- 0.52***	0.23
Group A	**- 0.97***	0.23
Affinity		
Group H	**- 0.93***	0.24
Group E	**- 0.62***	0.24
Group A	**- 1.44***	0.24
Entitlement		
Group H	- 0.46	0.26
Group E	**- 0.71***	0.26
Group A	**- 0.91***	0.26
Dependence		
Group H	**- 0.89***	0.23
Group E	**- 0.60***	0.24
Group A	**- 0.80***	0.23
Meat Attachment		
Group H	**- 0.74***	0.18
Group E	**- 0.59***	0.19
Group A	**- 1.01***	0.19
Policy Agreement		
Tax Agreement		
Group H	**1.04***	0.35
Group E	**1.14***	0.35
Group A	**1.20***	0.35
Overall Agreement		
Group H	**0.57***	0.23
Group E	**0.64***	0.23
Group A	**0.64***	0.23

Changes to Meat Consumption

Significant changes in willingness and intentions to reduce (t-tests), reduction frequencies (Chi-square), and meat intake frequency (Wilcoxon Signed-Ranks Test) were observed for experimental groups

Willingness and Intentions to reduce:

Paired sample t-tests for willingness and intentions to reduce meat intake

	Pre M	Post M	*t*	df
Willingness				
Group H	4.06	5.70	**4.85***	21
Group E	4.94	5.51	2.23	20
Group A	4.30	5.59	**3.54***	20
Control	5.02	4.60	**-3.05***	20
Intentions				
Group H	3.28	5.60	**5.57***	21
Group E	3.87	5.15	**4.56***	20
Group A	3.42	5.50	**5.91***	20
Control	3.84	3.58	-.81	20

Reduction frequencies:

Significant interaction between watching meat-related film and increased rate of meat reductions:
$X^2(1) = \mathbf{11.21}$, p <.001

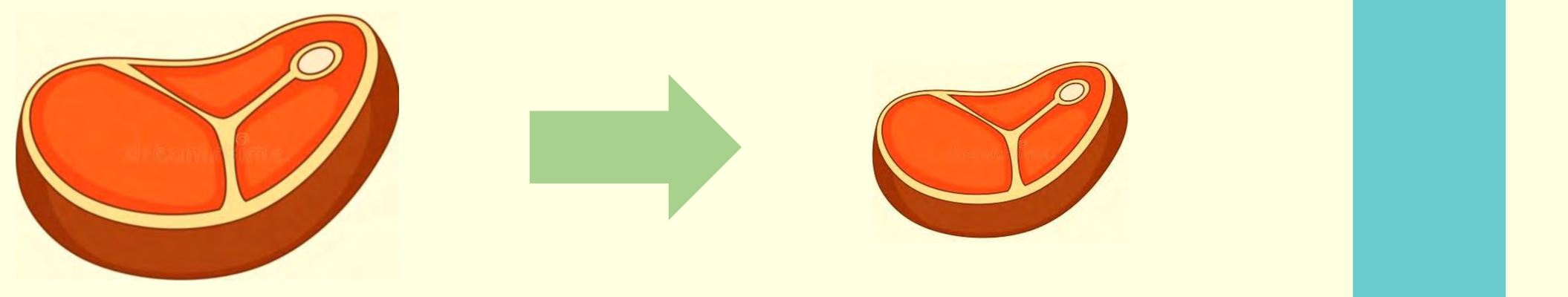
Group frequencies of meat reduction post-film

	Non-reducer	Reducer	Total
Group H	10	12	22
Group E	10	11	21
Group A	8	13	21
Control	18	3	21

Meat Intake Frequency:

Wilcoxon Signed Ranks Test:

- ❖ Group H: Significant decline ($Z = \mathbf{-1.9}$, $p < .05$)
- ❖ Group E: Significant decline ($Z = \mathbf{-2.6}$, $p < .05$)
- ❖ Group A: Significant decline ($Z = \mathbf{-1.8}$, $p < .05$)
- ❖ Control: No change ($Z = -1.3$, $p = .172$)



Conclusions

Motivations

- ❖ Animal welfare information – increases 'animal welfare' reduction motivation (sustained, i.e. still present one month after viewing)
- ❖ Health information – increases 'health benefits' reduction motivation (not sustained)
- ❖ Environmental information – no significant increases in 'environmental benefit' reduction motivation

TPB

- ❖ Framings that can reduce positive attitudes towards meat (greatest to least):
  - Animal welfare
  - Health
  - Environment
- ❖ Framings that can increase PBC:
  - Health (sustained)
  - Animal welfare (not sustained)

MAQ

- ❖ All framings can reduce meat attachment
- ❖ Compared to the control:
  - Animal welfare: largest declines in hedonism, affinity, and entitlement;
  - Health: largest declines in dependence.

Policy Agreement

- ❖ Framings that can increase agreement with proposed meat-reduction policies (greatest to least):
  - Environmental
  - Animal welfare
  - Health
- ❖ Simple exposure to potential policies may (slightly) increase agreement (i.e. mere-exposure effect)

Willingness, intentions, reduction frequencies, and meat intake

- ❖ All framings:
  - Increased willingness and intentions to reduce meat intake
  - Increased reduction frequencies
  - Decreased meat intake frequencies (Environmental frame showed greatest declines)

General Trends

- ❖ Impacts of information on meat-related variables
  - Most prominent immediately after exposure to information, diminish over time
- ❖ Animal welfare frame:
  - Wider variation in impacts between individuals
  - Thus, may resonate more strongly with select individuals
- ❖ Health and environmental frames:
  - May show weaker effects, but are more consistent across individuals
- ❖ Health and animal welfare frames:
  - Largest impacts on attitudes, PBC, and meat attachment
- ❖ Environmental frame:
  - Largest impacts on policy agreement and meat intake frequency.

Implications and future directions

- ❖ Exposure to health, environmental, or animal welfare information all increased not only personal meat-related variables (i.e. attitudes, attachment, intake frequency etc.), but also increased agreement with more societal-level approaches (i.e. policy measures) that would seek to address some of meat's associated impacts
- ❖ Individuals, organizations, and/or governments can utilize these results when seeking to design or implement any strategies (either at personal or societal scale) that seek to promote meat reduction for environmental sustainability and/or improved public health.
- ❖ This study sought to understand differences between information framings, but future studies could combine different provisioning techniques and/or framings to better understand the potential interactions and their effects on meat-related variables, policy agreement, and/or intake frequencies.

References

1. Bellarby, J., Foereid, B., Hastings A., and Smith, P. (2008). Cool farming: Climate impacts of agriculture and mitigation potential. Amsterdam, Netherlands: Greenpeace International. Retrieved from http://www.greenpeace.org/international/en/publications/reports/cool-farming-full-report/
2. Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V. & de Haan, C. (2006). Livestock's long shadow: environmental issues and options. Food and Agriculture Organization of the United Nations: Rome. Retrieved from http://www.fao.org/docrep/010/a0701e/a0701e00.HTM
3. Stehfest, E., Bouwman, L., Van Vuuren, D., Den Elzen M., Eickhout, B. & Kabat, P. (2009). Climate benefits of changing diet. Climatic change, 95(1-2), 83-102.
4. Mekonnen, M. & Hoekstra, A. (2012). A global assessment of the water footprint of farm animal products. Ecosystems, 15(3), 401-415.
5. Aiking, H. (2011). "Future protein supply." Trends in Food Science & Technology 22(2): 112-120.
6. Ripple, W. J., et al. (2014). "Status and ecological effects of the world's largest carnivores." Science 343(6167): 1241484.
7. Ripple, W. J., et al. (2015). "Collapse of the world's largest herbivores." Science Advances 1(4): e1400103.
8. Bouwman, L., Goldewijk, K., Van Der Hoek, K., Beusen A., Van Vuuren D., Willems, J., Rufino, M. & Stehfest, E. (2013). Exploring global changes in nitrogen and phosphorus cycles in agriculture induced by livestock production over the 1900–2050 period. Proceedings of the National Academy of Sciences, 110(52), 20882-20887.
9. Sutton, M., Oenema, O., Erisman, J., Leip, A., van Grinsven, H. & Winiwarter, W. (2011). Too much of a good thing. Nature, 472(7342), 159-161.
10. Ministry for the Environment (2018). New Zealand's Greenhouse Gas Inventory. Wellington, NZ.
11. Aston, L., Smith, J., & Powles, J. (2012). Impact of a reduced red and processed meat dietary pattern on disease risks and greenhouse gas emissions in the UK: a modelling study. *BMJ Open,* 2(5), e001072.
12. Aune, D., Ursin, G., & Veierød, M. (2009). Meat consumption and the risk of type 2 diabetes: a systematic review and meta-analysis of cohort studies. *Diabetologia,* 52(11), 2277-2287.
13. Campbell, T. & Campbell, T. (2006). *The China Study: The Most Comprehensive Study of Nutrition Ever Conducted and the Startling Implications for Diet, Weight Loss, and Long-term Health.* Dallas, TX: BenBella Books.
14. Friel, S., Dangour, A., Garnett, T., Lock, K., Chalabi, Z., Roberts, I., Butler, A., Butler, C., Waage, J. & McMichael, A. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture. *The Lancet* 374(9706), 2016-2025.
15. Huang, T., Yang, B., Zheng, J., Li, G., Wahlqvist, M. & Li D. (2012). Cardiovascular disease mortality and cancer incidence in vegetarians: a meta-analysis and systematic review. *Annals of nutrition and metabolism,* 60(4), 233-240.
16. Pan, A., Sun, Q., Bernstein, A., Schulze, M., Manson, J., Stampfer, M., Willett, W. & Hu, F. (2012). Red meat consumption and mortality: results from 2 prospective cohort studies. *Archives of internal medicine,* 172(7), 555-563.
17. Wang, Y. & Beydoun, M. (2009). Meat consumption is associated with obesity and central obesity among US adults. *International Journal of Obesity,* 33(6), 621-628.
18. Fiala, N. (2008). Meeting the demand: An estimation of potential future greenhouse gas emissions from meat production. *Ecological Economics,* 67(3), 412-419.
19. Lentz, G., Connelly, S., Mirosa, M., & Jowett, T. (2018). Gauging attitudes and behaviours: Meat consumption and potential reduction. *Appetite*, *127*, 230-241.
20. Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In *Action control* (pp. 11-39). Springer, Berlin, Heidelberg.
21. Graca, J., Calheiros, M. & Oliveira, A. (2015a). Attached to meat?(Un) Willingness and intentions to adopt a more plant-based diet. *Appetite*, 95, 113-125.