final report

Meat mood map: Investigate sensory red meat cues (by cut) and their effect on consumer choice and wellness (mood)

Executive summary

Meat mood map aims to identify consumers who seek to choose food to improve their physical and mental (emotional state/mood) wellness. Initial survey results from New Zealand (n=113 respondents) showed that 70% of consumers would pay more for red meat products that would improve wellness (mood), which represents an opportunity to create and capture higher value for the red meat industry. The significant **desirability** of this value proposition was further demonstrated by collecting extensive quantitative data through on-line surveys using two platforms, Qualtrics in Australia (n=523) and Amazon Mechanical Turk in the USA (n=1,000). Over 90% of respondents to the on-line surveys (n=1,523, USA plus AUS) indicated they were interested (mildly, moderately or very interested) in purchasing and eating red meat that would improve their physical or mental wellness. In addition, 85% indicated they were willing to pay more for red meat that would provide physical or mental wellness benefits, with an average margin of 38% and 41%, respectively, supporting the **viability** of this concept. American respondents were more interested and were willing to pay more for the value proposition than Australian respondents.

Overall, few other demographic variables (e.g. economic situation) aside from country were associated to differences in purchasing and eating red meat for improved wellness, indicating that a broad population rather than a single demographic or segment was interested in consuming beef and lamb for wellness benefits. Over 90% of respondents were somewhat dissatisfied with their physical and mental wellness by indicating willingness to improve both. Consumers are shifting towards a more holistic view of health with growing focus on mental wellness. Overall survey results reflected this trend by the top areas that respondents sought improvement as physical energy (77%), improved mood (56%), muscle strength (56%), cognitive function (55%), joint health (50%) and calmer mood/less anxiety (50%). American respondents showed greater priority than Australians to mental wellness benefits (e.g. cognitive function and improved mood).

The **feasibility** of the value proposition relies on available evidence that regular meat consumption results in mental health benefits. Such claims will require additional review of the regulations and the literature focused on intervention research to gain understanding of the regulatory landscape and to identify publications that could provide the basis for mental health claims. If there is weak published evidentiary base, it would be required to undertake substantial research efforts involving randomised control trials to support evidence-based claims around mental health benefits from red meat consumption. The link between sensory experiences and emotional states during meat consumption is another research area to be developed for obtaining more information from consumers beyond hedonic and sensory responses. This would provide additional product insights to support consumer-driven new product development and marketing. Emotional consumer responses (n=160, Chinese) were evaluated to see if approaches developed for other foods would be valuable in the meat context. The applied emotional circumplex approach provided insightful meat profiles showing clear association of red meat (roasted lamb and beef steak-internally pink) with emotional activation and pleasure, mainly 'Energetic-Excited', 'Enthusiastic-Inspired' and 'Happy-Satisfied'. In contrast, other food protein sources were dominated by emotional deactivation like steamed tofu ('Secure-Ease' and 'Relaxed-Calm') and boiled chicken breast ('Dull-Bored' and 'Passive-Quiet') or emotional activation with displeasure like steamed bull frog, raw oyster and beef steak-bloody ('Jittery-Nervous' and 'Tense-Bothered').

Innovative advances in real-time (e.g. positive emotional activation and pleasure) and longer-term mental health (e.g. cognitive function, improved mood, calmer mood-less anxiety, reduced mood swings) benefits from red meat consumption represent cutting edge areas of research in Meat Science. Positive outcomes would provide the industry a unique opportunity to position meat outlining qualities that support improved mood and mental health. Packaging meat featuring perceived mood improvement nutrients represents a revolutionary concept that resonates with consumers' growing interest in mental wellness.

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1 Background

Meat mood map aims to identify consumers who seek to choose food to improve their wellness (emotional state/mood). Results from this work will provide preliminary data to demonstrate how red meat can be positioned to deliver wellness and mood change in addition to current eating hedonics such as tenderness, juiciness and flavour. Initial survey results from New Zealand have shown that 70% of consumers would pay more for red meat products that would improve wellness (mood) which represents an opportunity to create and capture higher value for the red meat industry.

The work summarized in Milestone 2 involved collection of *qualitative* data (on-line screening survey with 113 responses followed by phone interviews of 11 participants) to explore the desirability of the concept that red meat can have a positive impact on wellness (mood) and consumers are willing to pay more for meat that enhances wellness. This survey did not identify a specific target group, although menopausal women were later postulated as a potential target group.

To be more specific about target segments, the research team decided to undertake a more detailed market research survey to more clearly identify types of respondents interested in eating meat for wellness benefits. *Quantitative* data were collected through two on-line surveys with high numbers of respondents and more detailed questions than those in Milestone 2, specifically focussed on gathering additional demographic information in Australia and the USA. This market research survey aimed to provide quantitative evidence of **desirability** for the preliminary value proposition that consumers are willing to pay more for meat that improves wellness (mood).

A major **feasibility** component of the business model involves the development of methodologies to measure consumer emotional responses to meat, by initially implementing/adopting in the meat context established techniques for other food products. Emotional associations to meat were studied using a previously developed emotion circumplex approach and applied to a Chinese consumer panel in Auckland, New Zealand. Emotional responses were analysed to provide insightful emotional meat profiles.

The **viability** of the concept of merchandising meat based on improved wellness (mood) was explored by identifying the willingness to pay of respondents for this value proposition and identifying a target segment(s) that would indicate the potential size of the market.

2 Project objectives

1. Evaluation of consumers who seek to choose food (experience) to change/improve wellness/mood - understanding for red meat to address this "pain point" and consider if red meat can be positioned as delivering wellness and mood change in addition to current eating profile cue such as tenderness, juiciness and flavour.

2. Final report of key findings and testing of proof of concept and value proposition and recommended next steps plan – stage 2 research.

3   Methodology

3.1   Consumer Surveys

The **desirability** of the concept that red meat can have a positive impact on wellness (mood) and that consumers are willing to pay more for meat that enhances wellness has been initially explored in Milestone 2. To gather *quantitative* data and be more specific about target segments, two on-line surveys were carried out in Australia and the USA with high numbers of respondents and more detailed questions than those in Milestone 2, specifically focussed on collecting additional demographic information.

The surveys aimed to identify consumers who are more likely to eat meat if they knew that meat can improve their wellness/mood and characterize them. The demographic characteristics of these consumers were identified and their willingness to pay a premium for cuts of red meat with the potential to improve their physical and mental wellness were quantified. The market research surveys were created using two platforms, Qualtrics in Australia (n=523 respondents) and Amazon Mechanical Turk, a crowdsourcing internet marketplace, in the USA (n=1,000 respondents) and consisted of a series of multichoice questions (Appendix 9.1). The study was approved by AgResearch Human Research Ethics Committee (Ethics approval no. 6/2019).

Statistics Analysis

Consumer responses and demographics from the on-line surveys were summarized using R version 3.5.1 (Team, 2018) and plotted using Microsoft Excel. The canonical correlation analysis was performed between red meat-wellness responses and consumer demographics conducted using the mixOmics package version 6.6.2 (Rohart et al., 2017) in R with the "shrinkage" method.

Age and gender characteristics of respondents are summarised in the table below for the aggregate sample (n=1,523) and by country (USA=1,000 and AUS=523). A complete demographic characterization of the respondents is provided in section 9.2 of the Appendix. Gender distribution was reasonably balanced in both surveyed populations. Age distribution was balanced for the Australian respondents (15-20% in each of six age category), while the distribution of Americans was skewed towards younger respondents (50% in the first two age categories: 18-24 and 25-34 years old).

Summary of age and gender characteristics of all respondents and by country (USA and AUS).

	TOTAL	USA	AUS
N	1,523	1,000	523
Gender (%)			
Female	767 (50%)	520 (52%)	247 (47%)
Male	756 (50%)	480 (48%)	276 (53%)
Age, years old (%)			
18-24	186 (12%)	104 (10%)	82 (16%)
25-34	494 (32%)	402 (40%)	92 (18%)
35-44	343 (23%)	260 (26%)	83 (16%)
45-54	210 (14%)	130 (13%)	80 (15%)
55-64	165 (11%)	82 (8%)	83 (16%)
65 or older	125 (8%)	22 (2%)	103 (20%)

3.2   Emotional Associations to Protein Food Sources

A major feasibility component of the business model involves the development of methodologies to measure consumer emotional responses to meat, by initially implementing/adopting in the meat context established techniques for other food products. Emotional associations to meat were evaluated in this study using a previously developed emotion circumplex approach (Jaeger et al. 2019) and applied to a Chinese consumer panel (n=160) to provide insightful emotional meat profiles. The study was conducted at the Consumer and Sensory Science Laboratory of Plant and Food Research in Auckland, New Zealand.

Fourteen high-protein foods, mainly meat and seafood, were selected to evaluate consumers degree of liking and emotional associations to those foods. Consumers evaluated degree of liking using a fully labelled 9-point category scale with end-point anchors 1='dislike extremely' and 9='like extremely' (Peryam & Pilgrim, 1957) based on their previous consumption experience and perception of the product without food tasting. The following food products were selected by discussion with scientists from Plant and Food Research including Chinese researchers: pork belly, pork mince, lamb sausage, roasted lamb, beef steak (bloody), beef steak (internally pink), boiled chicken breast, roasted duck, stewed pigeon, steamed tofu, steamed bullfrog, steamed prawns, raw oyster and stewed carp.

Consumers evaluated each product for degree of liking followed by emotional associations using a circumplex ballot that consisted of 12 word pairs describing different feelings (Appendix 9.3). The 12 dimensions in the ballot radiated from the centre of a circle including: "Active/Alert"; "Energetic/Excited"; "Enthusiastic/Inspired"; "Happy/Satisfied"; "Secure/At ease"; "Relaxed/Calm"; "Passive/Quiet"; "Dull/Bored"; "Blue/Uninspired"; "Unhappy/Dissatisfied"; "Tense/Bothered"; and "Jittery/Nervous" (presented in a fixed clockwise order starting from 0:00/12:00). Participants were instructed to select the one dimension that best indicated how they "feel right now". As indicated by Jaeger et al. 2019, the ballot was initially derived from Yik, Russell, and Steiger (2011) and based on Russell (1980) conceptualisation of the cognitive structure of human affect and its representation in a two-dimensional space spanned by an axis of "arousal" (from activation to deactivation) and an axis of "valence" (from pleasure to displeasure). Despite eliciting a single response per respondent per sample, the circumplex ballot delivers insightful emotional product profiles (e.g. Cardello et al., 2016; Jaeger, Cardello, Cheang, et al., 2017).

Statistical Analysis

Liking scores were analysed using a linear mixed effects model including protein source as fixed effect and panellist as random effect. Emotional Circumplex data were analysed applying pairwise McNemar tests. Significance level was considered at $P<0.05$. Plots (heatmaps) were produced to show liking and emotional frequencies. Principal component analysis of centred frequencies (%) of use of emotion pairs by Chinese consumers was done using the mixOmics package version 6.6.2 (Rohart et al., 2017). All analyses were conducted using R version 3.5.1 (Team, 2018) with the "rcompanion" (Salvatore, 2019) and "predictmeans" (Dongwen et al., 2018) methods. Statistical analysis was not possible for "Blue/Uninspired", "Unhappy/Dissatisfied" and "Jittery/Nervous" as there were not enough counts (low selection by respondents) for these feeling pairs.

3.3 Business Model Canvas

The results of the online surveys were used to populate answers to the nine key areas of the Business Model Canvas. These were then refined to provide evidence of desirability, feasibility and viability for the Preliminary Value Proposition.

4 Results

4.1 Consumer Surveys

4.1.1 Frequency of meat consumption

Respondents that consumed meat once a month or less were not eligible to continue the survey. Most surveyed respondents ate lamb or beef more than twice a week indicating high frequency of red meat consumption *per capita* in all countries including New Zealand which was previously surveyed (n=113, Milestone 2 report). American participants showed a slightly higher frequency of meat consumption than those from Australia and New Zealand.
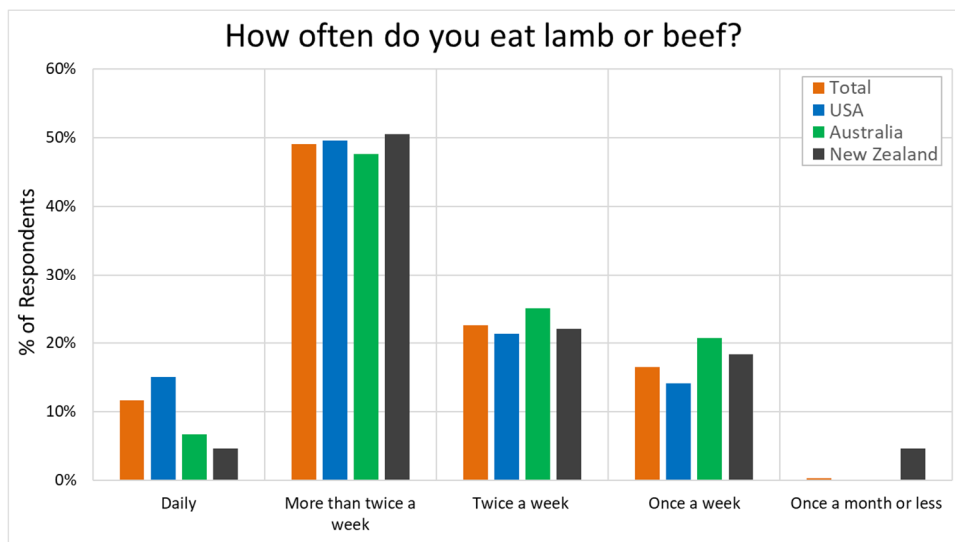
	TOTAL	USA	AUS
Once a month or less	0 (0%)	0 (0%)	0 (0%)
Once a week	249 (16%)	141 (14%)	108 (21%)
Twice a week	344 (23%)	213 (21%)	131 (25%)
More than twice a week	745 (49%)	496 (50%)	249 (48%)
Daily	185 (12%)	150 (15%)	35 (7%)

4.1.2 Wellness

4.1.2.1 Physical

Around half of the respondents rated their physical wellness as very good or good, about 40% as fair and the remaining 10% as bad or very bad, with Americans rating slightly higher good scores than Australians.
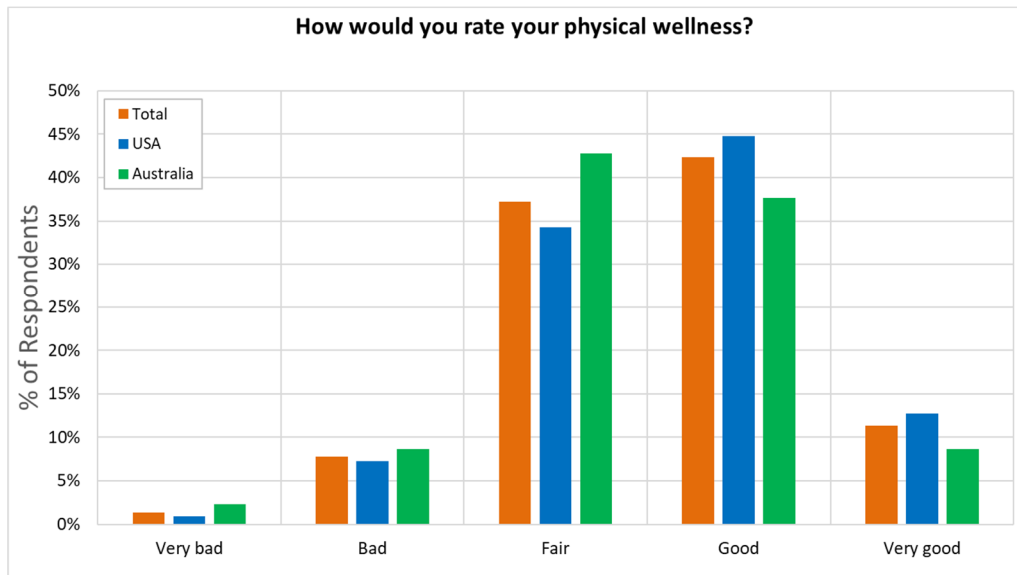
	TOTAL	USA	AUS
Very bad	21 (1%)	9 (1%)	12 (2%)
Bad	118 (8%)	73 (7%)	45 (9%)
Fair	566 (37%)	343 (34%)	223 (43%)
Good	644 (42%)	448 (45%)	196 (38%)
Very good	172 (11%)	127 (13%)	45 (9%)

Almost all American and Australian respondents were willing to improve their physical wellness.

*Do you want to improve your **physical wellness** even further? (Yes/No)*

	TOTAL	USA	AUS
Yes	1,427 (94%)	965 (97%)	462 (89%)
No	91 (6%)	35 (4%)	56 (11%)

4.1.2.2 Mental

Around 60% of respondents rated their mental wellness as very good or good followed by fair (close to 30%) and the approximate 10% balance as bad or very bad, with Americans rating slightly higher good scores than Australians.

How would you rate your mental wellness?
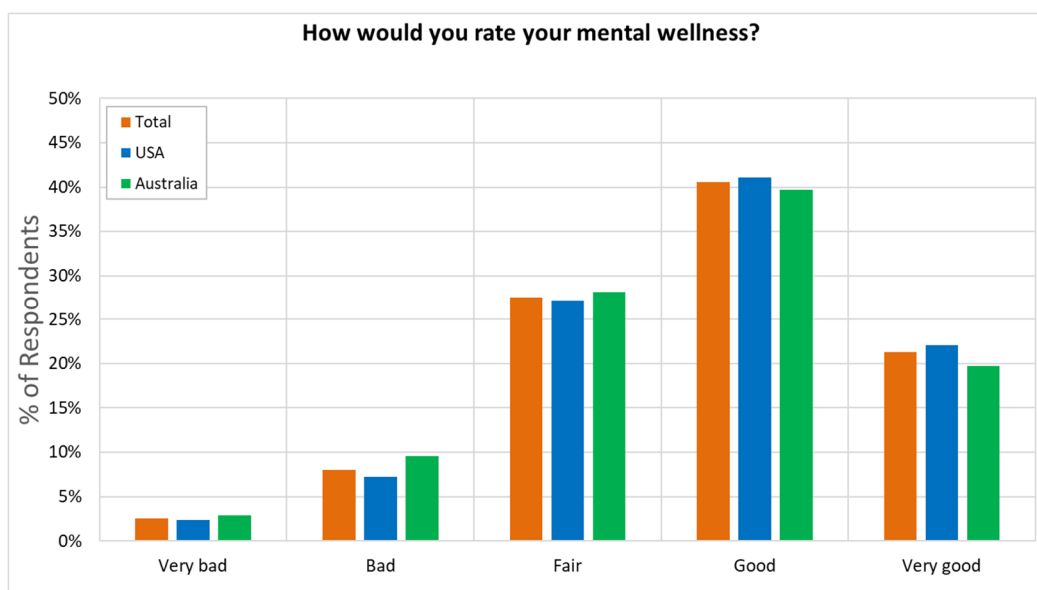
	TOTAL	USA	AUS
Very bad	39 (3%)	24 (2%)	15 (3%)
Bad	122 (8%)	72 (7%)	50 (10%)
Fair	419 (28%)	272 (27%)	147 (28%)
Good	618 (41%)	411 (41%)	207 (40%)
Very good	324 (21%)	221 (22%)	103 (20%)

Almost all American and Australian respondents were willing to improve their mental wellness.

*Do you want to improve your **mental wellness** even further? (Yes/No)*

	TOTAL	USA	AUS
Yes	1351 (89%)	923 (92%)	428 (82%)
No	170 (11%)	77 (8%)	93 (18%)

4.1.3 Wellness and Food

4.1.3.1 Physical

Most respondents were interested (mildly, moderately or very interested) in improving their physical wellness through diet with a higher interest by Americans than Australians participants (97 and 90%, respectively), while a minor percentage of participants were neutral or not interested (3 and 10%, respectively).

Would you be interested in purchasing and eating certain foods that could improve your physical wellness?
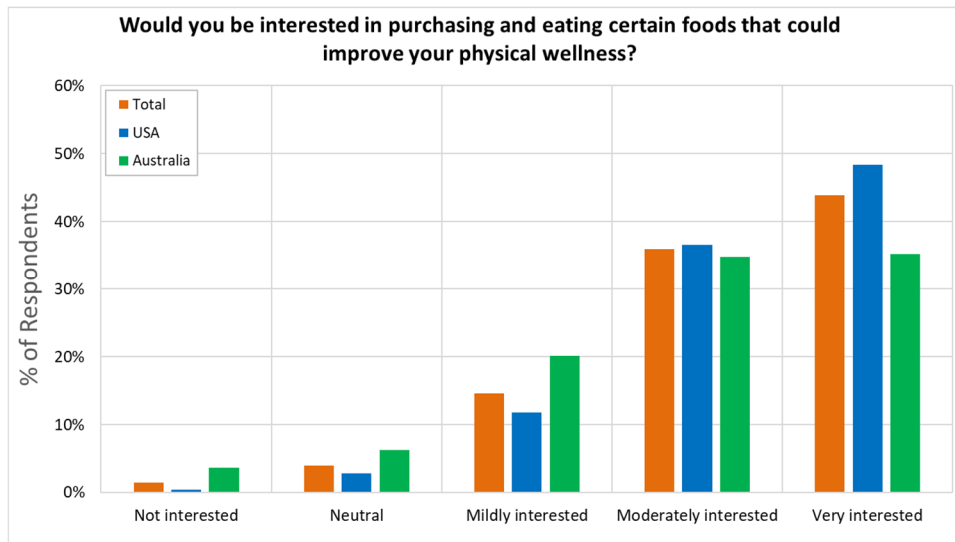
Category	TOTAL	USA	AUS
Not interested	23 (2%)	4 (0%)	19 (4%)
Neutral	61 (4%)	28 (3%)	33 (6%)
Mildly interested	223 (15%)	118 (12%)	105 (20%)
Moderately Interested	548 (36%)	366 (37%)	182 (35%)
Very interested	668 (44%)	484 (48%)	184 (35%)

4.1.3.2   Mental

Similarly, most respondents were interested (mildly, moderately or very interested) in improving their mental wellness through diet with a higher interest by Americans than Australians participants (95 and 87%, respectively), while a minor percentage of participants were neutral or not interested (5 and 13%, respectively).

Would you be interested in purchasing and eating certain foods that could improve your mental wellness?
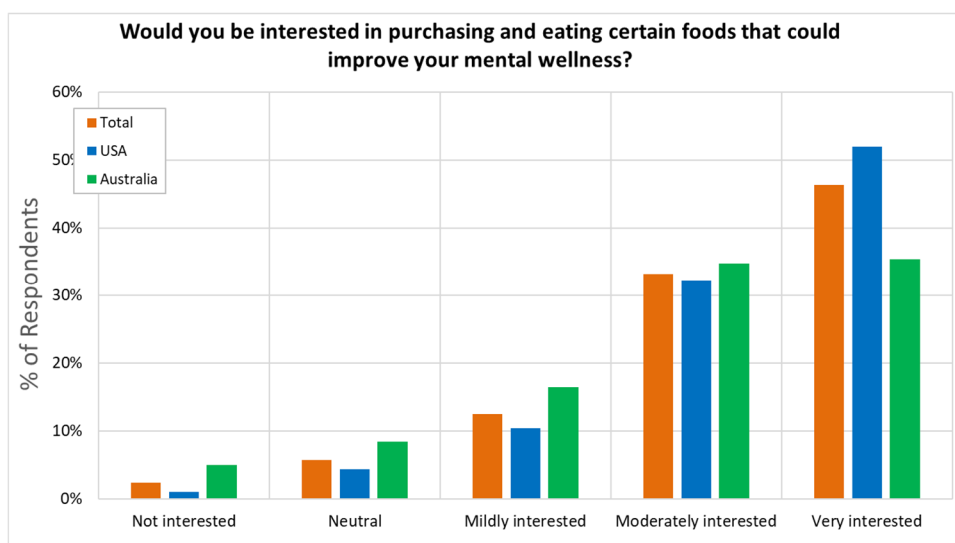
Category	TOTAL	USA	AUS
Not interested	36 (2%)	10 (1%)	26 (5%)
Neutral	87 (6%)	43 (4%)	44 (8%)
Mildly interested	190 (12%)	104 (10%)	86 (16%)
Moderately Interested	505 (33%)	323 (32%)	182 (35%)
Very interested	705 (46%)	520 (52%)	185 (35%)

The main wellness aspects that Americans would like to improve were physical energy, cognitive function, and improved mood, while Australians would like to mainly improve physical energy and joint and gut health.
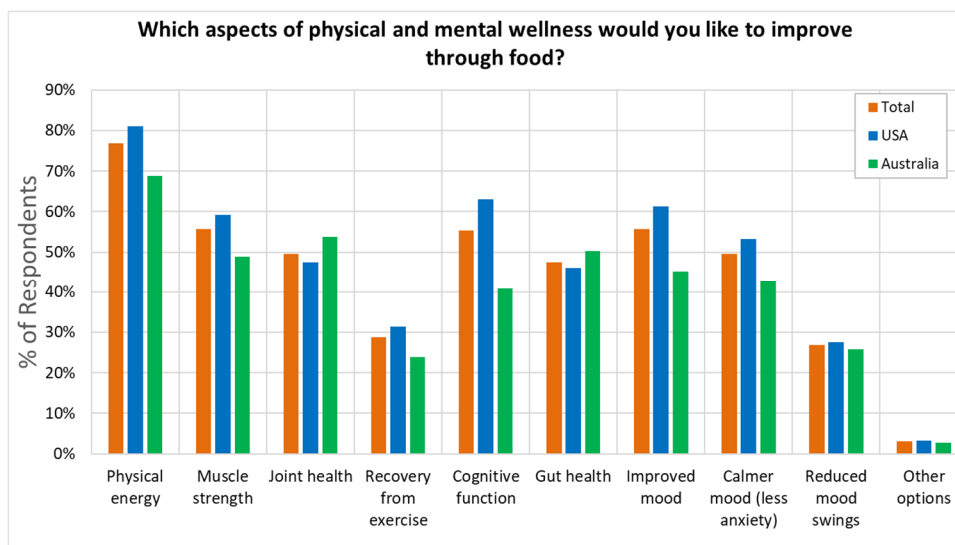
	TOTAL	USA	AUS
Physical energy	1171 (77%)	811 (81%)	360 (69%)
Muscle strength	848 (56%)	592 (59%)	256 (49%)
Joint health	756 (50%)	475 (48%)	281 (54%)
Recovery from exercise	439 (29%)	314 (31%)	125 (24%)
Cognitive function	844 (55%)	630 (63%)	214 (41%)
Gut health	723 (47%)	460 (46%)	263 (50%)
Improved mood	849 (56%)	613 (61%)	236 (45%)
Calmer mood (less anxiety)	756 (50%)	532 (53%)	224 (43%)
Reduced mood swings	410 (27%)	275 (28%)	135 (26%)
Other	46 (3%)	32 (3%)	14 (3%)

4.1.4 Wellness and Red Meat

4.1.4.1 Physical

About half of the respondents were very interested in eating red meat for improved physical wellness, around 30% were moderately interested and the rest (about 20%) were poorly or not interested. Americans showed a slightly higher interest than Australian participants.
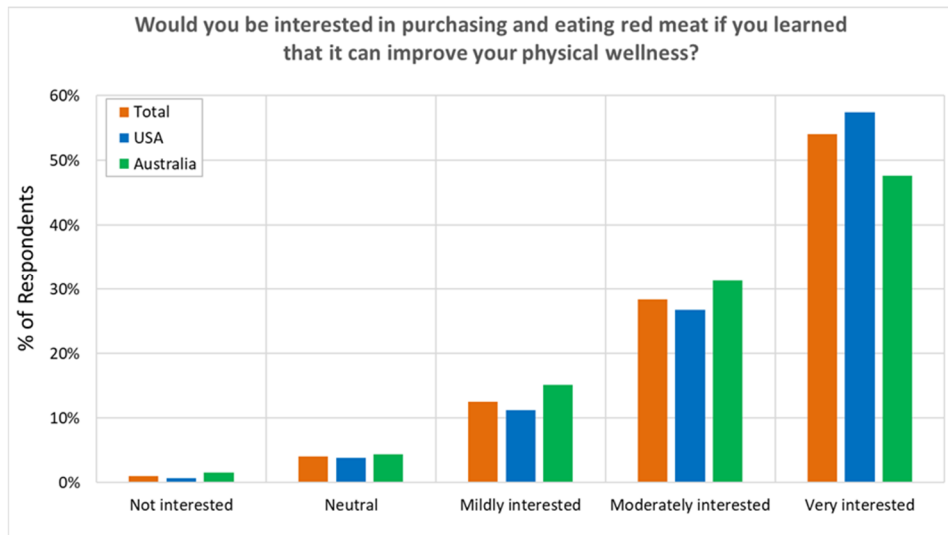
Category	TOTAL	USA	AUS
Not interested	15 (1%)	7 (1%)	8 (2%)
Neutral	62 (4%)	39 (4%)	23 (4%)
Mildly interested	191 (13%)	112 (11%)	79 (15%)
Moderately Interested	432 (28%)	268 (27%)	164 (31%)
Very interested	823 (54%)	574 (57%)	249 (48%)

About 40, 30 and 20% of respondents were willing to pay 10-25, 25-50 and 50-150% extra for a specific cut of lamb or beef with a high chance of improving their physical wellness, respectively. Americans were willing to pay more than Australian respondents for meat that could improve their physical wellness.
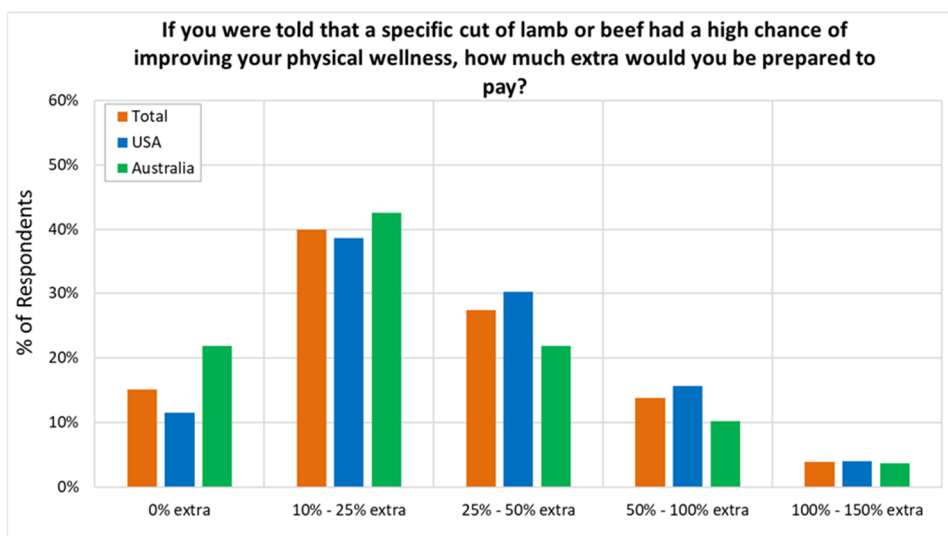
Category	TOTAL	USA	AUS
0% extra (not willing to pay more)	229 (15%)	115 (12%)	114 (22%)
10% - 25% extra (willing to pay a little more)	609 (40%)	387 (39%)	222 (42%)
25% - 50% extra (willing to pay more)	416 (27%)	302 (30%)	114 (22%)
50% - 100% extra (willing to pay up to 2 times)	209 (14%)	156 (16%)	53 (10%)
100% - 150% extra (willing to pay 2 times or more)	59 (4%)	40 (4%)	19 (4%)

4.1.4.2 Mental

About 93% of Americans and 90% of Australians were interested (mildly, moderately to very interested) in eating red meat for improved mental wellness, while 6 and 11% were neutral or not interested, respectively.
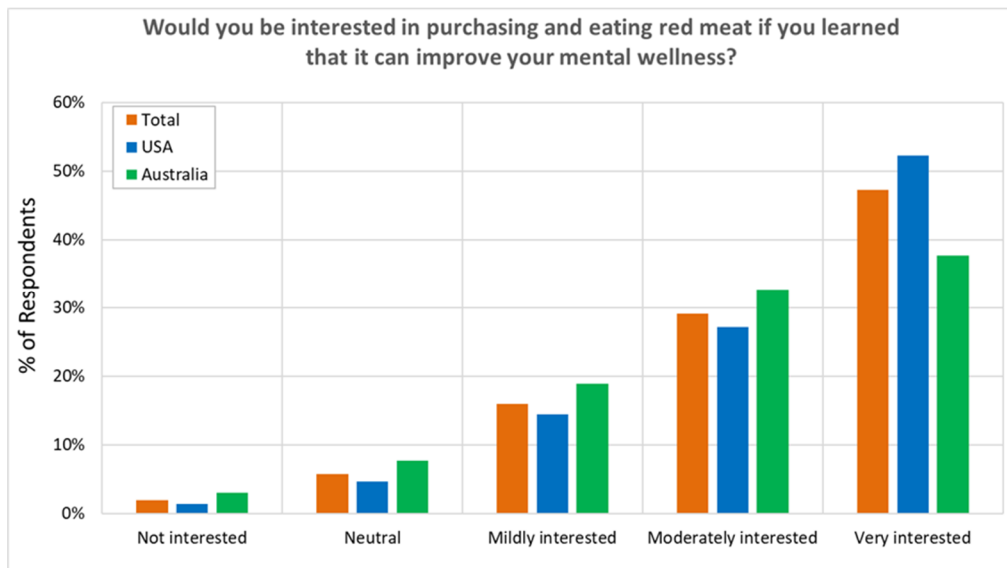
	TOTAL	USA	AUS
Not interested	30 (2%)	14 (1%)	16 (3%)
Neutral	87 (6%)	47 (5%)	40 (8%)
Mildly interested	243 (16%)	144 (14%)	99 (19%)
Moderately Interested	443 (29%)	272 (27%)	171 (33%)
Very interested	720 (47%)	523 (52%)	197 (38%)

The willingness to pay by respondents for a specific cut of lamb or beef with a high chance of improving their mental wellness was very similar to the results for physical wellness improvement above.
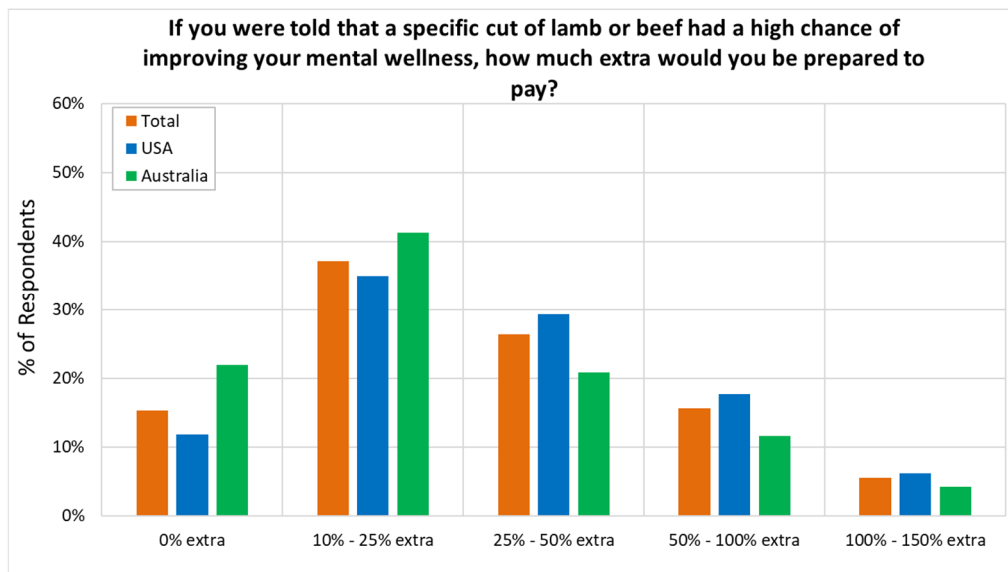
Category	TOTAL	USA	AUS
0% extra (not willing to pay more)	233 (15%)	118 (12%)	115 (22%)
10% - 25% extra (willing to pay a little more)	566 (37%)	350 (35%)	216 (41%)
25% - 50% extra (willing to pay more)	402 (26%)	293 (29%)	109 (21%)
50% - 100% extra (willing to pay up to 2 times)	238 (16%)	177 (18%)	61 (12%)
100% - 150% extra (willing to pay 2 times or more)	84 (6%)	62 (6%)	22 (4%)

4.1.5   Wellness and Red Meat - Demographics

Responses to the four questions about wellness and red meat were poorly correlated with demographic characteristics of respondents as shown by the results from canonical correlation analysis between questions and demographics below.

Two groups of respondents were considered to compare the frequencies (%) of their demographic responses according to their interest in purchasing red meat to improve their physical and mental wellness: 'Not to mildly interested' vs. 'Moderately to very interested'. Most of the frequencies of the demographic responses did not differ between the two groups of participants (see Tables in Appendix 9.3).

Canonical correlation analysis between questions and demographics:
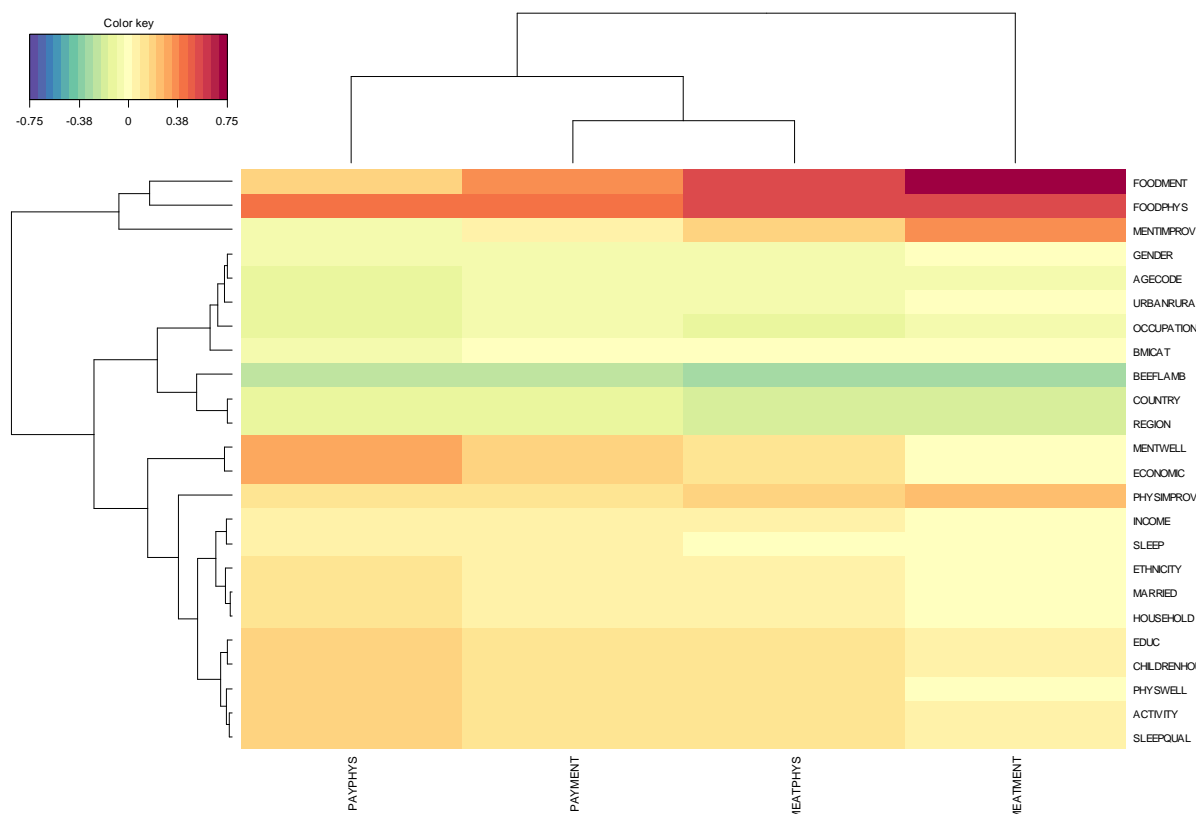
Positive correlations are displayed in red and negative correlations in blue colour. Colour intensity is proportional to the correlation coefficient.

Coding correspondence for horizontal axis (see Appendix 9.1 for full description):
PAYPHYS: If you were told that a specific cut of lamb or beef had a high chance of improving your **physical wellness**, how much extra would you be prepared to pay?
PAYMENT: If you were told that a specific cut of lamb or beef had a high chance of improving your **mental wellness**, how much extra would you be prepared to pay?
MEATPHYS: Would you be interested in purchasing and eating **red meat** if you learned that it can improve your **physical wellness**?
MEATMENT: Would you be interested in purchasing and eating **red meat** if you learned that it can improve your **mental wellness**?

Coding correspondence for vertical axis (see Appendix 9.1 for full description):
FOODMENT: Interest in purchasing and eating certain foods that could improve mental wellness, FOODPHYS: Interest in purchasing and eating certain foods that could improve physical wellness, MENTIMPROV: Willingness to improve mental wellness, GENDER: Gender, AGECODE: Age, URBANRURA: Description of living area, OCCUPATION: Occupation, BMICAT: BMI (body mass index) computed using weight and height. BEEFLAMB: Frequency of meat consumption, COUNTRY: USA or AUS, REGION: region in each country, MENTWELL: Mental wellness rating, ECONOMIC: Economic position, PHYSIMPROV: Willingness to improve physical wellness, INCOME: Income level, SLEEP: Hours of sleep per night, ETHNICITY: Ethnicity description, MARRIED: Relationship status, HOUSEHOLD: Number of people in household, EDUC: Education level, CHILDRENHOUSEHOLD: Number of children in household, PHYSWELL: Physical wellness rating, ACTIVITY: Physical activity, SLEEPQUAL: Refreshed after sleeping.

Survey Summary

The key findings of the US and AUS surveys are that most Americans (~95%) and Australians (~90%) are interested (mildly, moderately or very interested) in eating red meat for improved physical and mental wellness, and a majority (88% Americans/ 78% Australians) are willing to pay extra (most commonly 10-25%), with Americans willing to pay more (up to 50% and 100%) than Australians. Fewer other demographic variables aside from country predicted differences in purchasing and eating red meat for wellness benefits. These findings suggest that broad marketing of beef and lamb for wellness benefits could attract interest from a high proportion of Americans and Australians, with slightly more interest from people interested in improving their health or who are from higher economic or educational backgrounds. However, it is not necessary or recommended to market expressly by economic indicators as that demographic variable was poorly to modestly associated with interest in purchasing red meat for wellness benefits and the willingness to pay more.

4.2 Emotional associations to protein food sources

4.2.1 Product acceptability

The degree of liking of 14 different protein food sources rated by Chinese consumers (n=160) is shown in the Figure and Table below. Consumers have not tasted the products but have assigned liking scores based on their previous experience and perception of each product. Roasted lamb and duck showed the highest liking scores followed by steamed prawns and tofu and beef steak (internally pink), while steamed bullfrog and boiled chicken breast showed the lowest acceptability scores (< 5 which correspond to some degree of disliking). Different degrees of doneness (medium: internally pink vs. rare: bloody) were included in the product list for beef since a preliminary assessment showed that Chinese consumers rejected meat that was cooked to 'rare' degree of doneness with a 'bloody' appearance at the centre of the sample. These results also showed a clear preference of Chinese consumers for beef cooked to high (beef steaks 'internally pink', average liking score=6.8) compared with low degree of doneness (beef steaks 'bloody', average liking score=5.3).

Frequency representation of degree of liking of 14 different protein food sources by Chinese consumers (n=160).
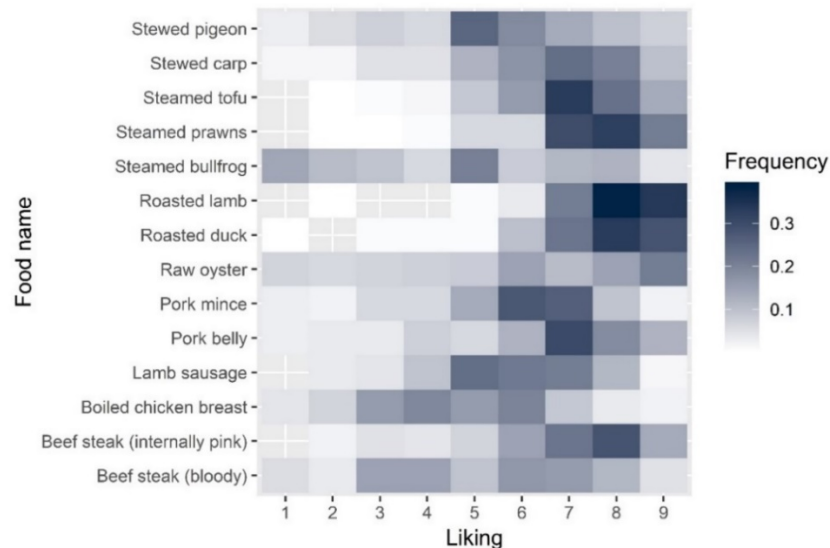
Consumer liking scores (1-9 Likert scale, 1: dislike extremely to 9: like extremely) for 14 different protein food sources by Chinese consumers (n=160).
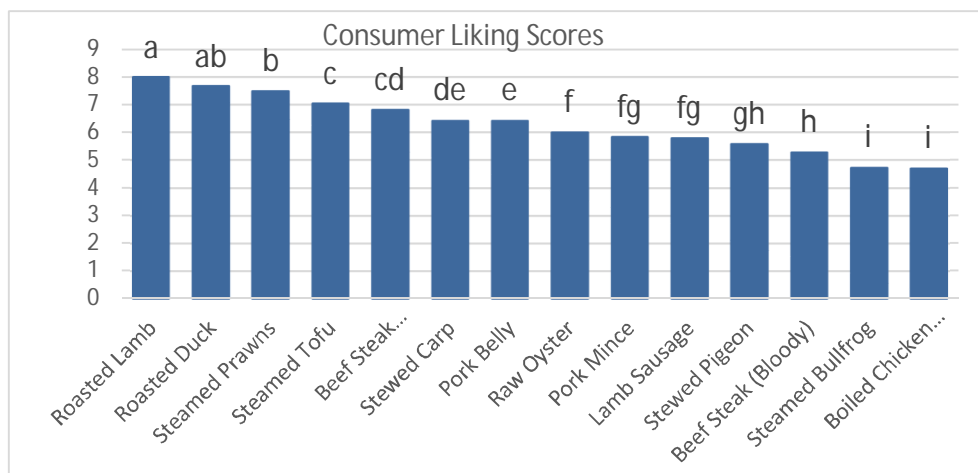
4.2.2 Emotional associations

The emotional associations to the 14 different protein food sources by Chinese consumers (n=160) are shown in the Figures and Table below. Emotional associations were well aligned with the liking scores for each of the different protein food sources. For example, roasted lamb and duck, steamed prawns and beef steak (internally pink) were mainly associated with terms linked to emotional activation and pleasure ('Active-Alert', 'Energetic-Excited', 'Enthusiastic-Inspired', 'Happy-Satisfied'), while steamed bullfrog and boiled chicken breast were associated with terms linked to displeasure and emotional activation ('Jittery-Nervous') or deactivation ('Dull-Bored' and 'Passive-Quiet'), respectively. Steamed tofu had relatively high consumer liking scores but was mainly associated with terms linked to emotional deactivation ('Secure-Ease' and 'Relaxed-Calm').

Frequency representation of emotional associations to 14 different protein food sources by Chinese consumers (n=160).
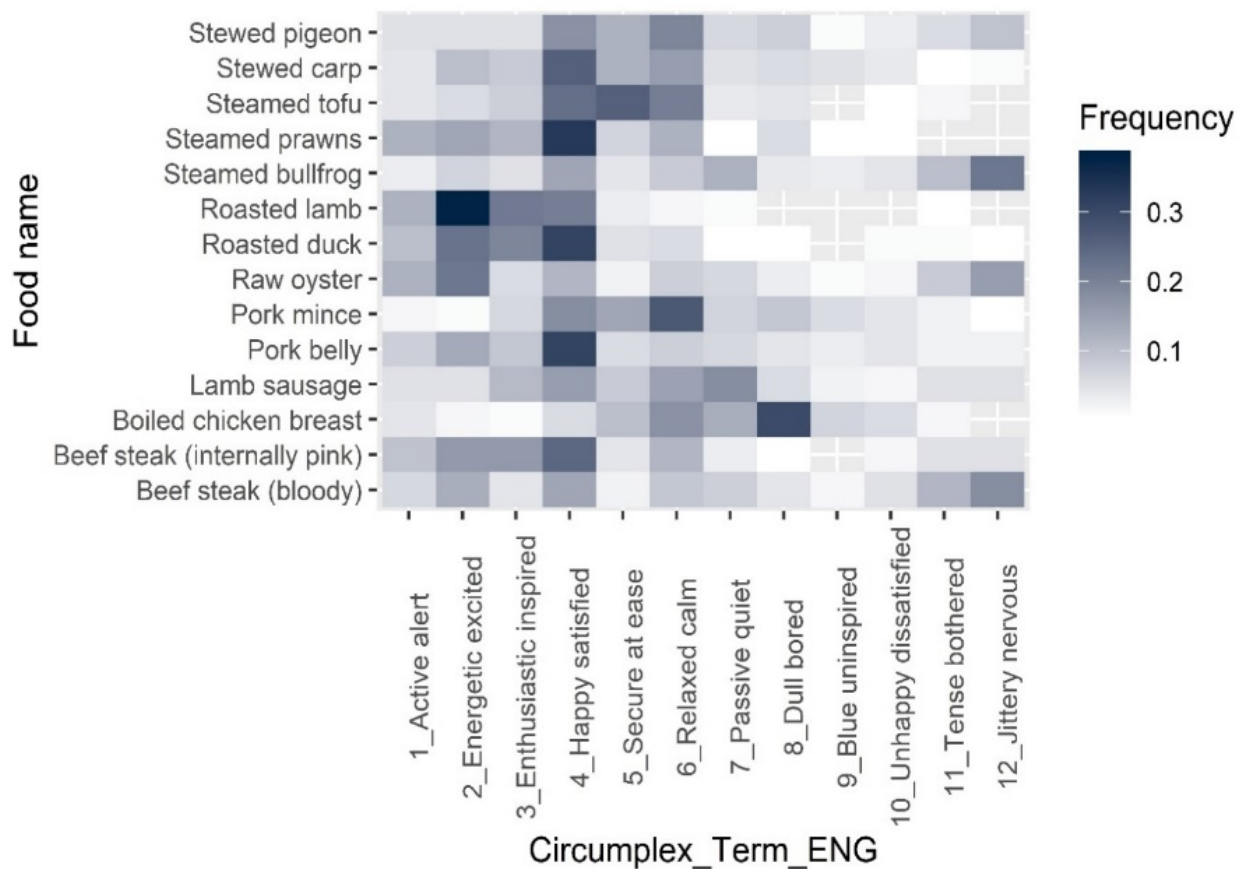
Principal Component Analysis of frequencies of emotional associations (12 pairs) by Chinese consumers (n=160) to the 14 different protein food sources.
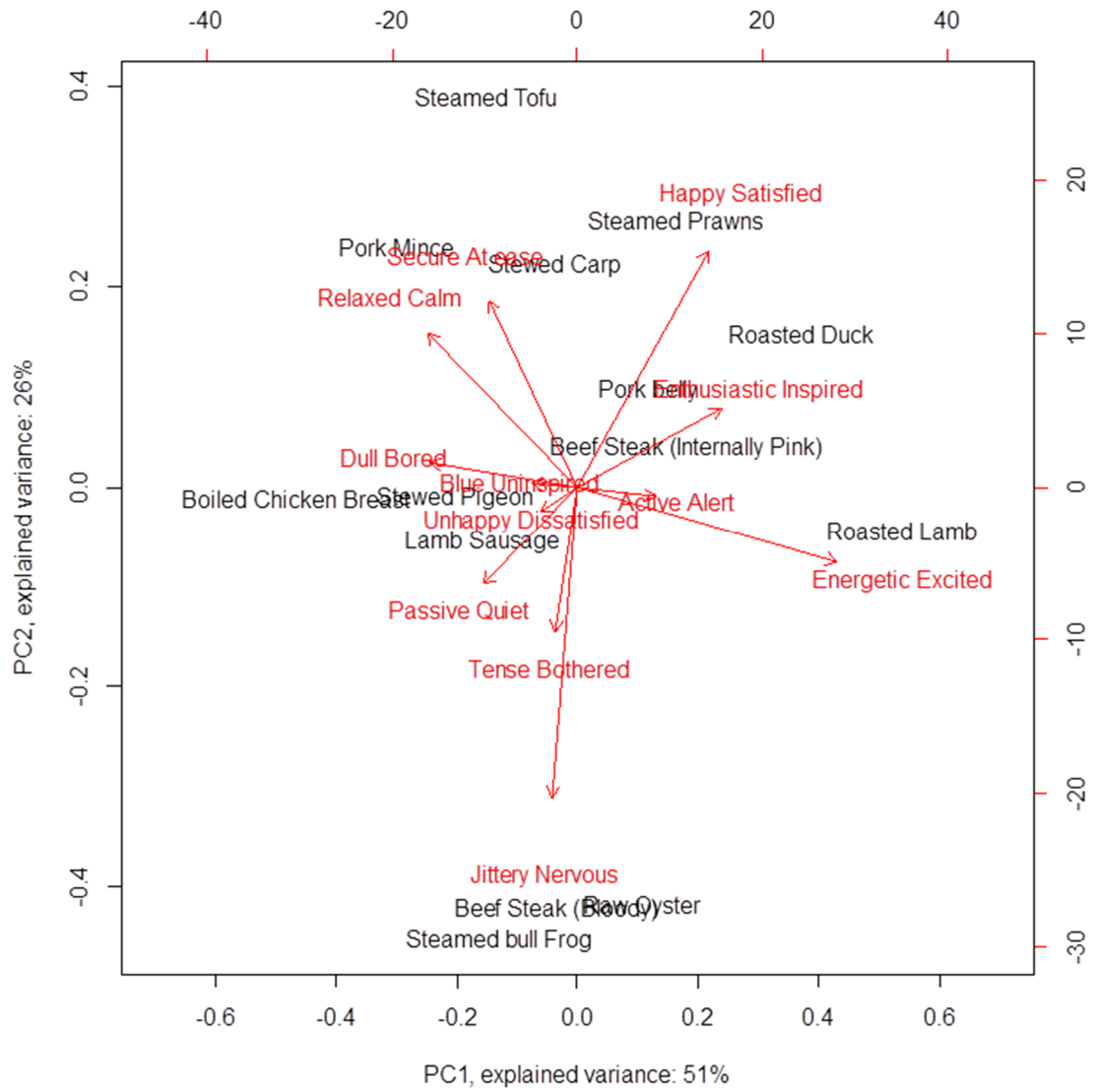
Frequency of use (%) for emotion words by Chinese consumers (n=160) for 14 different protein food sources.

Emotion Circumplex	Active Alert	Energetic Excited	Enthusiastic Inspired	Happy Satisfied	Secure At ease	Relaxed Calm	Passive Quiet	Dull Bored	Blue Uninspired	Unhappy Dissatisfied	Tense Bothered	Jittery Nervous
Beef Steak (Bloody)	7_{abc}	13_{abc}	5_{ab}	14_{ab}	3_a	9_{abc}	8_{ab}	5_{ab}	2	**5**	**12_a**	**18**
Beef Steak (Internally Pink)	10_{ab}	**16_{ade}**	**16_{cde}**	**25_{cdef}**	5_{abc}	12_{abcd}	3_{acd}	1_{cd}	0	2	5_{abcd}	5
Boiled Chicken Breast	5_{abc}	2_{fg}	1_a	6_g	10_{bcd}	18_{ade}	**13_{be}**	**30_e**	**7**	**6**	2_{bce}	0
Lamb Sausage	5_{abc}	5_{fgh}	11_{bcd}	16_{abce}	8_{abcd}	15_{abd}	**18_e**	6_a	3	2	5_{abcd}	5
Pork belly	8_{abc}	14_{abd}	9_{bc}	**31_{df}**	6_{abc}	8_{bc}	7_{ab}	5_{abc}	3	5	3_{bcde}	3
Pork Mince	2_c	1_f	7_b	18_{abce}	**14_d**	**27_e**	7_{ab}	**9_a**	**6**	5	3_{bcde}	1
Raw Oyster	**12_a**	**22_{de}**	6_{ab}	12_{ag}	3_a	8_{bc}	7_{ab}	3_{abcd}	1	2	**8_{ad}**	**16**
Roasted Duck	10_{ab}	**23_e**	**20_{de}**	**31_{df}**	5_{abc}	6_{cf}	1_c	1_{bcd}	0	1	1_{bce}	1
Roasted Lamb	**12_a**	**38_i**	**22_e**	21_{abcde}	3_a	2_f	1_{cd}	0_d	0	0	1_{be}	0
Steamed bull Frog	3_{bc}	7_{bcgh}	5_{ab}	14_{abc}	5_{ab}	8_{bc}	**12_{be}**	4_{abc}	3	**5**	10_a	**22**
Steamed Prawns	**12_a**	14_{abde}	12_{bcd}	**33_f**	7_{abcd}	12_{abcd}	1_c	6_a	1	1	0_e	0
Steamed Tofu	5_{abc}	6_{cgh}	8_{bc}	**24_{bcdef}**	**26_e**	**21_{de}**	4_{acd}	5_{abc}	0	1	2_{bce}	0
Stewed Carp	5_{abc}	10_{abch}	8_{bc}	**26_{def}**	**12_{cd}**	16_{abd}	5_{ad}	6_a	**5**	4	1_{be}	1
Stewed Pigeon	5_{abc}	5_{fgh}	5_{ab}	18_{abce}	**12_{cd}**	**20_{de}**	7_{ab}	**8_a**	1	3	**6_{acd}**	10

a,b,c,d,e,f,g,h Frequencies within a column with different letters are significantly different (P<0.05).

Pink colour represents a combination of **positive and active** feelings, **Yellow** colour represents a combination of **positive and passive/quite** feelings, **Blue** colour represents a combination of **negative and passive/quite** feelings while **Green** colour represents a combination of **negative and active** feelings.

4.3   Business Model Canvas

Key Partners	Key Activities	Value Proposition	Customer Relationships	Who will benefit?
Psychologists Consumer Scientists	Regulatory landscape	**Value Proposition** (in red)	Package information at retail	Consumers who choose meat for wellness benefits
	Intervention studies	Meat Cues: Positive impact on wellness (mood)		
Processors Butchers Retailers	Methods to measure wellness (mood)			
		What is their problem and Why?	**Channels**	88% USA 78% AUS 70% NZ
Marketing & Communications	**Key Resources** Marketing & Communications	Growing interest in mental health	Supermarkets or e-commerce	
		Willingness to improve mental wellness (improved mood, cognitive function, calmer mood-less anxiety)		
		Lack Information: Meat - Mood		

Cost Structure	Revenue Streams
Complete research Scale-up cost for an early adopter: 3-10 x research cost	41% extra for wellness benefits from meat

5   Discussion

5.1   Consumer Surveys

SURVEY HIGHLIGHTS	USA	AUS
Willingness to **improve** physical/mental **wellness**	~ 95%	~ 85%
Aspects of **wellness** to improve through **diet**	physical energy cognitive function improved mood	physical energy joint health gut health
Mildly, moderately or very interested in **red meat** for improved physical/mental **wellness**	~ 95%	~ 90%
Moderately or very interested in **red meat** for improved physical/mental **wellness**	~ 80%	~ 70%
Willingness to **pay extra** for **red meat** to improve **wellness**	~ 88%	~ 78%

Survey respondents were regular and frequent consumers of red meat in both countries with a slightly higher frequency of meat consumption in the USA. Responses from American and Australian consumers about wellness were similar, revealing a slightly higher rating and willingness to improve physical (97% vs. 89%) and mental (92% vs. 82%) wellness by American than Australian respondents. About 95% of American and 85% of Australian respondents indicated interest (mildly, moderately to very interested) in foods that could improve their physical and mental wellness. Physical energy, cognitive function and improved mood were top choice for physical and mental wellness improvement by Americans while Australians prioritized physical energy and joint and gut health.

Most American and Australian respondents were interested (mildly, moderately to very interested) in purchasing red meat for physical (95% and 94%, respectively) and mental (93% and 90%, respectively) wellness benefits. The majority of interested respondents were *moderately to very* interested. Moreover, around 84% of respondents were willing to pay more (62-69% would pay 10-50% extra while 14-20% would pay 50-150% extra) for a specific cut of lamb or beef with a high chance of improving their physical or mental wellness. Similarly, results from the previous on-line survey conducted in New Zealand indicated that most of the respondents (69%, n=113, Milestone 2 report) were willing to pay more for meat that made them feel good and improved their mood.

The data clearly shows the high importance of both physical and mental wellness for respondents and their interest in the role of food including red meat in wellness improvement. However, most demographic characteristics of respondents did not differ between those poorly or not interested (not to mildly interested) and those interested (moderately to very interested) in improving physical and mental wellness or willing to pay more for improved wellness. Thus, the data does not highlight a specific demographic of the population (e.g. menopausal women) that would be more interested in wellness improvement through meat consumption.

Healthy living has often been focused on physical wellness but there has been a recent shift in attention to mental well-being becoming a priority in many governments' agenda. According to the World Health Organization, depression is expected to become the second leading cause of disability in the world by 2020. Consumers are also shifting towards a more holistic view of health and well-being and are not only interested in looking good but also feeling good. This growing focus on mental well-being leads to behavioural changes including diet and more active lifestyles.

Red meat (such as lamb or beef) contains high amounts of protein and nutrients (iron, zinc, magnesium, B vitamins), all of which are essential for good health throughout life (FAO, 1992). These nutrients are also vital to brain function and mood. For example, there is emerging evidence showing lower incidence of depression and anxiety for people who eat recommended amounts of red meat (Baines et al. 2007, Jacka et al. 2012). Potential mechanisms linking red meat to mood have been recently reviewed (Modlinska, 2018). Some indispensable amino acids are closely linked to mood as they are precursors of neurotransmitters. Tryptophan is the precursor of serotonin linked to emotional regulation and sleep, while tyrosine is the precursor for dopamine which contributes to regulate motivation, concentration and the ability to experience pleasure (Rintamäki et al. 2011). A regular supply of indispensable amino acids through diet is needed and meat is an ideal dietary source.

Although a few correlation studies have shown a positive link between red meat consumption and better mental health, scientific evidence showing a medium-term effect of red meat consumption on mood improvement is required to support product claims and build consumer trust around claim-based labelling and branding. A full review of the literature is required to determine whether intervention studies exist to show a causal link between meat consumption and mood improvement. If no such research has been done, then supporting evidence can be generated by conducting interventions studies to test the effects of eating red meat on mood over a period of time. Furthermore, the potential mood benefits depending on the type and quality of meat (fresh vs. processed, different cuts, grass-fed vs. grain-fed) should be explored under the hypothesis that the higher the nutritional value of meat, the higher the impact on mood improvement.

This cutting-edge research would provide the meat industry a better understanding of the issues around mental wellness and the potential of red meat to prevent and mitigate them, while fitting into consumers' lifestyle changes. A literature review is the next feasible step in this research program. Depending on the results of that literature review, intervention research may be warranted. Intervention research would require more resources including a multidisciplinary team involving psychologists, nutritionists, doctors, consumer and meat scientists and representatives of the meat sector. However, the increased focus of consumers on mental wellness and their significant willingness to pay more for improved mood through nutrition highlights a unique opportunity to position meat outlining features that support improved mental health. Packaging meat featuring perceived mood improvement nutrients represents a revolutionary concept that resonates with consumer trends around mental health.

5.2   Emotional associations to protein food sources

Current marketing is looking into developing emotional connections with their brands. Marketing expert Duncan (2010), summed the concept as 'Creating loyalty beyond reason requires emotional connections that generate the highest levels of love and respect for your brand'. A recent study (Maddock and Hill 2016) looked at how food advertising utilises and implies different associations between food and mood. The study found a clear dominance of positive emotional appeals and from a series of food advertisements (n=37), almost 2/3 emphasised emotion suggesting happiness, tradition, glamour, indulgence, and only 1/3 of the advertisements emphasised information about nutritional benefits, taste or culinary facts. An example of emphasis on emotion is the Tim Tam Brand that 'gives you ripples of happiness in every bite, for the perfect chocolate experience, for young females who treat and indulge themselves…'. Another example is the Moo-Phoria Collection by Ben&Jerrys icecream playing with words to imply indulgence and mood enhancement. A savory example is Dr. Oetker Pizza, where the hedonic experience is presented at the front of the package with language of romance and indulgence suggesting immediate gratification, while the convenience aspect is relegated to the back of the package.

Traditional product-focused consumer research involves evaluation of hedonic and sensory responses that provide meaningful product insights. More recently, additional product insights are gained by obtaining more information from consumers by combining acceptability measures with other responses such as sensory perceptions (Lawless and Heymann 2010), emotional associations (Jaeger *et al.* 2019), attitudes (Ng *et al.* 2013) or situational appropriateness (Giacalone *et al.* 2015). The link between sensory experiences and emotional states during food consumption has been established for diverse foods (beer: Cardello et al. 2016, Jaeger et al. 2017a; chocolate: Jaeger et al. 2017b, Gunaratne et al. 2019; spiced extruded snacks: Bell et al. 2017; fruit-flavoured liqueurs: Porcherot et al. 2015).

Emotional responses were analysed in the current study to see if approaches developed for other foods would be valuable in the meat context and provide insightful emotional meat profiles. Roasted lamb had the highest liking scores of all 14 protein food sources and was mainly associated by Chinese consumers with 'Energetic-Excited', 'Enthusiastic-Inspired', 'Happy-Satisfied' and 'Active-Alert' emotion pairs in decreasing order. Similarly, beef steak (internally pink) which was also highly rated in liking scores (5th out of 14 products) was mainly linked to 'Happy-Satisfied' followed by 'Energetic-Excited' and 'Enthusiastic-Inspired' emotion pairs. The results also showed a clear

preference of Chinese consumers for beef cooked to high (beef steaks 'internally pink') compared with low degree of doneness, as indicated by the significantly lower liking scores and high frequency of 'Jittery-Nervous' and 'Tense-Bothered' emotion pairs for beef steaks with a 'bloody' appearance.

It is interesting to note that protein food products like steamed tofu which was rated 4th out of 14 products in liking scores, was mainly associated with positive but deactivation emotional profile ('Secure-Ease', 'Happy-Satisfied' and 'Relaxed-Calm') as oppose to high emotional activation profile for red meat. Some food products showed divergent emotional profiles as raw oysters, which were mainly associated with 'Jittery-Nervous' and 'Tense-Bothered' but also with 'Energetic-Excited' and 'Active-Alert'. Some consumers showed high degree of liking for raw oysters while others clearly disliked the product reflecting a controversial emotional profile for this protein source. The lowest liking scores were assigned to boiled chicken breast which was mainly associated with 'Dull-Bored', 'Relaxed-Calm' and 'Passive-Quiet' emotion pairs as it would be expected from dry and relatively flavourless poultry breast.

Results from this preliminary study indicate that developed techniques that measure emotional responses to other foods can be implemented in the meat context to gain additional product insights beyond consumer liking. The emotional circumplex approach provided insightful meat profiles showing clear association of red meat (roasted lamb and beef steak-internally pink) with emotional activation and pleasure, mainly 'Energetic-Excited', 'Enthusiastic-Inspired' and 'Happy-Satisfied'. In contrast, other food protein sources were dominated by emotional deactivation like steamed tofu ('Secure-Ease' and 'Relaxed-Calm') and boiled chicken breast ('Dull-Bored' and 'Passive-Quiet') or emotional activation with displeasure like steamed bull frog, raw oyster and beef steak-bloody ('Jittery-Nervous' and 'Tense-Bothered').

Jaeger et al. (2019) evaluated supplementing hedonic and sensory consumer research on beer with cognitive and emotional measures and indicated that each response type (hedonic, sensory, emotional and cognitive) provided different insights, which, when combined, resulted in in-depth sample characterisation and discrimination. Other studies have shown that emotion can be robustly measured with validated questionnaires such as EsSence™ (Samant et al. 2017; Schouteten et al. 2018), ScentMove™ (Porcherot et al. 2015) and Visual Analogue Mood Scales (Porcherot et al. 2015). Objective physiological measures such as body temperature, electrical conductance of the skin, eye movements and heart rate can also indicate emotional state (Fuentes et al. 2015; Lagast et al. 2017; Kantono et al. 2019), as can micro-movements of the eyes and face (Mojet et al. 2015; Kostyra et al. 2016; Samant et al. 2017).

Reported successful approaches to measure emotional responses to other foods, the limited information available for red meat and the potential for gaining a deeper understanding of consumers' product experiences support the need for future work exploring emotional associations during meat consumption.

5.3   Business Model Canvas

5.3.1   Who will benefit?
Over 90% of respondents to the on-line surveys (n=1,523) in USA and Australia indicated they were interested (mildly, moderately or very interested) in purchasing and eating red meat that would

improve their physical or mental wellness. This highly significant result seems to be a population statistic as the survey results do not indicate a specific demographic that would be significantly more interested in wellness improvement through meat consumption.

5.3.2 What is their problem and why is it an issue for them?

Over 90% of respondents to the on-line surveys (n=1,523) were somewhat dissatisfied with their wellness by indicating their willingness to improve their physical and mental wellness. The World Health Organization highlighted depression as the second leading cause of disability in the world by 2020. Consumers are shifting towards a more holistic view of health with growing focus on mental wellness. This was reflected in the survey results by the combination of top five areas that respondents (n=1,523) sought improvement as physical energy (77%), improved mood (56%), muscle strength (56%), cognitive function (55%), joint health (50%) and calmer mood/less anxiety (50%).

The landscape of consumer health and nutrition is rapidly changing with large amounts of easily available information and consumers looking to make changes to their healthcare pursuing more natural choices. For example, stress and anxiety traditionally treated with medicines may now be focused on dietary and lifestyle changes to prevent and deal with this problem. Survey results indicated significant desirability of consumers to purchase meat for mental wellness improvement. However, there is currently no information available to consumers, either at retail or via a website, about the link between meat and wellness-mood benefits.

5.3.3 Customer relationships

Customers would typically purchase these products from retail or wholesale suppliers. This means that specific information about meat cues that improve wellness (mood) would have to be available on the packaging (e.g. label information, picture) or via a website that allows consumers to select their cuts based on their mood/emotions.

5.3.4 Supply channels

Supply channels would typically be via supermarkets where consumers choose meat cuts using intrinsic and extrinsic meat cues available at the point of purchase or e-commerce where clients can enter their requirements and suppliers can provide them with the specific cuts and portion size that meet their needs. This information would be fed back to meat processors and ultimately producers.

5.3.5 What research needs to be undertaken and how novel is it?

The next phase of the project will be to undertake a literature and regulations review to identify publications that provide evidence of a causal link between red meat consumption and mental wellness benefits. The expectation is to find at least one publication based on a randomised control trial that would form the basis for a mental health claim. Once this has been identified, the project could progress with the development and trial marketing of at least one product that could validate this concept. The review of regulations will help determine what evidence is needed to make a health claim for mental benefits. Current regulations for claiming physical health benefits could be applied in a similar fashion to mental health benefits.

Once the literature and regulations reviews are completed, it would become clearer if evidence-based claims about mental health benefits and meat consumption can be done with current published information. If there is lack of strong published evidentiary base, researchers would need

to set up, carry out and publish the results of a randomised control trial (intervention study) that aims to determine causality. Furthermore, the potential mood benefits depending on the type and quality of meat should be explored under the hypothesis that the higher the nutritional value of meat, the higher the impact on mood improvement.

The link between sensory experiences and emotional states during meat consumption is another research area to be developed for obtaining more information from consumers and gaining additional product insights to support consumer-driven new product development and marketing. The results from applying the Emotional Circumplex approach to the meat context provided insightful emotional profiles aligned to liking scores for a range of protein sources.

The link between mental wellness benefits and regular inclusion of red meat in the diet and emotional responses of consumers during meat consumption represent new areas of research in Meat Science. This cutting-edge research would provide the meat industry a unique opportunity to position meat outlining features that support improved mood and mental health. Meat merchandising based on improved wellness (mood) beyond eating quality profile (tenderness, flavour, juiciness) is a revolutionary concept.

5.3.6 What needs to sit around the research to make it adoptable?
Most demographic characteristics of respondents did not differ between those poorly or not interested and those interested in improving and paying more for enhanced mental wellness. Results suggest (n=1,523) that broad marketing of beef and lamb for wellness benefits could appeal to over 90% of consumers, especially people interested in improving their health or who are from higher economic or educational backgrounds. However, it is not recommended to market expressly by economic or educational indicators as they were only weakly associated with interest in purchasing red meat for wellness benefits.

Research showing positive links between regular red meat consumption and improved mental wellness-mood will require Marketing & Communications to develop a broad merchandising system based on key messages from research including, for example, informative packaging. Consumer education and marketing approaches can be tested with some early adopters.

5.3.7 Who would we need to work with to adopt the solution?
The research team together with MDC/MLA will need to work with Marketing & Communications and key supply chain participants, psychologists, consumer and meat scientists, marketers, processors, butchers and retailers to develop a strategy and tactics for developing appropriate beef and lamb information packages related to physical and mental wellness (mood) benefits.

5.3.8 How much could be gained from the solution if others adopted it (time/$/growth/trust)?
Based on the responses gathered through the on-line surveys conducted to date, the average premium that 85% of respondents were prepared to pay for red meat that had a high chance of improving their physical or mental wellness was 38% and 41%, respectively.

5.3.9 What is the cost to undertake the research + cost to scale?
Typically, the cost to scale is between 3 and 10 times the research cost, which is difficult to estimate at this early stage of the project.

5.3.10 Desirability

With over 90% of our on-line survey respondents (n=1,523) indicating they were interested (mildly to very interested) in purchasing and eating red meat that would improve their physical or mental wellness, the desirability of this concept has been proven.

5.3.11 Feasibility

This is a very exciting new area of research in meat science which seems to have significant potential. There is considerable research to be undertaken to better understand the link between meat nutrients and mental wellness. As this relationship is better understood, the marketing messaging will be key to the overall success.

5.3.12 Viability

85% of the on-line survey respondents (n=1,523) indicated they were willing to pay more for red meat that had a high chance of improving their physical or mental wellness, with an average margin of 38% and 41%, respectively. The key to viability will be to differentiate this new product via effective marketing and communication linking meat by cut with improved mental and physical wellness.

It will be important to ensure that all supply chain participants, especially producers, are able to benefit from the additional returns that should be available, once products using this concept are on the market.

6   Conclusions/recommendations

Survey results confirm the **desirability** of the concept that red meat can have a positive impact on wellness (mood) and consumers are willing to pay more for those benefits. Over 90% of respondents to the on-line surveys (n=1,523, USA plus AUS) indicated they were interested in purchasing and eating red meat that would improve their physical or mental wellness. In addition, 85% indicated they were willing to pay more for red meat that would provide physical or mental wellness benefits, with an average margin of 38% and 41%, respectively, supporting the **viability** of this concept.

The **feasibility** of the value proposition relies on available and credible evidence that meat consumption results in mental health benefits. A systematic review of literature focused on intervention research and regulatory aspects is recommended to understand if current information supports evidence-based claims around red meat and wellness (mood) benefits. A lack of suitable information would indicate that intervention trials would be needed to provide evidence for claimed wellness benefits from red meat consumption.

Additional product insights to support consumer-driven new product development and marketing can be obtained by combining emotional with hedonic and sensory responses of consumers to red meat. Results from applying an emotional circumplex approach to a Chinese consumer panel (n=160) provided insightful meat profiles.

Meat Standards Australia has successfully outlined pathways based on meat cues and sensory traits that can produce predictable red meat eating profiles for different cut and cook methods. Meat cues beyond tenderness, flavour and juiciness involving wellness benefits (nutrition, functionality,

mood, mental health) would perceive a premium if carcasses were mapped and fabricated based on wellness cues to suit increasingly complex consumer choices.

Innovative advances addressing concomitant and longer-term wellness (mood) benefits from red meat consumption represent cutting edge areas in Meat Science with considerable research efforts to be undertaken. Positive outcomes would provide the industry a unique opportunity to position meat outlining features that support improved mood and mental health, resonating with consumers' growing interest in mental wellness.

7 Key messages

Consumers are shifting towards a more holistic view of health with growing focus on mental wellness. Consumer surveys (New Zealand: n=113, Australia: n=523 and USA: n=1,000) strongly indicated their interest in red meat consumption to improve wellness (mood) and that they are willing to pay more for meat cuts that provide those benefits. Providing credible evidence that meat consumption can result in immediate and/or longer-term wellness (mood) benefits would represent a major opportunity to create and capture more value for the red meat industry. Once the role of red meat in improving mental wellness is better understood, the key to viability will be to differentiate this value proposition through effective marketing and communication.

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9 Appendix

9.1 Survey questions

Red Meat and Consumer Wellness Study

How often do you eat lamb or beef?

1. Daily
2. More than twice a week
3. Twice a week
4. Once a week
5. Once a month or less

If response is once a month or less, not eligible to continue.

If response is once a week or more then continue.

WELLNESS, HEALTH, AND MOOD MEASURES

First, we would like to know about your health.

SLEEP

In a typical week, how many hours did you usually sleep per night? **[SLEEP].**

Response options: 0-20 hours (in half hour increments).

When you wake up from sleeping, how refreshed do you feel? **[SLEEPQUAL]**

Never refreshed	A little or Somewhat refreshed	Moderately refreshed	Mostly refreshed	Very refreshed
0	1	2	3	4

EXERCISE

In a typical week, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places but should not include housework or physical activity that is part of your job.

Response options:

[0] 0 days a week

[1] 1 day a week

[2] 2 days a week

[3] 3 days a week

[4] 4 days a week

[5] 5 days a week

[6] 6 days a week

[7] 7 days a week

ATTENTION

This question is checking that you are paying attention to the questions, so please pay close attention. To show that you have read these instructions, please select the answer '8 days per week' for the following question. How many days in a week do you drink **coffee**?

Response options: 0 days per week to 8 days per week

- *If 8 days per week is not selected, survey is terminated.*

What is your weight?

_____ *kg or* _____ *lbs.*

[pull down menu 25 kg to 150 kg]

[pull down menu 50 lbs. to 300 lbs.]

What is your height?

_____ *cm or* _____ *ft.*

[pull down menu 120 cm to 215 cm]

[pull down menu 3"11' feet/inches to 7"0' feet/inches

From this, **BMI** (body mass index) was computed.

-next page-

Wellness is defined as being healthy in body and mind, especially as the result of deliberate effort.

For example, someone with *physical wellness* is healthy for their age and strives to make healthy lifestyle choices (e.g., through diet, physical activity, or sleep, etc.). Someone with *mental wellness* is happy in their life, experiences more positive than negative moods, and strives to maintain this

outlook (e.g., through setting goals, socialising, exercising, meditating, or other activities that improve mood).

How would you rate your **physical wellness**? Would you say it is:

> 5. Very good
>
> 4. Good
>
> 3. Fair
>
> 2. Bad, or
>
> 1. Very bad

Do you want to improve your **physical wellness** even further?

> Yes (1)
>
> No (0)

How would you rate your **mental wellness**? Would you say it is:

> 5. Very good
>
> 4. Good
>
> 3. Fair
>
> 2. Bad, or
>
> 1. Very bad

Do you want to improve your **mental wellness** even further?

> Yes (1)
>
> No (0)

Many people know that the foods they eat can impact physical wellness, but fewer people know that foods can impact mental wellness (e.g., by improving mood or reducing mood swings). Here, we would like to know your interest in eating foods based on your wellness benefits.

Would you be interested in purchasing and eating certain foods that could improve your **physical wellness**?

> 5. Very interested
>
> 4. Moderately interested
>
> 3. Mildly interested
>
> 2. Neutral
>
> 1. Not interested

Would you be interested in purchasing and eating certain foods that could improve your **mental wellness**?

    5. Very interested

    4. Moderately interested

    3. Mildly interested

    2. Neutral

    1. Not interested

Which aspects of **physical and mental wellness** would you like to improve through food? [Tick all that apply]

☐ Physical energy   ☐ Improved mood

☐ Muscle strength   ☐ Calmer mood (less anxiety)

☐ Joint health   ☐ Reduced mood swings

☐ Recovery from exercise   ☐ Other

☐ Cognitive function

☐ Gut health

-next page-

Red meat (such as lamb or beef) contains high amounts of protein and nutrients (iron, zinc, magnesium, B vitamins), all of which are essential for good health throughout life (FAO, 1992). These nutrients are also vital to brain function and mood. For example, there is emerging evidence showing lower incidence of depression and anxiety for people who eat recommended amounts of red meat (Baines et al. 2007, Jacka et al. 2012).

Would you be interested in purchasing and eating **red meat** if you learned that it can improve your **physical wellness**?

    5. Very interested

    4. Moderately Interested

    3. Mildly interested

    2. Neutral

    1. Not interested

If you were told that a specific cut of lamb or beef had a high chance of improving your **physical wellness**, how much extra would you be prepared to pay?

100% - 150% extra (willing to pay 2 times or more)
50% - 100% extra (willing to pay up to 2 times)
25% - 50% extra (willing to pay more)
10% - 25% extra (willing to pay a little more)
0% extra (not willing to pay more)

Would you be interested in purchasing and eating **red meat** if you learned that it can improve your **mental wellness**?

5. Very interested

4. Moderately Interested

3. Mildly interested

2. Neutral

1. Not interested

If you were told that a specific cut of lamb or beef had a high chance of improving your **mental wellness**, how much extra would you be prepared to pay?

100% - 150% extra (willing to pay 2 times or more) [5]
50% - 100% extra (willing to pay up to 2 times) [4]
25% - 50% extra (willing to pay more) [3]
10% - 25% extra (willing to pay a little more) [2]
0% extra (not willing to pay more) [1]

DEMOGRAPHIC CHARACTERISTICS

Lastly, we would like to ask you some demographic questions.

What is your year of birth?

Drop down menu (birthdates should be in reverse order like this)

1930 or earlier
1931
1932
1933
...
2000
2001
2002
2003
2004 or later

Year of birth used to compute:

Age of participant, from 18 to 88 years old

Age category of participant:

       18-24 years old

       25-34 years old

       35-44 years old

       45-54 years old

       55-64 years old

       65 or older

What is your gender?

Male   ☐
Female   ☐

How would you describe your ethnicity?

Ethnicity category of participant:

1	=	White (Caucasian/White/European/Australian European, etc.)
2	=	Black (African/Black/African-American/African British)
3	=	Asian
4	=	Latino (Hispanic/Latino/Spanish)
5	=	Mixed (Selection of two or more categories)
6	=	Other (all remaining least common ethnicities)

Which of the following best describes the area you live in?

_0_ Urban

_1_ Suburban

_2_ Rural

_3_ Unsure – please describe (Free Text)

Are you currently married or in a domestic partnership?

0 No, 1 Yes

How many people live in your household (yourself included)?   _ _

How many children live in your household by age?

    0 No = no children currently in household

    1 Yes = children currently in household (one or more)

Please describe your level of education:

___1___ Did not complete high school
___2___ Completed high school
___3___ Currently attending University, Polytechnic, or other tertiary institution for
        undergraduate degree
___4___ Completed undergraduate degree at University, Polytechnic or other tertiary institution.
___5___Currently attending University, Polytechnic, or other tertiary institution for higher degree
___6___ Completed higher degree at University, Polytechnic or other tertiary institution

What is your occupation?

Occupation category of participant:

1	=	Professional
2	=	Administrative/Office
3	=	Sales/Service
4	=	Technical
5	=	Trades/Laborer
6	=	Retired
7	=	Homemaker
8	=	Student
9	=	Unemployed/Disabled
10	=	Multiple
11	=	Other

Which of these income levels best represents your combined household income per annum?

☐ Less than $25,000 [1]

☐ $25,001 to $40,000 [2]

☐ $40,001 to $55,000 [3]

☐ $55,001 to $70,000 [4]

☐ $70,001 to $100,000 [5]

☐ $100,001 to $150,000 [6]

☐ More than $150,000 [7]

How would you describe your current economic position (indicate the box that best reflects your situation)?

1	2	3	4	5	6	7

Difficult   Wealthy

What region of the country do you live in?

For American sample

[1] ☐ Midwest - IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI

[2] ☐ Northeast - CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT

[3] ☐ Southeast - AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV

[4] ☐ Southwest - AZ, NM, OK, TX

[5] ☐ West - AK, CA, CO, HI, ID, MT, NV, OR, UT, WA, WY

For Australian sample

[6] ☐ New South Wales

[7] ☐ Northern Territory

[8] ☐ Queensland

[9] ☐ South Australia

[10] ☐ Tasmania

[11] ☐ Victoria

[12] ☐ Western Australia

9.2 Demographic characteristics of respondents

Summary of demographic characteristics of all respondents and by country (USA and AUS).

	TOTAL	USA	AUS
N	1,523	1,000	523
Gender (%)			
Female	767 (50%)	520 (52%)	247 (47%)
Male	756 (50%)	480 (48%)	276 (53%)
Age (%)			
18-24	186 (12%)	104 (10%)	82 (16%)
25-34	494 (32%)	402 (40%)	92 (18%)
35-44	343 (23%)	260 (26%)	83 (16%)
45-54	210 (14%)	130 (13%)	80 (15%)
55-64	165 (11%)	82 (8%)	83 (16%)
65 or older	125 (8%)	22 (2%)	103 (20%)
Ethnicity (%)			
White (Caucasian / White / European / Australian European, etc)	1121 (74%)	692 (69%)	429 (82%)
Black (African / Black / African-American / African British)	93 (6%)	89 (9%)	4 (1%)
Asian	110 (7%)	65 (7%)	45 (9%)
Latino (Hispanic/Latino/Spanish)	83 (5%)	80 (8%)	3 (1%)
Mixed (selection of 2 or more categories)	69 (5%)	56 (6%)	13 (2%)
Other (all remaining least common)	47 (3%)	18 (2%)	29 (6%)
Area (%)			
Urban	119 (23%)	317 (32%)	436 (29%)
Suburban	308 (59%)	508 (51%)	816 (54%)
Rural	95 (18%)	175 (18%)	270 (18%)
Unsure	1 (0%)	0 (0%)	1 (0%)
Married (%)			
No	643 (42%)	434 (44%)	209 (40%)
Yes	877 (58%)	563 (56%)	314 (60%)
Number of people in Household (%)			
1	253 (17%)	175 (18%)	78 (15%)
2	411 (27%)	236 (24%)	175 (34%)
More than 2	842 (56%)	581 (59%)	261 (51%)
Children (%)			
No	898 (59%)	569 (57%)	329 (63%)
Yes (one or more)	625 (41%)	431 (43%)	194 (37%)
Education (%)			
Not Completed High School	62 (4%)	2 (0%)	60 (11%)
Completed High School	411 (27%)	245 (25%)	166 (32%)
Undergraduate degree student	155 (10%)	92 (9%)	63 (12%)
Completed Undergraduate degree	532 (35%)	387 (39%)	145 (28%)
Higher Degree Student	60 (4%)	46 (5%)	14 (3%)
Completed Higher Degree	302 (20%)	228 (23%)	74 (14%)
Occupation (%)			
Professional	364 (24%)	274 (27%)	90 (17%)
Administrative/Office	215 (14%)	159 (16%)	56 (11%)

|			
Sales/Service	215 (14%)	153 (15%)	62 (12%)
Technical	112 (7%)	100 (10%)	12 (2%)
Trades/Laborer	108 (7%)	67 (7%)	41 (8%)
Retired	129 (8%)	26 (3%)	103 (20%)
Homemaker	106 (7%)	51 (5%)	55 (11%)
Student	86 (6%)	46 (5%)	40 (8%)
Unemployed/Disabled	81 (5%)	39 (4%)	42 (8%)
Multiple	65 (4%)	48 (5%)	17 (3%)
Other	42 (3%)	37 (4%)	5 (1%)
Income (%)			
Less than $25,000	185 (12%)	132 (13%)	53 (10%)
$25,001 - $40,000	306 (20%)	200 (20%)	106 (20%)
$40,001- $55,000	255 (17%)	192 (19%)	63 (12%)
$55,001- $70,000	235 (15%)	162 (16%)	73 (14%)
$70,001- $100,000	264 (17%)	170 (17%)	94 (18%)
$100,001- $150,000	186 (12%)	98 (10%)	88 (17%)
More than $150,000	92 (6%)	46 (5%)	46 (9%)
Region (%) USA			
Midwest		203 (20%)	
Northeast		178 (18%)	
Southeast		241 (24%)	
Southwest		149 (15%)	
West		229 (23%)	
Region (%) AUS			
New South Wales			155 (30%)
Northern Territory			2 (0%)
Queensland			107 (20%)
South Australia			47 (9%)
Tasmania			13 (2%)
Victoria			153 (29%)
Western Australia			46 (9%)

9.3 Emotional Associations to protein food sources

Consumers evaluated each product for degree of liking using a 9-point hedonic scale and emotional associations using a circumplex ballot that consisted of 12 word pairs describing different feelings.

1. Overall, how much do you like or dislike this food?

☐₁ ☐₂ ☐₃ ☐₄ ☐₅ ☐₆ ☐₇ ☐₈ ☐₉

| Dislike extremely | Dislike very much | Dislike moderately | Dislike slightly | Neither like nor Dislike | Like Slightly | Like moderately | Like Very much | Like extremely |

2. How do you feel? Please circle <u>one</u> word pair.
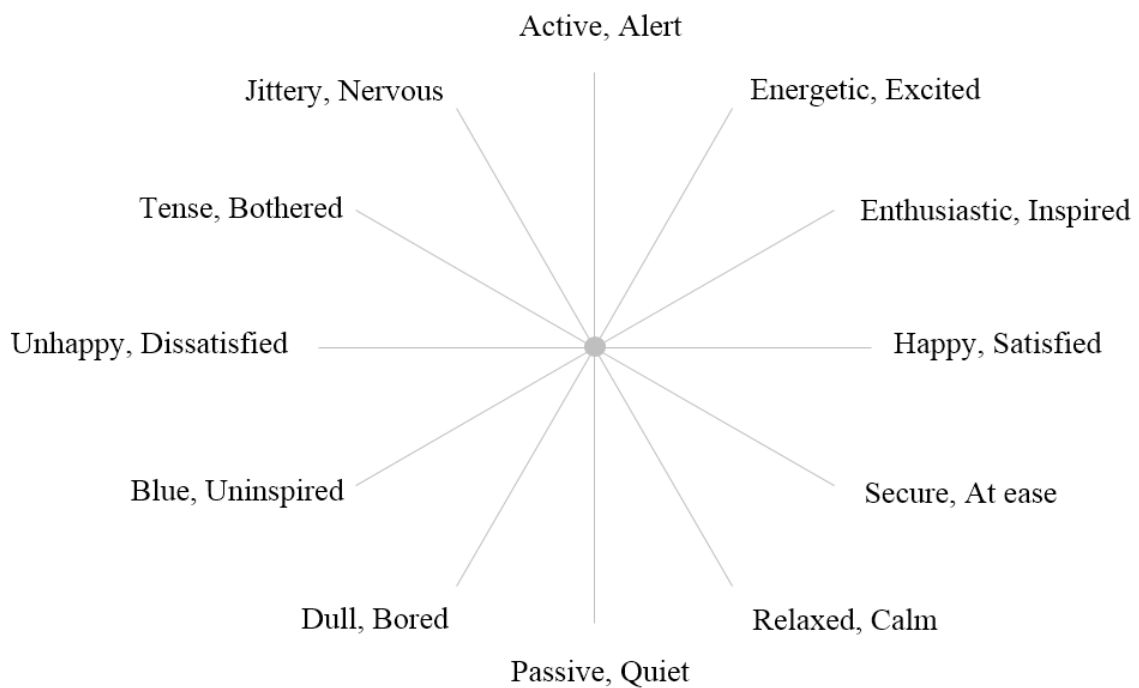
9.4   Frequencies of demographic responses

Would you be interested in purchasing and eating **red meat** if you learned that it can improve your **physical wellness**?

	USA		AUS	
	Not to mildly interested	Moderately to very interested	Not to mildly interested	Moderately to very interested
Freq. meat consumption	158	842	110	413
Daily	18 (11%)	132 (16%)	7 (6%)	28 (7%)
More than twice a week	54 (34%)	442 (52%)	37 (34%)	212 (51%)
Twice a week	35 (22%)	178 (21%)	26 (24%)	105 (25%)
Once a week	51 (32%)	90 (11%)	40 (36%)	68 (16%)
Once a month or less	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Age, years old	158	842	110	413
18-24	17 (11%)	87 (10%)	23 (21%)	59 (14%)
25-34	65 (41%)	337 (40%)	11 (10%)	81 (20%)
35-44	49 (31%)	211 (25%)	15 (14%)	68 (16%)
45-54	18 (11%)	112 (13%)	16 (15%)	64 (15%)
55-64	8 (5%)	74 (9%)	20 (18%)	63 (15%)
65 +	1 (1%)	21 (2%)	25 (23%)	78 (19%)
Gender	158	842	110	413
Male	78 (49%)	442 (52%)	52 (47%)	195 (47%)
Female	80 (51%)	400 (48%)	58 (53%)	218 (53%)
Children	158	842	110	413
None	92 (58%)	477 (57%)	82 (75%)	247 (60%)
Yes (1 or more)	66 (42%)	365 (43%)	28 (25%)	166 (40%)
Education	158	842	110	412
No High School	0 (0%)	2 (0%)	17 (15%)	43 (10%)
Completed High School	35 (22%)	210 (25%)	40 (36%)	126 (31%)
Student (undergraduate)	15 (9%)	77 (9%)	14 (13%)	49 (12%)
Completed degree	64 (41%)	323 (38%)	30 (27%)	115 (28%)
Student (higher degree)	12 (8%)	34 (4%)	2 (2%)	12 (3%)
Completed higher degree	32 (20%)	196 (23%)	7 (6%)	67 (16%)
Income, $ per annum	158	842	110	413
< 25,000	22 (14%)	110 (13%)	15 (14%)	38 (9%)
25,001-40,000	37 (23%)	163 (19%)	27 (25%)	79 (19%)
40,001-55,000	28 (18%)	164 (19%)	12 (11%)	51 (12%)
55,001-70,000	25 (16%)	137 (16%)	14 (13%)	59 (14%)
70,001-100,000	21 (13%)	149 (18%)	21 (19%)	73 (18%)
100,001-150,000	17 (11%)	81 (10%)	9 (8%)	79 (19%)
> 150,000	8 (5%)	38 (5%)	12 (11%)	34 (8%)

Would you be interested in purchasing and eating **red meat** if you learned that it can improve your **mental wellness**?

	USA		AUS	
	Not to mildly interested	Moderately to very interested	Not to mildly interested	Moderately to very interested
Freq. meat consumption	205	795	155	368
Daily	23 (11%)	127 (16%)	7 (5%)	28 (8%)
More than twice a week	66 (32%)	430 (54%)	56 (36%)	193 (52%)
Twice a week	58 (28%)	155 (19%)	42 (27%)	89 (24%)
Once a week	58 (28%)	83 (10%)	50 (32%)	58 (16%)
Once a month or less	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Age, years old	205	795	155	368
18-24	21 (10%)	83 (10%)	30 (19%)	52 (14%)
25-34	90 (44%)	312 (39%)	13 (8%)	79 (21%)
35-44	57 (28%)	203 (26%)	24 (15%)	59 (16%)
45-54	21 (10%)	109 (14%)	27 (17%)	53 (14%)
55-64	13 (6%)	69 (9%)	24 (15%)	59 (16%)
65 +	3 (1%)	19 (2%)	37 (24%)	66 (18%)
Gender	205	795	155	368
Male	108 (53%)	412 (52%)	74 (48%)	173 (47%)
Female	97 (47%)	383 (48%)	81 (52%)	195 (53%)
Children	205	795	155	368
None	121 (59%)	448 (56%)	111 (72%)	218 (59%)
Yes (1 or more)	84 (41%)	347 (44%)	44 (28%)	150 (41%)
Education	205	795	155	367
No High School	1 (0%)	1 (0%)	25 (16%)	35 (10%)
Completed High School	38 (19%)	207 (26%)	60 (39%)	106 (29%)
Student (undergraduate)	16 (8%)	76 (10%)	19 (12%)	44 (12%)
Completed degree	85 (41%)	302 (38%)	36 (23%)	109 (30%)
Student (higher degree)	13 (6%)	33 (4%)	3 (2%)	11 (3%)
Completed higher degree	52 (25%)	176 (22%)	12 (8%)	62 (17%)
Income, $ per annum	205	795	155	368
< 25,000	31 (15%)	101 (13%)	20 (13%)	33 (9%)
25,001-40,000	37 (18%)	163 (21%)	38 (25%)	68 (18%)
40,001-55,000	35 (17%)	157 (20%)	20 (13%)	43 (12%)
55,001-70,000	33 (16%)	129 (16%)	20 (13%)	53 (14%)
70,001-100,000	35 (17%)	135 (17%)	25 (16%)	69 (19%)
100,001-150,000	27 (13%)	71 (9%)	19 (12%)	69 (19%)
> 150,000	7 (3%)	39 (5%)	13 (8%)	33 (9%)