The Use of Facial Hedonic Measurements to Explore Relationships between Food Structure, Oral Processing and Acceptability

Bei Li

2017

A thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy, completed at the School of Psychology at Massey University (Albany campus), New Zealand.

Acknowledgements

I would like to thank my primary supervisor Dr Peter Cannon for his support, guidance and limitless patience. I know a lot more about Psychophysiology, psychology, SPSS and facial EMG from him.

My thanks go to my previous supervisor Dr Kylie Foster who gave me the financial support to attend international conferences. My thanks also go to Dr John Grigor for his professional guidance of sensory science.

Thank you to everyone in the office with whom I worked: Hongyan Yao, Liangjue Lin, and Shuo Yang. I would also like to thank to my best friends in New Zealand, Tingting Sun, Jessica Zhou and Justin Geng who gave me their time and encouragement. Thank you to everyone who joined my research project. Lastly, thank you to my family, friends and my lovely Doberman for putting up with me while I wrote this thesis.

Conference presentations

Chapter Number 3.2 and 3.3

Li, B., Cannon, P.R., Foster, K.D., & Grigor, J.M.V. (2015). Development of a dynamic psychophysiological technique (facial electromyography) to assessing food appearance. Oral session presented at the 2nd Asian Sensory and Consumer Research Symposium, Shanghai, China.

Chapter Number 4.4

Li, B., Cannon, P.R., Foster, K.D., & Grigor, J.M.V. (2015). Facial Electromyography: Dynamic facial muscle activity predicts affective rating of liquids. Oral session presented at the 7th European Sensory and Consumer Research Symposium, Dijon, France.

Paper

Chapter Number 4.4

P.R.Cannon., B, Li., Grigor, J.M.V. (Submitted, under review). Predicting subjective liking of bitter and sweet liquid solutions using facial electromyography during emptying, swirling, and while thinking about the taste. *PLOS One*

MASSEY UNIVERSITY
GRADUATE RESEARCH SCHOOL

STATEMENT OF CONTRIBUTION TO DOCTORAL THESIS CONTAINING PUBLICATIONS

(To appear at the end of each thesis chapter/section/appendix submitted as an article/paper or collected as an appendix at the end of the thesis)

We, the candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated below in the *Statement of Originality*.

Name of Candidate: Bei Li

Name/Title of Principal Supervisor: Dr Peter Cannon

Name of Published Research Output and full reference:

Li, B., Cannon, P.R., Foster, K.D., & Grigor, J.M.V. (2015). Development of a dynamic psychophysiological technique (facial electromyography) to assessing food appearance. Oral session presented at the 2nd Asian Sensory and Consumer Research Symposium, Shanghai, China.

Li, B., Cannon, P.R., Foster, K.D., & Grigor, J.M.V. (2015).Facial Electromyography: Dynamic facial muscle activity predicts affective rating of liquids. Oral session presented at the 7th European Sensory and Consumer Research Symposium, Dijon, France.

In which Chapter is the Published Work:

Please indicate either:

- The percentage of the Published Work that was contributed by the candidate:

  and / or

- Describe the contribution that the candidate has made to the Published Work:

  Bei Li was responsible for designing the experiments (with support from Cannon, Grigor, and Foster), collecting data, analysing data (with training), designing slides for presentation (with support), and presenting at international conferences in Shanghai, China and Dijon, France.

Bei Li — Digitally signed by Bei Li Date: 2017.01.26 08:42:04 +13'00'

Candidate's Signature

16-01-2017

Date

p.r.cannon@massey.ac.nz — Digitally signed by p.r.cannon@massey.ac.nz DN: cn=p.r.cannon@massey.ac.nz Date: 2017.01.25 20:52:40 +13'00'

Principal Supervisor's signature

25-01-17

Date

Table of Contents

List of Tables

List of Figures

Abstract

Hedonic responses to food should vary over time because flavour perception during oral processing is dynamic. Hedonic liking scales and temporal drivers of liking (TDL) are frequently used to assess food acceptability during product development and evaluation. These tools are only able to provide an assessment of liking at a static time point and they are also interruptive of normal food behaviours. To overcome these limitations, this thesis assesses dynamic affective responses to imagery stimuli and tastant stimuli using facial electromyography as a psychophysiological measurement (EMG) (Chapter 3.3 and 4.4). Facial muscles that are used to display negative affect (M. Corrugator supercilii and M. levator), a muscle that is active when smiling (M. zygomaticus major) and a muscle that is active when chewing (M. masseter) were all recorded using facial EMG. Additionally, multi-level modelling (MLM) was used to predict the hedonic liking ratings to these stimuli (Chapter 5.3.3). This direct measure revealed that dynamic affective responses were able to be discriminated using facial EMG. Strong activity in corrugator and levator muscles was evoked by disliked stimuli, whereas for liked stimuli only the zygomaticus muscle increased in activity. From the multi-level modelling results, hedonic liking ratings were able to be predicted using facial muscle activity. Importantly, hedonic liking ratings were able to be predicted using muscle data at the beginning and the end of the tasting (Chapter 4.4). These experiments confirm that facial EMG is not only able to assess dynamic affective responses to foods, but also that facial muscle activity can predict hedonic liking ratings.