

A Gestalt-Taxonomy for Designing Multimodal Information Displays

by

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Certificate of Authorship of Thesis

Except where clearly acknowledged in footnotes, quotations and the bibliography, I certify that I am the sole author of the thesis submitted today entitled –
A Gestalt-Taxonomy for Designing Multimodal Information Displays

I certify that this thesis is my own work. However, some parts have been developed in collaboration with co-authors in the following publications. Parts of Chapters 3 and 5 appeared in a paper at the NICTA-HCSNet Multimodal User Interaction Workshop 2005. Parts of Chapter 3 were presented at the IEEE International Conference on Systems, Man and Cybernetics 2006. Parts of Chapter 4 were presented at the Australasian User Interface Conference 2007 and World Haptics Conference 2007. Except where otherwise stated, I declare that this thesis is my own original work.

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Abstract

The theory of *Gestalt* was proposed in the nineteenth century to explain and predict the way that people perceptually group visual elements, and it has been used to develop guidelines for designing visual computer interfaces. In this thesis we seek to extend the use of Gestalt principles to the design of haptic and visual-haptic displays.

The thesis begins with a survey of Gestalt research into visual, auditory and haptic perception. From this survey the five most commonly found principles are identified as *figure-ground*, *continuation*, *closure*, *similarity* and *proximity*. This thesis examines the proposition that these five principles can be applied to the design of haptic interfaces.

Four experiments investigate whether Gestalt principles of *figure-ground*, *continuation*, *closure*, *similarity* and *proximity* are applicable in the same way when people group elements either through their visual (by colour) or haptic (by texture) sense. The results indicate significant correspondence between visual and haptic grouping. A set of haptic design guidelines for haptic displays are developed from the experiments. This allows us to use the Gestalt principles to organise a Gestalt-Taxonomy of specific guidelines for designing haptic displays. The Gestalt-Taxonomy has been used to develop new haptic design guidelines for information displays.



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Dr. Keith Nesbitt has changed my life. I would like to thank him for teaching me about study and about interpersonal relationships.

At the completion of my thesis, I am overwhelmed with emotion and with gratitude. Over the past few years, throughout the process of research and writing this doctoral thesis, I have always had a great deal of support and encouragement from people I know. They have enabled me to persevere, and to tell myself constantly that the moment before dawn is always the darkest. And at last, dawn did bring about the clearing and warming sunshine and I have reached my aspiration. Now as I look back, it feels as if I have been through so many highs and lows, and experienced much pain and suffering. Yet, on second thought, all these seem transient. Compared to other great research, what I did is rather insignificant.

My first tertiary study was at Monash University, Australia. Truthfully speaking, I feel a lot for Monash; it is the cradle that nurtured me in academia. I began my PhD studies at Monash. Unfortunately, Monash was not able to provide appropriate PhD supervision. I constantly kept track of experts and scholars in related fields, and even proactively approached them, hoping that their expertise would be able to guide me.

Luckily, I read Dr. Keith Nesbitt's doctoral thesis and found that he had conducted in-depth research on multi-sensory displays. In August 2005, I drove some nine hours or so up the north from Melbourne to Charles Sturt University, Bathurst to meet him on a Saturday. I still remember Dr. Nesbitt spent the whole afternoon talking with me. He tried to understand my research situation and gave me many valuable suggestions. I am very grateful for his sharing and selflessly guiding me

though all my problems. In my most difficult hour, he gave me a hand, enabling me to see hope in my dark abyss. I will never forget what he has done for me as a supervisor. To him, I was only a stranger. He could have ignored me or just endured a casual meeting. However, because of his passion for academic research, he took me in, someone out of the blue, as his student on top of his busy workload. After meeting with Dr. Nesbitt, my research progressed by leaps and bounds. He helped me express all the knowledge I had accumulated from Monash in a structured manner. In 2006, Dr. Nesbitt took a postdoctoral position in Boston, and so he arranged to have me study under Associate Professor Stephen Barrass at the University of Canberra. In July that year, I officially registered at the University of Canberra and became a student of Associate Professor Barrass, with Dr. Nesbitt as my assistant supervisor.

Associate Professor Barrass helped to analyse the results from the experiments, to structure the Gestalt-Taxonomy, and to organise the presentation of the thesis. He has broad and deep scholarship, and he has been very kind in sharing his knowledge with me.

Generally speaking, Associate Professor Barrass and Dr. Nesbitt have different styles of teaching. They consider issues from different perspectives. To me, the two supervisors' collaborative pedagogical methods are complementary and one cannot do without the other.

One point that I must mention is that Associate Professor Barrass and Dr. Nesbitt do not give me direct answers. Their teaching method is always to suggest an approach or direction. As a result, I have continued to progress in the process of problem solving. From the strong points of these two supervisors, I have even learnt different thinking patterns and research methods. I am really grateful for their selfless attitude towards teaching. All this time, the two supervisors have played both the roles of teacher and friend, which completely changed my negative impression on research supervisors. I often think to myself: blessings do come in disguise. If it wasn't for the miserable experience at Monash, I would not have serendipitously met my two supervisors. Both of them are vitally important and indispensable to my academic life.

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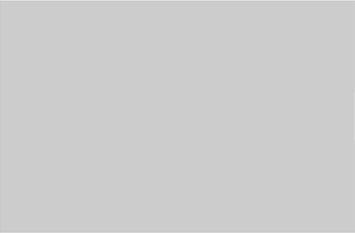
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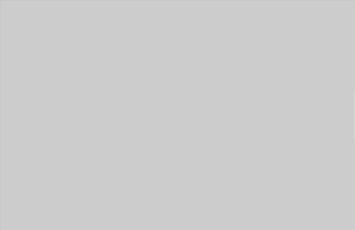
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