The Selection and Integration of Information to Guide Inductive Reasoning

Rachel Stephens

School of Psychology

The University of Adelaide

August 2012

Contents

Abstract

This thesis explores how people select and integrate information to guide inductive reasoning, with a focus on feature induction. Three separate (though related) key research questions are investigated.

First, do people readily integrate multiple kinds of knowledge to guide induction? The focus is the integration of similarity-based knowledge across objects, and knowledge of causal relations between particular features. Past research has found conflicting results about whether people integrate both. This thesis explores whether these discrepancies can be explained by the apparent strength of the causal feature relations: people's inferences might reflect a compromise between information sources when the feature relations are probabilistic, but agree more with the feature relations when they are deterministic. Support for this hypothesis was found in a new experiment that manipulated causal strength. A comparison of the predictions of five probabilistic graphical models showed that a model that integrated both sources of information best accounted for people's inferences. This suggests that people were typically integrating the different information, sensibly taking causal strength into account.

Second, does social context influence the use of category labels to guide feature induction? Do people assume that labels are particularly important cues for feature inferences? Therefore, do useful labels help adults to learn to predict new features more quickly (especially in a social context, with a human teacher) than do other equally predictive features? Experiments with adults typically have limited social context, but labels may seem more

relevant when verbally presented by a person trying to teach new concepts. The results of two new category learning studies demonstrate that the extent to which labels have a unique influence on learning depends on the task's context: in a social context, people learn quickly regardless of whether a label or another feature is most informative. Nevertheless, when the task is not social, labels can aid learning more than other features that are most closely matched in terms of salience and prior knowledge. This last finding shows that labels can be treated as especially important cues to guide feature induction.

Third, what information do people typically want to actively seek out, depending on the target feature being predicted? What seems to be the rationale behind their choices? In contrast to everyday reasoning, much of the existing research on feature induction both limits the amount of different information available to people, and may often suggest which information is relevant in virtue of the stimuli used. A new experiment provides a direct investigation of the types of information people freely choose to help predict different features. A relatively open task was used, with ten possible sources of information available. Using a biological domain, it was found that taxonomic or similarity-based information did not generally dominate people's inferences, as has been found with some novice populations. Instead, people systematically chose to consider different information for predictions of different features. They seemed to be largely seeking evidence for possible explanations behind the potential presence of the target feature, supporting a central role of causal reasoning in feature induction.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for joint-award of this degree.

I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library catalogue and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Rachel Stephens

August 2012

Acknowledgements

Unfortunately for some, when one person decides to embark on a PhD, unsuspecting others are swept up and dragged along for the ride. My heartfelt thanks go to all who helped make the journey worthwhile, in spite of a flooded office, catastrophic technical failures, and the usual PhD perils.

First and foremost, thank you to my star line-up of supervisors. I feel exceptionally fortunate to have worked with each of you. To Daniel Navarro, for first sparking my interest in Cognitive Psychology with your unrivalled lecturing style, and then surreptitiously steering me towards research. In short, thank you for getting me into this PhD madness, but then lending your keen eye and remarkable explanatory powers to guide me through. You have been vital in making the seemingly impossible possible. To John Dunn: I also blame and thank you for encouraging me to do a PhD. Thank you for always being there to magically help clarify my thoughts, for your invaluable MATLAB training, and for involving me with your research, which played a key role in fuelling both mind and belly. To Amy Perfors, for bringing new energy into my candidature, with your infectious enthusiasm. Thank you for challenging me, encouraging me to be daring and for all your support and bright ideas along the way.

Thank you also to Michael Lee from University of California, Irvine, for coding three of the five models presented in Chapter 2 and assisting with the reporting of these models. More importantly, thank you for helping to fulfil my childhood dream of going to Disneyland!

Further thanks also to Gert Storms and an anonymous examiner for their

insightful suggestions towards this final version of my thesis.

I would like to acknowledge the financial assistance I received from an Australian Postgraduate Award. Thank you also to *The Australian Federation of University Women: South Australia* (for a Brenda Nettle Bursary), the *Walter & Dorothy Duncan Trust*, plus The University of Adelaide's Faculty of Health Sciences and School of Psychology for the grants that allowed me to discuss and present my work both interstate and overseas (also facilitating the Disneyland adventure).

Special thanks must go to all my friends who have been there to provide the necessary support or distraction via coffee, dancing and other lovely outings. To Anastasia: Though floods and walls may separate us, we will always be the two-headed monster! To Erti, thank you for your helpful suggestions about my thesis – you have gone above and beyond the call of friendship-duty! To the other "girls" who have been there since those carefree undergraduate days: especially Cheryl, Suzie, Kim, and Daniel. To Vic, my travel buddy, for her LaTeX help and unwavering practicality that leads the way for us all. I also cannot forget my longest-serving friends: Diana, Natalie, Brooke and Katherine. MC Spanna, in every possible way, you are quack-tastic.

To all the as-yet-unmentioned members and associates of the CCSlab and John's lab, thank you for all the sharing of knowledge and laughs, especially Dragana, Angela, Fernando, Nick, Natalie, Belinda and Dinis. You inspire me.

Of course, thank you to my family for always encouraging and nourishing my studious tendencies: this includes Geoff, Dad, Dee and Bradley. Mum,

none of this would have been possible without you, and you have been the best of role models. Daniel, thank you for patiently tolerating my nocturnal lifestyle and for the awesome nights out. Special mention also goes to Grandma and Grandpa: I know that if Grandpa Fred were still with us, he would be bragging about this volume to anyone who would listen.

Last but certainly not least, to Christian. I could write another thesis thanking you for all you have done, but I know you would rather I just submit! I love you.