An Evaluation of Rastislav Rehák's Dissertation

April 21, 2023

I have now read through Rastislav's dissertation. My overall assessment is that it consists of three strong chapters, each of which makes an interesting contribution to information economics. The fact that people do not posses all of the relevant information when they make a decision – either due to the opportunity cost of information as in the first chapter, or due to other people's choices of what information to provide as in the second and third chapter – has now been demonstrated in a number of significant economic settings and has critical and nuanced implications for the analysis of data. In my (biased) opinion, getting a better understanding of how people deal with informational constraints is one of the most important areas of research economists can currently be working on.

Below I make a number of suggestions for each chapter. Let me be clear that I do not see any of the suggested changes as being necessary for the dissertation to be accepted. I instead view them as optional, up to Rastislav's discretion, and hope they are useful things to consider prior to submitting the different chapters for individual publication.

I have also sent along the dissertation with some highlighting. I tried to highlight things that I refer to in my comments so they are a bit easier to find and keep track of.

Chapter 1

My main comment on Chapter 1 is that I think it could be better motivated, it does not seem to me to be as well motivated as Chapter 2 and Chapter 3. Instead of footnote 2, I would like to see you discuss areas where confidence is important and, crucially, how your research helps us better understand them. Decision confidence provides cheap additional information, but how does your research help us to use that cheap additional information to better understand decisions? The agent does not consider the confidence system problem when they solve the decision system problem. So, maybe you could argue/frame this with "even if additional motivation/incentive is provided to an agent to be accurate after they make a decision they may still choose not to acquire

any additional information, and this depends in an interesting way on how long the initial decision took." Then, I would like to see some conclusion about the things I could infer from an agent not desiring more information about the decision environment or decision maker (what does it tell me about the noise, costs of learning, variance of payoffs, etc, or can it explain some behaviour we as a field have seen before and not understood). It is surprising that the fastest decisions together with the slowest decisions can lead to one-stage confidence, while only intermediately fast decisions lead to two-stage confidence, this is a nice result, but what does this help me to better understand? E.g. the work of Fudenberg, Strack, and Strzalecki (2018) predicts that choices are more likely to be correct when the agent chooses to decide quickly, which better matches the observed correlation between decision time and choice probability, and maybe tells me that when I observe this type of behaviour the agent is unsure of the utility difference between options.

I am not sure if this is helpful, but I hope it will be: Suppose a researcher wants to learn about the distribution of the differences in monetary values of the two options the agent is learning about (maybe they are two different consumption goods). The researcher assumes that $c = \bar{c}$, and to get a sense of the monetary values of the options they use money to incentivize a second task where, after the subject picks one of the two options, the subject can continue to learn about which option is better, and the researcher can incentivize this second task with money as opposed to paying the subject with their selected option because the researcher knows which option is better, they just do not know how much better it is in monetary terms. The researcher is surprised to see that only intermediate reaction times lead to the agent choosing to do any additional learning. What can the researcher conclude about the distribution of the differences in the monetary values of the two options? Or, can they maybe learn something at least about how the noise of information compares to the distribution of monetary values of the options?

To complement Theorem 1.1 and Figures 1.1. and 1.2: could you give me a result(s) about the existence of fastest reaction times where confidence is one-staged? Something like for all c, α, σ, if $X_0 = 0$, there exists $\bar{c}$ such that the fastest reaction times are one-staged and intermediate reaction times are two-staged. Or, give me conditions on the other parameters that guarantee that there is $\bar{c}$ such that the fastest reaction times are one-staged and intermediate reaction times are two-staged. Something along these lines might be interesting if it can give a sense of parameters that lead to this interesting phenomena, and help me infer something about the parameters when it is observed.

The decision system problem described by (1.3) is not what I was expecting. I was expecting

it to look more like equation (6) from the work of Fudenberg et al. (2018). On page 13 you say "Since the stopping problem of the decision system has been studied elsewhere (in particular, by Fudenberg et al. (2018))", which seems to imply the (1.3) is equivalent to their set up, but I must admit this equivalence was not immediately evident to me, so I would appreciate you making the relationship more evident/explicit.

Minor Comments

Is page vi supposed to be blank?

Page 9: the P you use when you describe the probability space does not seem to be the P you use as a probability measure. Shouldn't it be?

Page 10: it would seem more intuitive to me if negative values led to l being chosen and positive values leading to r being chosen, but I suppose you do it this way because when the particle moves up (positive direction) it is going to the left if you think of it facing forward in time.

Page 10: $P(\tau < \infty) = 1$ is missing parentheses?

Last paragraph before Section 1.3: I did not find this very clear or helpful. Would it be helpful to argue that $\bar{c}$ is likely less than c if we consider opportunity cost? Suppose the choice is between policies to adopt: the agent is not considering selecting neither option, so presumably they are both good, they are just not sure which is better, and thus there is an opportunity cost of taking a long time to decide because both are better than nothing, whereas once one has been picked there is maybe less time cost because I have at least selected one of the options and am not losing out on the benefit of at least having one of these beneficial policies? (I know mathematically this interpretation might not be the cleanest, but if it is a person picking an insurance policy maybe a psychological difference could be argued? Just a thought.)

Page 12: I would expand the equation in Theorem 1.1 out so that the intuitive properties you mention after are easier to observe: write out full fractions instead of using negative exponents and multiply the α^2 through the brackets.

I would provide some intuition for why c does not appear in the equation in Theorem 1.1. After some thought I think it makes sense, but it did not make sense right away.

Page 12: "her" seems like it can be deleted, particularly because you are about to talk about a male wrestler. I think the whole wrestler example could be made a bit more clear/more closely tied to the parameters of the model.

For Figures 1.1 and 1.2, it would be easier to see the change if the scale of the horizontal axis

was the same. Just food for thought.

Page 18: is the entire second bullet conjecture or just the second sentence in the second bullet? You seem to go on to say that the first sentence in the second bullet is not a conjecture, so maybe make it 3 bullets. I would like to see results along these lines, and you to do more of these kinds of comparative statistics.

Page 22: I would maybe expand on footnote 26 and put it in the main text.

Page 27: maybe instead "To further simplify notation" or "To simplify notation further." Or, maybe even better, "To simplify notation in Appendix 1.A.4."

Page 41: there is a ' that sould be a '.

Unnecessary blank page (48) at end of chapter? Same for page 43?

Chapter 2

I mainly wonder about how results in Chapter 2 could be further developed. I understand that you may have major issues with tractability, but in that case it seems like a number of natural simplifications could be explored.

In addition to Definition 2.1, I would like to see a formal description of what optimal "state pooling structure" can look like and an explanation of how much the outcomes for the "Procedure for discovery of the state-pooling structure of the optimal signal" can differ from optimal "state pooling structure." For instance: could optimality ever require a state to be in more than two pools? If it can't, could it be that the procedure ever result in a state "maybe" being in three or more pools? This is just off the top of my head, I think you could probably come up with more helpful information. Say I have 4 states of the world, could I have an optimal solution where state 4 is in its own pool, states 1 and 2 are in a pool, states 2 and 3 are in a pool, and states 1 and 3 are in a pool? Could I have an optimal solution where states 1 and 2 and 4 are in a pool, states 2 and 3 and 4 are in a pool, and states 1 and 3 and 4 are in a pool? It does not seem this type of thing is ruled out by Definition 2.1 or Proposition 2.3, but I would be surprised if it is possible. Can you tell me anything about when the optimal pools would be a partition such as in the left plot in Figure 2.1? Further, Definition 2.1 should be followed by a plain language description for people that are maybe not very theory literate but want to try to apply your results.

What are natural simplifications that could be used to help you extend results? Do you have more traction if, just as an example, the difference between $\rho(\omega)$ and ω is monotone? What if there are more than three states but the difference between $\rho(\omega)$ and ω only takes 3 different values?

These would seem like natural enough assumptions in many settings. Can you tell me anything about situations where the sender is required to choose a partition pool structure? What if the sender can only create pools of adjacent states? For the GDP example it would seem strange if the experiment could pool very low and very high levels of GDP. So if we have 4 states they could, for example, have two pools where pool one is states 1 and 2 and 3, while pool two is states 3 and 4, but they could not have that pool one is states 1 and 4 while pool two is states 2 and 3. Does this make it any easier to find optimal pools? Could additional structure be used to give you sufficiency in Proposition 2.2?

Can you, either with or without additional structure, use an observed optimal signal structure to tell me anything about ρ, or, again perhaps more importantly, the difference between $\rho(\omega)$ and ω? This would seem interesting to me, using an information structure to learn about the differences in ideal policies of the sender and receiver.

Minor Comments

To help the reader, in case they want to refer back to Figure 2.1, I would use the same payoff structure and notation in Figure 2.1 and the discussion about it as in lines 3 and 4 of page 56.

I am not sure if you want to cite the work of Lipnowski and Mathevet (2017).

I would mention the conditions you have for full disclosure from Section 2.4 (Proposition 2.2) in the intro in the paragraph where you mention Section 2.4.

If you are going to talk about "two different but connected issues" and "economy vs political situation" in the abstract I would expand on footnote 6. Perhaps it should not be a footnote if this generalization is desirable.

On page 56: it seems that the "Going backwards" refers to backwards induction, so I would instead say: "The receiver's optimal action given a posterior belief p is $a(p) = \mathbb{E}_p[\rho(\omega)]$. Hence, using backwards induction, the game reduces to..."

On page 57: I am not sure "ideally, she would like to reveal all states perfectly" is quite right. Maybe instead: "ideally, if all she cared about was the first term, she would like to reveal all states perfectly."

Page 60: I think you could be more descriptive than "more structured signals."

Looks like a typo on page 61.

Looks like a typo on page 62: maybe "a *clique*."

Page 62: strictly "above" or "larger than"? Maybe "above" is the standard word in graph

theory, I am not sure.

Should Proposition 2.4 be a theorem?

Seems like there is too large of a space after Proposition 2.4.

Chapter 3

My main feedback for Chapter 3 is that I would suggest you cite the recent work of Esponda, Oprea, and Yuksel (2023). In their paper they study a "representative signal distortion" bias whereby "when evaluating signals (e.g. evidence on behavior, credentials or performance) about a member of a group (e.g., a gender, nationality, race) people tend to misinterpret evidence to be more representative of that group (relative to another reference group) than it actually is. In other words, when evaluating a group member people (i) tend to see what they are "looking for" and (ii) "look for" evidence that is representative of the group"(Esponda et al., 2023, p. 2). At the end of their second page they even have an example with a hiring manager noticing representative evidence on a resume. I believe this paper is conditionally accepted at the QJE, which I think might be good news for your paper because I see your paper as largely complementary. They focus on the outcomes of the bias for choice, but you focus on and can demonstrate the information selection. I would also suggest you look through their paper for other relevant papers you might want to cite.

I would also like to see a few more things discussed in the body of the paper. First, how predictive is the gender of an assistant for if they score below median on the tolerance index? What percent of male subjects are above median and what percent of female subjects are above median? You say that "Only men reveal significantly more demographic information if a CV has a female name," and I am curious if this is due to less women being "biased against women" according to your index or if there is just a different behavioural outcome for women when they are biased according to the index. Second, it seems like from Table 3.B.6 that the "tolerant" assistants are perhaps not more likely to report demographic information about women, and all of the statistical significance is being driven by the "biased" half of subjects. If this is true I would mention it, as a simple diagnostic test being able to remove the half of subjects that drive the bias seems interesting to me.

Minor Comments

The first sentence of the last full paragraph on page 85 seems a little odd to me. I might re-write it "A distinctive contribution of our online experiment is the heterogeneity analysis on the

characteristics of assistants." And then just write "analysis is" and "analysis reveals" later in the paragraph (see highlighting). In the next paragraph, I might write "decision-makers" again instead of "them" (see highlight).

First full paragraph on page 87: I do not know if "directions" is the word you want. I also think the fact that they use machine learning is a bit irrelevant when discussing the complementary nature of the two projects.

Second paragraph on page 88: other than the first and last sentence, I think the paragraph should be in the appendix. You told me it is a representative sample, so I am happy enough with that level of information personally. More interesting: does the subset of subjects with recruitment experience seem to behave any differently? Obviously you might have major problems with statistical significance with a greatly reduced subset of subjects, but it might be worth mentioning either way.

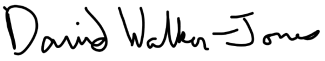
First full sentence on top of page 101: missing space.

Conclusion

It is my opinion that Rastislav's dissertation satisfies the formal and content requirements for a PhD thesis in economics. I recommend the dissertation for a defense. It was a pleasure to read each of the three chapters and I wish Rastislav all the best.

Sincerely,

Dr. David Walker-Jones (University of Surrey)



References

Esponda, I., Oprea, R., & Yuksel, S. (2023). *Seeing what is representative* (Tech. Rep.). Working paper.

Fudenberg, D., Strack, P., & Strzalecki, T. (2018). Speed, accuracy, and the optimal timing of choices. *American Economic Review*, *108*(12), 3651–84.

Lipnowski, E., & Mathevet, L. (2017). Simplifying bayesian persuasion. *Unpublished Paper, Columbia University.[642]*.