Evaluation of

Deception For The Greater Good: Minimizing Traffic Congestion With Information Design

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Abstract

The paper *Reducing Congestion Through Information Design* which is reviewed in the report *Deception For The Greater Good: Minimizing Traffic Congestion With Information Design* we are going to evaluate in this article, deals with the problem of suboptimal decisions of Bayesian agents in the context of games with uncertain congestions when given complete information of the system. The reviewing group developed and used simulation software to replicate the results seen in the aforementioned paper.

1 Evaluation

As we deal with three different texts throughout this evaluation it might help to assign to each of them a unique name. Therefore, if we speak of the *paper* we mean the original work by Das et al (2017) titled *Reducing Congestion Through Information Design*. The *report* denotes the review on the aforementioned paper and is titled *Deception For The Greater Good: Minimizing Traffic Congestion With Information Design* written by Kaïs Albichari, Raymond Lochner, Rodrigue Van Brande and Tanguy d'Hose. Lastly we will say the *article* when speaking about the evaluation you are reading right now.

The article is organized into two parts. In this one, apart from clarifying notation, we will evaluate the different sections of the report on the basis of the questions from the specification found online and the mail the report was attached to. The second part will provide overall general positive and negative remarks as well as questions on the content of the report.

1.1 Abstract and Introduction

The abstract should be more elaborated in terms of what the paper is about and which insights are aimed for. Also using the term *agent* both for the entity being routed and a potential supervisory structure (mis)leading the former might be confusing. After reading the abstract

the reader might now have a vague idea of the topics that are about to be discussed. We do not immediately see however why selfishness of agents in a traffic system is a motivation for the study.

The introduction provides a clear overview of the topics to be discussed but contains spelling mistakes, as does the abstract. Since this is the first impression the reader gets, we highly recommend to review and simplify the phrasing. Subsequently, the second paragraph states that the work is a 'very active topic' but supporting references originate from the same author and date back to 2005. While 2005 is clearly a lot more recent then 1920, the year it is referring to, it would be good to find a more recent paper (e.g. the one that is actually being reviewed) or to remove the claim.

Otherwise the paper is well summarized, touching on all the major parts without getting into too much detail, so the reader feels confident to dive in. It could be a little clearer though, that the report is mainly a reproduction and revisit of the original content rather then something completely novel.

1.2 Background Information

The sources cited in the introduction are sufficient to understand the relevance of the work, spanning both time and topics. There is one highly influential reference added to those already present in the paper, Pigou (1920), but it remains the only one. Citing sources encapsulated in parenthesis when introducing them directly is uncommon. Strangely, *Informational Braess' paradox: The effect of information on traffic congestion* (Acemoglu et al, 2016) is cited as being published in 2017 in the paper, though 2016 seems to be correct.

1.3 Methods

The methods used in the report can be divided into two parts. Those already found in the original work are predominantly well explained, but notational inconsistencies complicate comprehension (see subsection 1.6 for an elaboration of this issue).

New aspects, like the problem formulation for finding the optimal agent-to-path mapping, also suffer from notation noise, but are otherwise well presented. The so called *Simulator*, arguably the most original part of the whole work, is unfortunately only treated superficially without going into the implementational details. In particular it is not entirely clear, how and if it was used for the previously presented results.

1.4 Results and Questions

In the paper, the following questions are explored both on a general and systematic level.

1. How can providing partial information to agents in a routing game improve outcomes and restore efficiency?
    - In a simple example
    - In the *Wheatstone Network*

2. How to deploy network information to minimize congestion?
3. How to minimize the expected aggregated travel cost?
4. What is the influence of perfect, partial and no information on the expected aggregated travel cost?
5. What is the influence of *public signals* on the expected aggregated cost?

In the report, the results of the first example introduced in the paper are reviewed by introducing a similar example found in Pigou (1920). The network structure is identical, but more general, due to a newly introduced parameter ω_2 representing the fixed travel cost of the second path.

Based on this network the optimal agent-to-path mapping is laid out and the argument is made, that full information, counter intuitively, increases the expected aggregated travel cost. A remark on partial and no information is missing. The results are then nicely visualized (figure 2), but the travel cost for the second path (the red line) should have a positive slope, as the cost is zero when no agent takes the path, and one, if all agents take it (though this has no influence on the shape of the total cost).

When demonstrating the effect of public signals, the parameterization is changed to match the one found in the paper. The original results are subsequently paraphrased. It would have been more interesting to explain the method on different parameters, for instance those used before.

The second example is then also identical to the one found in the original work, though first introduced without the, seemingly helpful, zero cost path. As the parameterization is the same, the results are as well. A solution to the quadratic optimization problem is neither calculated nor explained.

Finally, the implementation of a simulator is discussed in a high level manner without providing explicit results.

To summarize, questions found in the paper are answered by and large, but a few intermediate results are missing and the, in large parts, recycled parameterization makes this section less exciting to read. Then again, a few new ideas are introduced and also visualized.

1.5 Conclusion

An actual conclusion is entirely missing. The report is not summarized at all but there is an outlook paragraph as part of the discussion. The discussion on the other hand is missing any reference to, and explanation of, the obtained results. While the naming of the concluding section has neither to be *Discussion* nor *Conclusion*–though this definitely is a fairly standardized naming convention–the content of those sections has to appear somewhere in the work.

1.6 Style

The overall style of the article is somewhat of a mixed bag. While the formulas and the text are nicely typeset, using subsections and paragraphs to increase readability, there are a lot of idiomatic and expressive flaws and spelling mistakes. The citation style is very unusual and

inconsistent. Many variable names are reassigned to new purposes multiple times (e.g. P_i being first a path name, then the argument to the cost function $c(\cdot)$–previously taking the share of agents x on a path also called s_i later while s is additionally a node in the directed graph– and then it becomes the path cost function itself) making it hard to follow the mathematical reasoning. The figures are informative and clear though the labeling of figure 2 is too small.

1.7 Missing Content

As already mentioned in subsection 1.5, the obtained results are not thoroughly discussed. Here and there, scattered throughout what seems to be the result section(s), explanatory sentences are to be found. There is however no clear and final overview of the obtained results, explaining their meaning and comparing them to those published in the original work.

The term *Bayesian persuasion* is neither used nor explained in the report though it is quite prominently placed as part of the abstract in the paper and then referred to multiple times.

2 Remarks

In this section we will state possible ways to improve the report on the basis of some specific positive and negative examples explained in the first section of this article as well as content wise questions.

2.1 Positive

1. **Pigou's example:** Introducing a new example from a highly popular source for the same problem encountered in the original work is a good way to revisit the content and to clarify it.
2. **Visualization:** Using graphs and figures helps a lot when struggling to understand the presented concepts by giving the reader a new perspective from which to approach it.
3. **Optimization:** The formulation of a general framework to find and optimal agent-to-path mapping challenges the reader to really interact with the content and thus deepens the understanding.

2.2 Negative

1. **Language:** The linguistic usage is in large parts perfectly adequate but there are several avoidable idiomatic and grammatical mistakes throughout the report which complicate understanding.
2. **Notation:** The notation used in the equations is in parts overloaded, when variables are reassigned to have new meanings and in parts redundant, when the same concept is assigned to several variables. This impedes comprehension significantly. Each abstraction should be explained explicitly instead of imposing on the reader to deduce it.

3. **Structure and Content:** The structure of the report is not very clear. Though there is an outline of what to expect in the introduction, the sections typically found in papers (*Introduction, Methods, Results/Discussion, Conclusion*) are only partially present and content expected in one section is found in another or is scattered over several sections.

2.3 QUESTIONS

1. **Simulator:** How exactly does the simulator work? How was it implemented and what are its capabilities and shortcomings?
2. **Discussion:** What can be learned from the obtained results? Are they useful and for what? How do they compare to those from the original work?
3. **Hindsight:** Looking back, what would you have done differently with the knowledge gained and where there any difficulties that arose during development? Did you find any contradictions or ambiguities in the papers or was everything clearly laid out?