

Beyond belief

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Valorisation

"Many that live deserve death. And some that die deserve life. Can you give it to them? Then do not be so eager to deal out death in judgement. For even the wise cannot see all ends....My heart tells me he [Gollum] has some part to play yet, for good or ill, before the end; and when that comes the pity of Bilbo may rule the fate of many - yours not least."

- Tolkien (1954, p.78)

In the above passage from J.R.R. Tolkien's *The Lord of the Rings*, Gandalf lectures Frodo Baggins about the value of life. More in particular about the value of Gollum's life, a wicked creature that poses a direct threat to Frodo and the fate of Middle-Earth, as Frodo holds possession of the powerful One Ring. With Gandalf's words in mind, Frodo chooses to show pity and mercy to Gollum in future encounters with the creature. This choice of kindness sets up the eventual eucatastrophe that saves Frodo and the entirety of Middle-Earth from evil, by having Gollum be alive at the right place and right time to fall with the One Ring into the fiery depths of Mount Doom.

There is an important lesson about **value** in this passage. To be very clear: I am certainly not that humble that I would compare this thesis to the abhorrent creature that is Gollum. Nor am I conceited enough to be saying that the fruits of my still young academic career will ever save Earth at a certain point in time. In fact, assuming such levels of certainty and finality with regard to creating and diffusing value is often unfounded. Frodo's decision to show kindness is one made when faced with heavy uncertainty and a very long path ahead. He supports his own decision however by his acquired understanding that any life has the potential to add some material value over time, if given the opportunity.

Also when attributing societal value to fundamental research, uncertainty and a long time horizon are inherent challenges. In fundamental research one seeks to create knowledge for the sake of knowledge itself. However, by providing a large and well-structured knowledge base to support on, it serves applied researchers in conducting their research. It is applied research that can provide direct societal impact. For economics, one can think here of policy recommendations, market design and patents.

The process of translating academic knowledge to practice and attributing societal value to it is called **valorisation**. This thesis looks at fundamental aspects of psychological game theory and therefore certainly falls into the category of fundamental research. As such, the process of valorisation for this thesis is not straightforward. Covering fundamental research, we must assume that the future societal value that can be attributed to the knowledge created in this thesis will accrue in indirect ways and over an extended period of time. The main avenue for this value creation for practical matters will be experimental research, as will be discussed in what follows.

Both psychological game theory as well as epistemic game theory are grounded in a practical view. The field of psychological game theory is motivated by the observation that in real life many people do not only have self-regarding preferences in the way that traditional game theory models them. Instead, people also exhibit belief-dependent motivations in economic situations, such as guilt-aversion or reciprocity-concerns. Epistemic game theory is motivated by explicitly modeling the reasoning processes of players in a game, instead of using common solution concepts as a black box. An important point of note here is that these black boxes, such as the classical Nash equilibrium, work well in traditional settings that are repeated often, such as in auctions or competition between businesses in markets. The repetition in such traditional game-theoretic settings allows for the learning of beliefs and thus also for eventually achieving correct beliefs, the reasoning assumption behind equilibrium concepts. However, many economic settings are not that often repeated or are even one-shot in-

teractions between multiple players. Equilibrium concepts are known to not perform well in describing decisions made by people under such conditions, because learning cannot take place. Examples include higher than expected effort provision in contests or more specifically overbidding in auctions. With psychological games these problems are amplified, as the variable of interest are the beliefs themselves, which may never be observed or deduced. Then there is not even a relevant basis to learn from. Additionally, as this thesis shows, the assumptions placed on reasoning processes by equilibrium concepts may be incompatible with belief-dependent motivations in certain settings. And even if all necessary assumptions for an equilibrium are met, a common issue in psychological games is that there are often multiple equilibria possible. A priori it is then still not unambiguously clear how players in fact will behave.

All of the previous points stress the necessity for a permissive view on *how* players in a game can reason towards particular decisions. Epistemic game theory provides the appropriate machinery to formalize testable hypotheses for experimental researchers regarding such reasoning processes. The results and discussion in each of the chapters in this thesis can help experimental researchers in doing so for psychological game theory in particular. The range of topics addressed in experimental research that have direct relevance for society is very diverse. Examples include understanding charitable giving when players can experience guilt or shame and tax morale with concerns for reciprocity or again aversion to guilt.

Understanding and describing real-life behaviour is important. However, the ultimate goal of game theory is to be able to provide well-founded predictions for economic scenarios. The accuracy of these predictions depend on many factors, but an important one is the complexity of the decision-problem at hand. Cognitive abilities are limited and so is time available for reasoning in many decision-problems. This is called bounded rationality. The more complex a decision-problem is to reason about, the less accurate the predictions may be. In this thesis we have argued that psychological games can be noticeably hard to

reason about. In CHAPTER 5 in particular we have argued that the simplicity of a psychological game can be partially assessed by whether it is solvable by an iterative elimination procedure that only eliminates (finitely many) choices. We provided conditions for when this is always possible and showed that if it is not solvable by such a procedure it is because of conflict in the underlying reasoning processes that can occur. Certainly more research is needed to investigate whether this intuition of the problem also extends to dynamic games. It will be the task for experimental research to find out whether in practice decision-makers on average do act more in line with predictions in such “simpler” settings than in other settings.

There is a lot of practical relevance to be found in such questions about bounded rationality. Namely, in many economic settings the game is designed with an intention. For instance, we can think of a manager designing for a group of workers with belief-dependent motivations incentive schemes that specifies per output level a certain reward. The manager may for instance have to choose between joint incentives and individual incentives for the workers, or between a scheme where workers have to simultaneously commit to a certain output level and a scheme where they do so sequentially. Given the predictions, the manager can set up an optimal incentive scheme that maximizes her organisation’s output. But if the game is hard to reason about, predictions based on a particular solution concept may get inaccurate and potentially lead to a waste of resources. To the extent these resources are government-funded or to the extent the organisation has a strong societal merit, this of course can trickle down to society. The previous is an example in the labour market, but one can also think of relevant examples in public choice settings with local (government) representatives that have belief-dependent motivations or tax audit designs that foster tax morale.

Finally, a few words on possible direct value for practitioners. It would be too much of a stretch to say that knowing how to surprise a student with an announced exam has much direct societal merit. However, the classroom is perhaps the one place where results of the type of

knowledge created in this thesis can create some direct societal impact. Many undergraduate and graduate degrees offer game theory courses. And although the exact results discussed in this thesis are not directly applicable to them, the intuitions may be of use to alumni in the future when they set up or manage their own organisations. For psychological game theory in particular, the intuitions will mostly be of use in small-scale organisation where one can distinguish on an individual basis in some way. Namely, business, corporations or other organisations cannot have psychological motivations. The individual human beings who make up these organisations however can have such motivations. Taking lessons from psychological game theory and acknowledging people may exhibit a wide array of motivations will create better people's managers, which is practically relevant.

In sum, the discussions and results in this thesis are mostly useful to experimental researchers. In general it helps in better formalizing testable hypotheses in strategic settings with belief-dependent motivations. More specifically there may be lessons found with regard to bounded rationality and accuracy of predictions. For the latter point more research is needed, also on a fundamental level. The fruits of such research can be relevant for e.g. labour markets and public choice settings.