

Hill-Climbers or Satisficers? On the Intelligence of Managerial Search in Agent-based Models

Friederike Wall

Department of Management Control and Strategic Management
Alpen-Adria-Universität Klagenfurt Austria

friederike.wall@aau.at

In agent-based computational economics there is a common understanding that human decision-makers are not as gifted as traditional schools of economics suggest. Hence modeling agents with some limited cognitive capabilities is a common trait of agent-based models in economics and managerial science. Often greedy algorithms and in particular hill-climbing algorithms are employed for representing experiential learning and search behavior of decision-makers (e.g. Gavetti and Levinthal 2000, Dosi et al. 2003, Siggelkow and Rivkin 2005, Wall 2017 for overviews, Ganco and Hoetker 2009, Baumann et al. 2019). However, based on experimental evidence, it has been argued that hill-climbing algorithms may be too pessimistic regarding agents' intelligence and thus hill-climbing algorithms may be inappropriate representations of managerial search behavior (Tracy et al. 2017, Gilbert 2008). With this, also the question arises in how far results of models relying on these representations may hold if other and possibly more realistic representations of managerial behavior are implemented.

Against this background, the paper suggests to capture managerial behavior in agent-based models following Herbert A. Simon's concept of "satisficing" (Simon 1955) which was found to be a relevant representation of human search behavior (e.g. Gigerenzer 2002, Guth 2010, Caplin et al. 2011). According to Simon, satisficing means a process of sequential search for options until a satisfactory level of utility is achieved. What is regarded as satisfactory is captured in the aspiration level which - depending on the difficulty of the problem to be solved - may be subject to adaptation over time as well as the maximum number of options searched.

In the paper, the satisficing algorithm proposed is contrasted to hill-climbing algorithms via the example of an agent-based simulation model based on the framework of NK fitness landscapes (Kauffman and Levin 1987, Kauffman 1993). This particular choice is made since the NK model serves as a kind of "quasi-standard" in studies on managerial search (for overviews, e.g. Baumann et al. 2019, Wall 2016). In the model, artificial organizations search for superior performance to a multi-dimensional binary decision problem which is decomposed into distinct sub-problems - each of which being exclusively delegated to a manager. The managers seek to contribute to the objective of the organization, but - due to specialization - each has a different view on the organization's overall decision problem. The model controls for the level of intra-organizational complexity, meaning the interactions among subordinate managers' decision problems.

The results suggest that the models' behavior may remarkably differ depending on whether satisficing or hill-climbing algorithms serve as representation for managerial search. Moreover, for satisficing, results indicate on oscillating aspiration levels and intense and potentially destabilizing search activities of managers when intra-organizational complexity is high. Given that these results are obtained for comparably simple - for not to say simplistic - organizations, one may infer that further research is required to assess the effects of the representation of managerial behavior on the results of agent-based models in managerial science.

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