

# Pioneers and Followers: Innovation with Heterogeneous Beliefs

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## Extended Abstract

Innovation is often started by pioneers who appear overconfident about the likelihood of a quick success, as demonstrated through statements promising the next big step within an optimistic time frame (nuclear fusion: 20 years; self-driving cars: a few years; etc.). While such optimism has plausible benefits by motivating individuals to engage in innovation despite capturing only part of the surplus, optimism also carries the risk of faster disillusionment with a lack of progress and organizational frictions. The aim of this paper is to understand this trade-off, both for the single-agent problem and for innovation by a heterogeneous group of agents.

To this purpose, we study such heterogeneity in beliefs in a classic model of innovation with Poisson arrival of a breakthrough. Agents share a prior belief in the basic viability of the project (whether the state is good or bad), but disagree about the arrival rate of success conditional on a viable project. As a consequence of this heterogeneity, agents who are optimistic about the conditional arrival rate are initially optimistic about the expected benefit from innovation. This optimism, however, also causes (subjectively) faster learning: If there is no success, their belief in the viability of the project shrinks to zero more quickly. This learning channel causes a reversal of beliefs: After sufficient time has elapsed without a breakthrough, agents who are more optimistic about the conditional arrival rate will be less optimistic about the expected arrival rate and therefore about the expected payoff of continuing with the project. Depending on the parameters of the problem, total effort exerted can both increase (when the project is not or only barely viable for realists) or decrease (when even realists would exert effort for a long time) as a result of such optimism.

In a setting with observable effort and heterogeneous beliefs, the equilibrium has a sequential structure: One agent is working after the other going from the most confident (who also grow disillusioned the quickest) to least confident (who are least put off by a lack of past success). The total amount of activity is determined by the most persistent agent: Heterogeneity can help get projects off the ground but can also lead to excessive

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perseverance. Belief heterogeneity allows the equilibrium to select the most persistent agent, but the outcome is equivalent to the single-agent problem this agent.

When there is learning-by-doing, overconfident agents can serve as "pioneers": They start projects others consider nonviable and get discouraged quickly, but in doing so lay the groundwork for future investment by making the projects viable for their less optimistic peers.

We also study equilibria when effort is not observable and incentives to motivate innovation in teams with belief heterogeneity.