Decoding team and individual impact in science and invention
(Ahmadpoor and Jones (2019))

The Question: How can an individual's contribution be disentangled from the overall output of a team? Is the impact of a team project (as measured by citations) influenced most heavily by the highest impact individual team member, or the lowest impact individual team member?

The Setting: Across most disciplines, team production is becoming increasingly common. The authors examine 24 million research articles from all fields in science, engineering, social science, the arts, and humanities (from the Web of Science Database), as well as 3.9 million patents (from the U.S. Patent and Trademark Office). The outcome of interest is the impact of a paper or patent as measured by the number of citations received. Their aim is twofold: to develop and test a tool to capture each individual's impact, and to determine whether a project's impact is determined by the team member with the highest or the lowest individual impact.

Because any individual scientist or inventor participates in many different teams (including sometimes working by themselves), the authors are able to estimate simultaneously the average impact (citations) generated by each individual, and how the abilities of multiple team members contribute to the impact of the team output. The statistical analysis assumes that the number of citations received by papers and patents is a function of a generalized mean of the individual abilities of all contributors. The generalized mean has two parameters: one that captures the magnitude of the extra advantage from teamwork, and one that captures how impact changes as team members' individual abilities are more disparate.

The Results: When the authors estimate these two parameters, they find that there is on average a large, additional impact advantage from teamwork, even when controlling for individual contributors' abilities. However, they also find that the impact of a team-produced project is on average determined more by the lowest-impact individuals on the team. This implies that the ability of high impact individuals is diluted if they work on teams together with much lower impact individuals. Given this, it is not surprising that the paper finds that in general individuals tend to work with collaborators who have similar average impact.

To test their measure of individual contributions, the authors re-estimate their model using other commonly used measures in the literature and find that these are a worse fit for the data. Moreover, the authors' measure more highly ranks members of the National Academy of Science than other widely used measures of impact, suggesting that this measure is better capturing the overall impact and contribution of individuals.

The Lessons: Across a wide variety of academic fields and technology classes, team production is characterized by two offsetting features: there is a benefit to teamwork, but the impact of a project is predicted more strongly by the lower-impact individuals on a team. Thus, team projects will have more impact than individual projects, as long as the team members are of similar abilities. There is also evidence that individuals of similar individual impacts tend to collaborate with each other.