Does interdisciplinary research lead to higher scientific impact?

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[Introduction]:

A variety of science policy instruments aim to foster Interdisciplinary Research (IDR) since it is perceived as more successful in achieving scientific and technological breakthroughs. However, there is little evidence showing that interdisciplinarity systematically leads to achievement, although there are plenty of historical studies suggesting that interdisciplinary research environments play a key role in scientific breakthroughs (e.g. Hollingsworth, 2006). Some recent studies have obtained conflicting results on this issue, looking at the impact in terms of citations, and using as units of analysis the paper (Adams et al, 2007; Lariviere and Gingras, 2010) or the journal (Lewitt and Thelwall, 2008). In this study we investigate the relation between interdisciplinarity and scientific impact at paper level, using established and novel measures of diversity as indicators of interdisciplinarity (Porter et al, 2007; Rafols and Meyer, 2010). We aim at improving our understanding on the effects of interdisciplinarity research by: a) distinguishing three attributes of diversity, namely: variety, balance and disparity; and b) assessing whether (and to what extent) these different aspects of diversity affect scientific impact (Yegros et al, 2010).

[Method]:

Data sources: In building our dataset we have used two sampling criteria, one based on papers belonging to the same scientific discipline, and another one based on papers produced by researchers participating in a specific R&D program, encompassing different disciplinary fields. Regarding the first sample, we collected publication data from Web of Science for four subject categories (i.e. Cell Biology; Engineering, Electrical & Electronic; Food Science and Technology; and Physics, Atomic, Molecular & Chemical) for the year 2005, corresponding to any of the following document types: articles, proceedings papers or reviews. The total number of articles collected amounts to 74996 records. Regarding the second sample, we also collected publications from the Web of Science, which have been generated from 1990 to 2003 by 62 research groups of the Spanish Council for Scientific Research (CSIC) that were funded by the Spanish Food Technology Program. Even though a large proportion of these groups belong to the field of Food Technology, many of the participating research groups belong to other scientific fields. This second sample consists of 2578 publications.

Key variables and method: We have measured scientific impact using the conventional field-normalisation, i.e. using number of citations divided by the expected citation rate for the field, using a five-year citation window. Our indicators of diversity are based on the distribution of disciplines associated to each of the references cited by the papers collected. We have constructed three measures to capture different aspects of diversity: variety (the number of cited disciplines); balance (the evenness of the distribution of the references across disciplines); and disparity (the cognitive distance between cited disciplines – Rafols & Meyer, 2010). We have used econometric techniques, using OLS, Tobit and Count data models, in order to assess the relative effect of the different measures of diversity on scientific impact.

[Results and discussion]: Our preliminary findings indicate that the three aspects of diversity have a distinct, significant effect on scientific impact. While variety has a positive and significant effect on citations, balance and disparity have a negative and significant effect on the scientific impact of publications. Therefore, the number of different scientific fields a publication draws upon has a strong positive effect on the citations, but this effect can be outweighed by the effects of too high a distance between the scientific fields (high disparity) or too little specialization across scientific fields (high balance). In other words, a high number of citations is most commonly achieved by citing only across related disciplines, and sparingly. We propose that there are two possible interpretations to these results, one from the perspective of the publication, and one from the perspective of the audience. The first interpretation would be that successful scientific papers benefits from diverse disciplines, but only to the extent that it can manage their integration. Beyond certain cognitive distance the costs of coordination become too onerous. The second interpretation would be that, given the current institutional structure of science, citation practices disadvantage highly interdisciplinary papers. This might be for several reasons: for example, because the audience can not relate to them, or because they can not be published or presented in the most prestigious journal or conferences. In either case, we notice that this study takes citations as a proxy only for scientific quality. We caution against a reading of these results as assessing the value of interdisciplinary research. This value needs to be assessed in wider perspectives, including its contribution to the creation of variation and critical views in science, field cross-fertilisation and its key role in fostering innovation and/or addressing societal needs.