

**Title**

Conducting pro-social research: cognitive diversity, research excellence and awareness of the social impact of research

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University-business collaboration, prosocial research, cognitive diversity, research excellence.

## **Introduction**

The growing emphasis to encourage university-business collaborations has been recently matched by an interest in the micro-foundations of scientists' engagement in knowledge and technology transfer activities (Rothaermel et al., 2007). This interest partly stems from the important challenges faced by academic scientists when planning to work at the interface between academic and business environments, having to reconcile different (often conflicting) norms, priorities and incentives (Jain et al., 2009; Philpott et al., 2011). This paper aims to contribute to this subject by investigating the antecedents of scientists' engagement in knowledge transfer activities.

First, we propose the concept of pro-social research as reflecting the adoption of attitudes and conducts that place social relevance as a critical goal of research. We argue that pro-social conducts represent a behavioural antecedent of the actual engagement of scientists in knowledge transfer activities. Second, we investigate the impact that different cognitive aspects have on the development of pro-social research behaviour. In particular, we examine if certain types of research skills (i.e. cognitive diversity and research excellence) have a positive impact in shaping a pro-social research behaviour and, more critically, if they act as substitutes for prior experience in knowledge transfer activities.

## **Background and hypotheses**

Social psychology research proposes that developing a pro-social identity has important consequences on individual behaviour. Integral to a pro-social identity is the desire to positively affect the beneficiaries of one's work (Audrey et al., 1997; Batson & Powell, 2003; Grant, 2007). Pro-social identities are logically ingrained in the academic entrepreneurship and technology transfer literatures, with studies that propose that scientists who have an aspiration to achieve a broader societal impact from their research, are more willing to embrace a favourable attitude towards knowledge transfer activities (Jain et al., 2009; Lam, 2011; Weijden et al., 2012). According to these studies, adopting attitudes and conducts that place social relevance as a critical goal of research are crucial to reconcile the conflicting priorities and incentives faced by academic scientists when planning to work at the interface between academic and business environments.

Pro-social research behaviour is generally epitomised by three types of conducts, in this literature: (i) recognition of research results with a potential social impact (Shane & Venkataraman, 2000); (ii) identification of the potential users' of research findings (Shane, 2000; Stokes, 1997); (iii) delegation on intermediary agents to realise the social impact of research (Jain et al., 2009). We characterise pro-social research behaviour as comprising these three conducts.

We extend the knowledge transfer literature by examining the factors that contribute to the configuration of pro-social research behaviour. More specifically, we are particularly interested in identifying those skills that are conducive to pro-social research among scientists with no (or very little) prior experience in knowledge transfer activities. Drawing on the academic entrepreneurship literature, we anticipate two potentially relevant skills to predict the emergence of pro-social research behaviour: research excellence and cognitive diversity.

First, we hypothesise that research excellence is positively linked to pro-social research behaviour, as scientists with outstanding research performance may enjoy a particularly high visibility on potential users of their findings, favouring the scientists' awareness of the social impact of their research (Landry et al., 2006; Perkmann et al., 2011). Second, we hypothesise that cognitive diversity is positively linked to pro-social research, as scientists with a broader expertise across fields of science are likely to conduct more distant search and to develop gatekeeper roles (within and outside academy), which should enhance identification of new lines of inquiry and awareness of social relevance and commercial opportunities of their research (Fleming et al., 2007; D'Este et al., 2012).

Finally, while we expect that those scientists with more knowledge transfer experience will exhibit greater concern about the social impact of their research (Hoye & Pries, 2009), we also hypothesise that both research excellence and cognitive diversity are likely to act as substitutes for knowledge transfer experience. In other words, we expect that these two skills should play a stronger role to enhance pro-social research among scientists with no (or little) knowledge transfer experience, compared to those who have already developed the required enacting skills for knowledge transfer.

## Data and Measures

### *Data*

The main source of data comes from a large scale survey conducted on all (tenured) scientists at the Spanish Council for Scientific Research (CSIC) - the main public research organisation in Spain, covering all fields of science. The sample frame consisted of 3199 CSIC scientists, and the survey was conducted between April and May 2011. We reached a 40% response rate, with 1295 valid responses. Responses are representative of the original population in terms of age, gender, academic rank and scientific field. We supplemented the survey with (i) administrative data on socio-demographic characteristics of our population of scientists (i.e. gender, age, academic rank and institute of affiliation), and (ii) bibliometric data from ISI-SCI, to get publication and citation profiles, as well as the scientific field of specialisation, for all the scientists in our study.

### *Measures and Method*

Our dependent variable, *pro-social*, is built from the responses to a question that asked scientists to report the frequency (according to a 4-point Likert scale ranging from 'never' to 'regularly') with which they engaged in the following three activities when conducting research projects: (i) identifying potential results from research, (ii) identifying potential users and (iii) identifying intermediary actors to help transfer the results of their research. We computed an average of the responses to these three items, as they were strongly correlated to each other - suggesting that all items of the scale were measuring the same construct and that the scale was consistent (Cronbach alpha of 0.8).

The explanatory variables were measured as follows. *Research excellence* was measured, for each scientist, as the average number of citations per paper and year, considering all the publications of each scientist until 2010. Our measure of *cognitive diversity* is based on the number of subject categories of the journal articles published by each researcher. We use the Shannon entropy measure, which has the attribute that the scores of the index depend on both the number of subject categories and the degree

of balance with which the papers are distributed across the subject categories (i.e. even distributions score higher than distributions where most of the papers are concentrated in few subject categories). We measure *knowledge transfer experience* as the total value of R&D contracts and consulting activities in which the scientists were engaged over the period 1999-2010, as reported in the administrative data provided by CSIC.

We run Tobit regression analysis given that our dependent variable, *pro-social*, corresponds to a scale composed of items whose values range between 1 and 4. In order to control for additional aspects of individual heterogeneity that could shape pro-social research behaviour, we considered some control variables: socio-demographic characteristics; motivational factors connected to the different types of benefits expected by scientists from the interaction with non-academic agents; and the scientific disciplines of our sample of scientists.

### **Results**

Our results show that both research excellence and cognitive diversity play an important role in explaining pro-social research behaviour. Research excellence shows a U-shape relationship with pro-social research behaviour: scientists are comparatively reluctant to embrace pro-social research behaviour at intermediate levels of research excellence. Cognitive diversity has a positive impact on pro-social research behaviour, suggesting that interdisciplinary skills contribute to fostering pro-social research behaviour.

Finally, while our results show that, as expected, past experience in knowledge transfer activities is a very strong predictor of pro-social research behaviour, we find that cognitive diversity acts as a substitute for experience in knowledge transfer: that is, the impact of cognitive diversity on pro-social research is stronger for scientists who exhibit little or no previous knowledge transfer experience.

### **Preliminary conclusions**

This paper sheds light on the antecedents of academic knowledge transfer by investigating the type of skills that shape pro-social research behaviour. Our findings suggest, on the one hand, that interdisciplinary research tracks constitute a powerful means to enhance the formation of favourable attitudes and conducts to engage in knowledge transfer activities. Moreover, interdisciplinary research skills moderate the role of knowledge transfer experience, as cognitive diversity has a particularly strong impact in shaping pro-social research behaviour among those scientists with no previous experience in knowledge transfer activities.

On the other hand, our results indicate that pro-social research behaviour may conflict with the search for peer recognition through scientific impact, unless a researcher conforms to the category of star-scientist. This suggests that policies supporting changes in the incentives to engage in knowledge transfer, such as the inclusion of knowledge transfer activities in the set of merits for academic promotion, could contribute to attenuating the obstacles towards pro-social behaviour faced by a large proportion of scientists.

We believe these contributions are important for two reasons. First, the paper advances theory by putting forward the concept of pro-social research as a behavioural antecedent of knowledge transfer. Second, the paper contributes to the micro-foundations of

scientists' engagement in knowledge transfer, by building a comprehensive picture of the type of skills through which pro-social research behaviour is formed and nurtured.

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