INGENIO WORKING PAPER SERIES

Who do you care about? Scientists' personality traits and perceived beneficiary impact

Óscar Llopis, Joaquín M. Azagra-Caro

Working Paper Nº 2015-03

INGENIO [CSIC-UPV] Ciudad Politécnica de la Innovación | Edif 8E 4º | Camino de Vera s/n | 46022 Valencia
tel +34 963 877 048 | fax +34 963 877 991 | innco@ingenio.upv.es

Who do you care about? Scientists' personality traits and perceived beneficiary impact

Óscar Llopis[1,2], Joaquín M. Azagra-Caro[2,a]

[1] Gretha-Université Bordeaux IV (Bordeaux, France)

[2] INGENIO, CSIC-UPV (Valencia, Spain)

Abstract: Policymakers compel scientists to influence colleagues, corporations and non-commercial actors. In the current study, we examine the relationship between biomedical scientists' psychological characteristics –personality traits and motivations– and their perceived impact on these different stakeholders. Taking the scientist as the main unit of analysis, we merge the organizational psychology and research evaluation literature to better understand the individual origins of societal impact. We also combine motivation and personality research with science policy studies to predict perceived beneficiary impact. Our focus is on biomedicine and its interest in and consequences for industry and patients, and we measure psychological characteristics through a large-scale survey. Openness to experience increases biomedical scientists' perceived impact on the academic community, extraversion on industry and conscientiousness on patients. Accounting for these effects opens new paths for designing more effective policies regarding scientific mobility, allocation of research activities and incentive schemas.

Keywords: perceived beneficiary impact, psychological motivations, big five personality traits, biomedicine

JEL Codes: O31, O32, O33

---

[a] Corresponding author:
Tel.: +34963877007 ext: 78498; fax: +34963877991; email: jazagra@ingenio.upv.es

> *"Social impact (of science) is difficult to plan; it sometimes happens unexpectedly, or can even be unintended. It is only by analysing the processes that induce impact that we have a chance of recognizing potential research impacts and the contributions made by research that might otherwise not be evident" (Spaapen and van Drooge 2011, p. 213).*

1 Introduction

Since the 1990s, there has been a visible trend, which has been encouraged by policy makers and science funders, to demonstrate the value of science to multiple stakeholders (Bornmann, 2013; Martin, 2011). The assumption that non-academic groups can automatically reap the benefits of scientific knowledge is being challenged as evidenced by a number of policies promoting societal accountability of science. For instance, the scope of research evaluation has widened to include broader societal returns (Donovan, 2011). Research on the universities' third mission or the triple helix, and on the convenience of cross-organizational research (Etzkowitz et al., 2000; Gibbons et al., 1994; Molas-Gallart et al., 2002) also urges consideration of the societal returns from knowledge as a primary goal of scientific organizations.

In this environment, scientists are under increasing pressure to redesign their research agendas to include demands. However, the final decision to reorient and design research agendas is still the reserve of the individual scientist (Stern, 2004; Tartari and Breschi, 2012). Grounded on the idea that individuals are the fundamental origins of collective phenomena (Coleman, 1994; Felin and Foss, 2005), this paper is motivated by the need to understand whether and why scientists differ in the relevance they attach to the potential beneficiaries of their research activities. Scientists are heterogeneous in their "taste for science" (Roach and Sauermann, 2010) and their preferences for publishing (Sauermann and Roach, 2014), and different branches of psychology note the tight links between psychology and attitudes to science (Feist, 2012, 2006). In this paper, we employ the concept of perceived beneficiaries, which has been used in the research evaluation literature (Lyall et al., 2004; Molas-Gallart et al., 1999) and work on management psychology (Belle, 2014; Grant, 2012; Grant et al., 2007). Our study focuses on the biomedical field, where non-academic actors, such as patients or industry, are pivotal actors, in order to move knowledge "from the bench to the bedside" (Bornstein and Licinio, 2011; Collins, 2011).

The objective of this paper is to explain the sources of differences in perceived beneficiaries in terms of personality traits and motivations. The influence of individual motivations and personality traits has been analysed mostly in other fields than science policy studies (although see Sauermann et al., 2010; van Rijnsoever et al., 2008). Merging science policy studies with the psychology of personality is a relatively new departure. Adding psychological characteristics to the more usual socio-demographic, organizational and institutional factors can enrich explanations of scientific activities and their impact. Some psychological characteristics work to modify the importance previously attributed to those other factors. So far, there are no studies that test whether intrinsic, extrinsic or prosocial motivations predict scientists' preferences towards a specific population. We also know little about the role played by open, extrovert or conscientious personalities in pushing the direction of biomedical research. Although several studies investigate intra-academic and university-industry relations, relations between scientists and the third sector, society (proxied in this study by patients), remain unexplored. In what follows, we provide a literature review and present the results of a survey measuring constructs typical of the psychology of personality to address this issue in the field of science policy studies.

The paper is structured as follows. First, we review the research on the societal impact of academic research. We then contextualize our study by discussing potential beneficiary groups in the biomedical field. This leads to a discussion of personality traits and motivations as potential antecedents to scientists' perceived impact on beneficiary groups. We exploit data from a large-scale survey of biomedical scientists to test our hypotheses. We conclude by reporting our results and discussing our findings, and derive some implications for practice.

2 Background literature and research hypotheses

2.1 Science and societal impact of research

Scientists deliver results for their academic peers and the wider community. They generate academic knowledge and address multiple stakeholders (De Fuentes and Dutrénit, 2012). The rationale behind public support for science is based largely on the fact that scientific outputs produce socially and economically relevant benefits (Bozeman and Gaughan, 2007). Public and private granting bodies are taking proactive roles by requiring scientists to include in their proposals a description of the impact of their research outside the lab (Owen-Smith and Powell, 2001). At the same time, the scope of research evaluation has broadened to incorporate societal impact as an indicator of success (Mostert et al., 2010). Ideally, these policies seek to integrate in a transdisciplinary way, the knowledge and needs of different beneficiary groups (Kasemir, 2003), in scientists' research agendas (Olmos Peñuela et al., 2014).

There is a broad consensus on the importance of supporting 'productive interactions' between the scientific and societal spheres as a way to generate scientific knowledge that has a greater societal impact (Spaapen and van Drooge, 2011). However, not all scientists are equally well equipped to accommodate to and adopt non-academic priorities as part of their research agendas. There is evidence that individuals differ in how they adopt supportive norms, routines and behaviours (Hogg and Terry, 2000). Some scientists may perceive that the norm of openness can be compromised when non-academic actors participate in research via industry funding (Walsh and Hong, 2003) and impose limits on knowledge disclosure. Lam (2011) refers to the concept of scientists' ambivalence to understand the tensions between the traditional norms of science and the need to engage with non-academic actors, thus, assuming divergent attachment to the traditional values of science. Against this background, this study argues that individual scientists differ in the degree of importance they attach to the potential beneficiaries of their research.

2.2 Who benefits? Conceptualizing beneficiaries of research

Performing societally relevant research implies exerting an impact on individuals or groups beyond academia. For instance, a focus of concern in biomedical science regards the gap between knowledge advances and their application (Coller, 2008). However, identifying and separating out the potential beneficiaries of a given research activity is neither easy nor trivial. Salter and Martin (2001) suggested a partition between the economic and non-economic benefits of scientific activities to evaluate the positive externalities of scientific research, but explicitly acknowledged the fuzzy boundary between both impact types. Similarly, Lyall et al. (2004) propose a research evaluation method based on the identification of diverse end-users of public sector research organizations, and a categorisation between upstream end-users, collaborators, intermediaries, and downstream end-users. And Molas-Gallart et al. (1999) emphasize the importance of considering the indirect and non-linear nature of research impacts and introduced the concept of 'beneficiaries' to distinguish between groups that may be potentially affected by the obtained results from a research project. On the whole, the existing models provide insights into the complexity associated with the identification and allocation of research efforts across diverse beneficiary groups. However, there is no generally accepted framework to identify the potential beneficiaries of scientific research, which has led to a lack of understanding of the origins of the societal impact of science (Bornmann, 2013).

Focusing on the individual scientist is a valid approach to identify and attribute differential weights to diverse beneficiary groups. The societal relevance of knowledge depends, in part, on the extent to which researchers consider the applicability of their work to diverse beneficiary groups in the early stages of the research cycle. This is likely to influence their decisions about how to address the research questions (Arvanitis et al., 2008). For a more precise understanding of the effects of beneficiary identification, we borrow from the organizational behaviour literature, which points to the importance of employees perceiving the link between their actions and the positive consequences of these actions for potential beneficiaries (George, 2009; Grant, 2007; Grant and Berry, 2011). Here, perceived beneficiary impact is defined as "the degree to which employees are aware that their actions affect others" (Grant, 2007: 399). In other words, it represents an explicit belief that the individual can benefit others through his or her work. Potential beneficiaries can include individuals or groups, either internal or external to the organization, which in turn comprise academic colleagues, patients, communities, supervisors, companies, etc. (Grant, 2007). Research indicates that heightening individual perception of the difference made to others (namely, beneficiaries) induces greater effort and persistence towards achieving this goal (Belle, 2014; Bellé, 2013; Grant and Campbell, 2007). For instance, Grant et al. (2007) find that connecting fundraising workers' to the beneficiaries of the collected funds increases the workers' dedication and effort, which results in more successful fundraising. Beneficiary impact seems to be particularly important in the case of public service workers such as scientists working in public research organizations. Workers with a better awareness of the impact of their work on society tend to perform better (Moynihan and Pandey, 2007). In linking lessons on the societal impact of research and theory on perceived beneficiaries, we would suggest that biomedical scientists differ in their perception of the impact on different communities.

In the biomedical context, there is increased interest the impact of biomedical research on non-academic beneficiaries. Traditionally, scientific significance and the scientific value of research within the academic community were the priority when evaluating academic research. Novel approaches to biomedical research based on translational models are endeavouring to give more weight to non-academic beneficiaries (Arar and Nandamudi, 2012; Collins, 2011). For instance, in certain biomedical fields, such as rare diseases, patient associations are the major players defining scientific research agendas (Fleurence et al., 2013; Mavris and Le Cam, 2012). Because patients are the direct recipients and beneficiaries of biomedical research, they should be considered legitimate actors with involvement in science-related decision-making. Despite the participation of beneficiaries in biomedical science decision-making being widely supported, few studies examine whether biomedical researchers attach importance to non-academic agents. There are a few works that suggest that scientists vary in relation to explicit awareness of different beneficiary groups. For instance, van der Weijden et al. (2012) surveyed 188 biomedical group leaders on the importance assigned to the societal orientation of their research activities. They found that, overall, scientists had a positive view of the societal impact of research, although there were differences depending on whether the research group was para-clinical, clinical or pre-clinical. Relatedly, Hobin et al. (2012) show that the opportunity to conduct research with an impact on human health was a key factor explaining scientists' decisions to build their own research agendas and select those projects with clearer societal impact. We contend that the psychological characteristics of these individuals help to explain the relevance they attach to diverse beneficiary groups.

2.3 Perceived beneficiaries and psychological differences

In examining scientists' responses to increasing pressure for societal impact, some of the empirical literature provides analyses of individual attributes such as age, gender, status or resource endowment (Azagra-Caro et al., 2006; Bonaccorsi et al., 2012). Other studies focus on contextual aspects such as the organization or institution (e.g. Rasmussen et al., 2014; Sánchez-Barrioluengo, 2014; Tartari et al., 2014). This suggests that scientists are heterogeneous in their concern for the usefulness of their research to non-academic groups, and the factors explaining this divergence. These findings are consistent with recent experimental research showing that employees differ in the weight they attach to the "non-monetary" content of their jobs (Fehrler and Kosfeld, 2014).

We trace the origins of societal impact to the personality characteristics of scientists as antecedents to the perceived impact on beneficiaries. Our baseline argument is that scientists' differ in the importance they attach to diverse beneficiaries, and that this can be explained in part by personality differences. In innovation studies, psychological characteristics have been used to explain relations between types of consumer innovativeness (how much consumers like to try new things) and the purchase of new products (Goldsmith et al., 1995); the influence of a religion-driven personality type on the style of R&D management (Ta-Cheng, 1997); the association among personality traits, entrepreneurship and innovativeness (e.g. (Marcati et al., 2008), etc. Similar efforts in the field of science policy are scarce. We follow others in highlighting this omission (Rothaermel et al., 2007; Tartari and Breschi, 2012). There are some exceptions such as van Rijnsoever et al (2008), which finds a positive effect of academics' innovativeness on interactions with other academic partners, but not industry partners ones, and Azagra-Caro et al. (2012) who show how controlling for founders' motivations for creating young innovative companies, reduces the impact of their R&D effort on the company's interaction with universities. We include patients as potential beneficiaries of these interactions, and apply a more refined measure to capture this explicit awareness. Among the numerous possible psychological characteristics, we focus on the dimensions of motivations and personality traits.

2.4 Psychological motivations and perceived beneficiaries

While psychological characteristics have been largely neglected by science policy studies, not every psychological aspect has been ignored. For instance, academics' motivation to engage into partnerships with industry has been shown to increase their scientific prestige (Azagra-Caro et al., 2008) and both academics and industrialist seek stability, but not control, and benefits for their organizations rather than for society (Ankrah et al., 2013). To reach society more generally, scientists need to work on improving their teaching and communication skills (Melton et al., 2005), and to increase public interest in and enthusiasm for science, requires a scientific culture and greater public awareness (Martín-Sempere et al., 2008).

A few authors show that motivation differs, measured on a validated psychological scale. To elaborate the role of motivations in scientists' awareness of their societal impact, we build on self-determination theory (Deci and Ryan, 2000, 1985), which suggests that motivation is not a uniform phenomenon. Rather, individuals can have different levels and types of motivation when engaging in a certain activities. Intrinsic motivation refers to actions that emanate from or are congruent with one's self, and reflect one's personal values and interests. In contrast, extrinsic motivation is fuelled mainly by internal or external pressures, such as tangible rewards or different forms of social recognition. In addition, it has been emphasized recently that the explicit desire to benefit others through ones' behaviours forms the basis of a third category of motivation, namely prosocial motivation (Grant, 2008a; Grant and Berry, 2011).

All three types of motivations are powerful drivers of action, and contrast with the state of *amotivation*, that is, lack of intention to act because of lack of contingency between one's actions and outcomes (Deci and Ryan, 1985). We assume that when scientists exhibit higher levels of motivation, their perceived impact on all beneficiary groups will be higher, so we adopt an exploratory perspective and do not predict any distinctive effects on particular beneficiary types.

2.5 Personality traits and perceived beneficiaries: some hypotheses

Personality traits are stable features that explain a person's behaviour in different situations (Allport, 1937; Cattell, 1946; Eysenck, 1950). One notable theory is the Five Factor Model, according to which there are five main personality traits that define a person: openness to experience, conscientiousness, extraversion, agreeableness (a.k.a. teamwork) and neuroticism (a.k.a. emotional instability) (Costa and McRae, 1985; Goldberg, 1981). These big five psychological traits have been applied in many fields of human action, such as job performance (Barrick and Mount, 1991), career success (Judge et al., 1999), love relations (Shaver and Brennan, 1992) and personal values (Roccas et al., 2002). Thus, it would be plausible to expect a certain relation with scientific activities, including the impact of research on beneficiaries. In a typical quantitative study, the target variable has several categories, for example, job performance can be related to "training proficiency", "occupations involving social interaction", etc. (Barrick and Mount, 1991); career success can include "job satisfaction" and "high income/status" (Judge et al., 1999); personal values can comprise "self-direction", "universalism", "achievement", "conformity" (Roccas et al., 2002), etc. The relation between each category and each of the big five personality traits is rarely either exhaustive or univocal, but rather tends to be complex. For instance, job performance related to training proficiency is linked only to openness to experience and conscientiousness; conscientiousness is related also to performance in jobs involving social interaction, but is not related to openness to experience, which is related to extraversion, and so on (Barrick and Mount, 1991). There are similar patterns of relations applying to career success and personal values (Roccas et al., 2002). Hence, we expect that psychological traits will have differential effects on each perceived beneficiary type. Predicting the direction of change in concrete personality traits in relation to particular beneficiary types is difficult,[b] but we try to identify some of the main relations based on scientific and technological norms (Dasgupta and David, 1994) and the small literature on the personality traits of scientists (Feist, 1998; Lounsbury et al., 2012).

Openness to experience is the extent to which individuals are imaginative, creative, curious or independent thinkers (McCrae and Costa Jr, 1997). We suggest that scientists characterized by high levels of openness to experience will attribute higher relevance to academic colleagues as their main beneficiaries, compared to scientists with lower scores for openness. The rationale underlying this hypothesis is based on the following arguments. First, the empirical evidence suggests that academic scientists are characterized by high levels of openness to experience (Feist, 1998; Lounsbury et al., 2012), but also less conscientious, extrovert or emotionally stable than other professionals (Lounsbury et al., 2012).[c] Second, openness is known to be a core norm of academic science. In the economics of science, openness refers to scientists' preferences for non-pecuniary rather than pecuniary rewards, for disclosure over secrecy and for the academic rather than the commercial world (Dasgupta and David, 1994). Among the so-called big five personality traits, openness to experience describes intellectual, curious, broad-minded people (Costa and McCrae, 1992). The parallel between both understandings of "openness" is straightforward and supports our expectation that openness, as a personality trait, is particular to the scientific norm. There is some evidence to support this view. Openness is associated with high performance in jobs that require proficiency, such as scientific research (Barrick and Mount, 1991), and with valuing self-direction and universalism, but conflicts with the motivational goals of

[b] van Rijnsoever et al. (2008) acknowledge the importance of the big five model, but qualify it thus: "not all factors are of likely influence on our dependent variables" (p.1258), and use it to argue about one single personality trait typically discussed in the management literature: global innovativeness. We analyse the effect of the big five personality traits through our dependent variable.

[c] Academic scientists' scores for agreeableness show that it is at an average level, although it contributes positively to career satisfaction (Lounsbury et al., 2012).

conformity, tradition and security (Roccas et al., 2002). Open individuals pursue knowledge and engage in intellectual activities to achieve it (Furnham et al., 2008).[d] Based on these theoretical notions, we hypothesize that:

Hypothesis 1. Openness to experience will increase biomedical scientists' perceived impact on academic community.

We predict also that higher levels of extraversion characterize scientists who orient their research towards industry needs, or technologists (Dasgupta and David, 1994). Extraversion is understood as a tendency for high levels of sociability, activity, sensation seeking and positive emotions and is manifested in outgoing, talkative and energetic behaviours (Revelle et al., 2010).

We are already familiar with some of the features of industry-oriented scientists. The industry norm for a technologist is a genuine interest in commercial, industrial and military R&D activities, and a preference for secrecy and pecuniary returns. Scientists are unstable (Lounsbury et al., 2012) and unstable extraverts perceive monetary rewards as signalling success (Gray, 1987). Therefore, we associate extraversion with technologists. Previous research shows that extraversion is linked positively to job performance involving social interactions, management and sales (Barrick and Mount, 1991), for example, with professions related to industry and entrepreneurship (Berings et al., 2004). Introverts tend to be high academic achievers, while extraverts find academic study boring (Eysenck, 1971). Thus, extravert scientists prefer research oriented to broader collectives such as industry. Thus, we propose that:

Hypothesis 2. Extraversion will increase biomedical scientists' perceived impact on industry.

In the case of scientists whose research is devoted to treating patients, we hypothesize that higher levels of conscientiousness will be associated with a greater appreciation of patients as the primary beneficiary group. Conscientiousness is a personality trait

---

[d] The term 'openness' is used also in innovation studies, in relation to 'open innovation', meaning a positive attitude to collaborating with others; so one would expect a positive impact of the personality trait 'openness' on industry and patients. However, the personality trait 'openness' is characterized by intellectual curiosity, and not necessarily the propensity to collaborate, so it does not correspond completely to the notion of 'open innovation'. Some prefer the term 'intellect' rather than 'openness'.

associated essentially with a taste for order and conformity to the rules, which has been shown to be correlated with a sense of purpose, obligation and persistence, to being risk averse and pursuing success according to socially approved standards (Roccas et al., 2002). Because awareness of patients' needs and interests involves conducting research close to clinical practice, which is not at the scientific frontier nor related to commercialized, marketable products, the normative difference between academic scientists and technologists does not tell us much about this group of scientists.

Psychology studies offer compelling arguments as to the positive association between conscientiousness and a higher perceived impact on patients. The empirical evidence shows a positive association between conscientiousness and several helping behaviours, helping preferences and empathy (Caspi et al., 2005; Pursell et al., 2008) or voluntary actions intended to help or benefit another individual or group of individuals. Similarly, studies exploring personality in organizational settings find positive correlations between conscientiousness and organizational citizenship behaviours (Organ, 1994), meaning that employees with higher scores for conscientiousness tend to devote more time and resources to actions not explicitly included in their job descriptions, but which have a positive impact on the organizational functioning. In our context, attributing higher weight to patients can be viewed as a reflection of the firm's societal commitment beyond earning scientific prestige or monetary reward.

A lower weight on earnings characterizes interest in social occupations (Berings et al., 2004), which suggests that scientists whose research is oriented towards patients will exhibit different traits from those research is oriented towards industry (extroverts according to Hypothesis 2). Note also that most biomedical scientists are not practitioners, so patients are ranked last in their target audiences. It is only more meticulous and hard working employees who will find the time to care about patients, that is, more conscientious employees.

Hypothesis 3. Conscientiousness will increase biomedical scientists' perceived impact on patients.

Because conscientiousness is related to order and conformity values, which leads to better job performance (George and Zhou, 2001), we can predict positive links with beneficiaries other than patients. More conscientious individuals tend to comply more easily with work ethics and social and professional norms (Grant, 2008b), and conscientious individuals generally exhibit more positive attitudes to science and scientific methods compared to those with lower conscientiousness (Feist, 2012). As a result, we expect that scientists scoring high for conscientiousness will comply more with the norms of academic science and, consequently, perceive a stronger link between their research activities and their potential impact on their academic peers. Hence:

Hypothesis 4. Conscientiousness will increase biomedical scientists' perceived impact on academic community.

3 Methods

3.1 Research setting and research procedure

The data for this study were collected through a large-scale survey of biomedical scientists in Spain. The survey was administered to 4,758 biomedical scientists and technicians belonging to research groups active in nine biomedical fields (diabetes, obesity, hepatic and digestive diseases, neurodegenerative diseases, rare diseases, mental health, bioengineering, respiratory diseases, and public health). The questionnaire was administered in electronic form in April 2013. We obtained explicit support from the scientific directors of the research groups to conduct the survey (5 out of 9 of them wrote support letters), and scientists were encouraged to participate. The choice of the research population was based on a number of reasons. First, the population covers a representative spectrum of biomedical research conducted in Spain. An important peculiarity of this sample is that our respondents are located in diverse organizational settings. For example, the sample includes scientists in university departments, hospitals, public research organizations and private foundations. In terms of biomedical sub-specialties, our population captures a broad range of disciplines. Second, all respondents are part of the CIBER programme, which covers a large number of biomedical areas in Spain. CIBER was launched by the Spanish Government and, in 2006, the Ministry of Health published a series of open calls to research groups located in Spain, with the aim of creating research consortia to include diverse biomedical fields. The main goal of CIBER was to promote collaborative scientific research and to provide solutions to the most predominant health problems in the Spanish National Health System (Delgado

Rodríguez, 2012). Third, biomedicine is a field in which non-academic communities play an important role in shaping scientists' research priorities. Much has been written recently about participant-centric initiatives providing the basis for tight connections between academic research and patient needs (Kaye et al., 2012). All these reasons lead us to expect that scientists from our sample will account for at least a minimum level of perceived impact on non-academic beneficiaries.

The different sections in the questionnaire included one that asked about scientists' motivations and personality differences. All scales were based on the literature and, if necessary, adapted to the biomedical field. Another section asked about scientists' perceived impact on different societal groups, which provided data for the construction of our dependent variables. The last section in the survey asked for information on various socio-demographic aspects, such as scientists' age, academic position and academic background, which data were used to construct our control variables. Both the independent and dependent variables were operationalized through self-reports. Although there are well known potential biases related to survey instruments, the advantages of self-reports are particularly appealing in the context of studies of human behaviour, as in our case (Howard, 1994). Prior research in related areas also relies on a survey approach to obtain this type of detailed data (D'Este and Perkmann, 2011; Link et al., 2007; Walsh et al., 2007). All respondents were assured that their individual responses would be reported only in aggregate, which would not allow individual respondent to be identified. Respondents were also assured of confidentiality, and individual responses were sent to us directly.

Before administering the survey, we conducted a pilot study involving 15 biomedical scientists, which helped us to refine the wording and validate the sense of the questions. This pre-test did not lead to any major change, but helped to clarify some of the questions. We obtained a response rate of 27 per cent, which is consistent with previous studies involving scientists (Perkmann et al., 2013; Tartari and Breschi, 2012). Due to missing values only 1,033 observations could be used for the econometric analyses.

Table 1 summarizes the descriptive statistics, and Table 2 presents the Pearson correlation coefficients of the variables described in the succeeding sub-sections.

{Table 1 here}

{Table 2 here}

3.2 Dependent variables

Perceived impact on beneficiaries. To capture the scientists' awareness of their research impact across different groups, we adopted the concept of perceived beneficiaries (Grant, 2007, 2012; Maurer et al., 2002). Our objective was to compile an extensive list of societal or professional groups that might benefit, directly or indirectly, from direct or indirect results, from our scientists' research outputs. We drew on the broad conceptualization of beneficiaries proposed by Grant (2007, 395): *"Beneficiaries can include individuals and social collectives internal or external to the organisation, such as co-workers, supervisors, subordinates, clients, customers, patients, and communities"* to compile a list of potential beneficiaries of biomedical research. We pilot-tested the list of beneficiary groups with biomedical researchers. This allowed us to refine the list by dropping, adding or merging beneficiaries, resulting in a final list of ten beneficiary groups. The survey asked respondents to report their perceived impact on each of these beneficiary groups. Specifically, we asked respondents, *"Research activities that you carry out have an impact across diverse groups. Please, indicate to what extent the following groups benefit from the results obtained from your research activities"*. Each beneficiary type was scored on a Likert scale, ranging from 1 (low importance) to 7 (high importance).

To build our dependent variables, we conducted principal components factor analysis (PCFA) on the survey responses. The analyses returned a three-factor solution. Table 3 shows the factor loadings. The first factor consists of beneficiaries within academic boundaries (e.g.: scientists from the respondent's own academic discipline). We labelled this category *academic community* (Cronbach's $\alpha = 0.66$). The second factor comprises beneficiary commercial groups (e.g. pharmaceutical industry) ($\alpha = 0.67$). We labelled this factor *industry*. The third factor we labelled *Patients & clinical staff*, since it covered beneficiary groups from the clinical and patient sides of biomedical research ($\alpha = 0.78$). Our three dependent variables are built by averaging the scores of the items in each category. The academic community would logically be the main perceived beneficiary of research, followed by patients and clinical staff, and finally industry.

{Table 3 here}

3.3 Independent variables

Motivation types. One of the most reliable scales to capture combinations of individual motivations is based on items from the Self-Regulation Questionnaire (SQR, Ryan and Connell, 1989). The present study is aimed at capturing domain-specific motivation types, namely the motivation types for engagement in biomedical research activity. One of the questions in the survey asked *"Why do you engage in biomedical research activities?";* a list of items adapted from the questionnaire was provided for each motivation type. Table 4 presents the factors resulting from the factor analysis. The responses related to *intrinsic motivation* include *"…because I enjoy it"*, *"…because I find it interesting"* or *"…because I find it personally satisfying"* (Cronbach's α = 0.73). Similarly, items related to *extrinsic motivation* include: *"…because I want to increase my economic earnings"*, *"…because I want to obtain recognition from my academic community"* or *"…because I want to improve my professional position"* (α = 0.80). The scale used to capture *prosocial motivation* is adapted from the SRQ and has been shown to have adequate reliability (Grant, 2008a; Grant and Sumanth, 2009). Items from this scale include motives such as *"…because I care about benefiting others through my work"* or *"…because it is important to me to do good for others through my work"* (α = 0.87). Respondents scored high for intrinsic and prosocial motivation (mean equal to 6), which suggests complementarity between fulfilment of personal goals and feeling useful to others. They scored lower for extrinsic motivation (3.7), thus, external rewards matter, but not much.

{Table 4 here}

Personality traits. The survey instrument to capture scientists' personality traits is based on the mini-International Personality Item Pool (IPIP) scale developed by Donnellan et al. (2006) and validated in a number of subsequent studies (e.g. Bellé, 2013; Grant and Wrzesniewski, 2010). This scale is derived from a longer list of items from the IPIP (Goldberg, 1999). The five-factor model of personality traits measures individual differences on the basis of the big five stable personality traits (see section 2.5). Previous studies provide support for the big five structure. Each item consists of a descriptive phrase, (e.g. "*I sympathize with others' feelings", "I am not interested in abstract ideas*"), and respondents were asked to indicate on a 7-point, Likert-type scale ranging from 1: 'disagree strongly' up to 7: 'agree strongly', how well they described themselves.

After reversing some of the items, scores for individual items were averaged to produce a global score for each of the five personality traits, i.e. *extraversion* (Cronbach's α = 0.70), *agreeableness* (α = 0.63), *conscientiousness* (α = 0.71), *neuroticism* (α = 0.61) and *openness to experience* (α = 0.64). The alpha values are acceptable for the mini-IPIP scale and in line with previous work (Baldasaro et al., 2013; Donnellan et al., 2006). We also conducted a confirmatory factor analysis to test reliability, which confirmed that items were clearly grouped into the five factors (see Table 5). The sample researchers exhibit high degrees of agreeableness, conscientiousness and openness, but lower levels of extraversion and neuroticism.

{Table 5 here}

3.4 Control variables

Individual socio-demographic variables. Based on the literature, we included a number of control variables in our models for potential determinants of perceived beneficiary impact, at both the individual and research team levels. Respondent's *Age* was included because some studies show that age is related to the scientist's propensity for participation in activities related to the commercialization of science (D'Este and Perkmann, 2011; Haeussler and Colyvas, 2011). Scientists' *gender* (coded 1 for female and 0 for male) was included to account for gender-based differences. We also accounted for scientists' *status* in their respective research groups. This was a categorical variable calculated as the average of five categories: principal investigator (PI), post-doctoral researcher with projects as a PI, post-doctoral researcher without projects as a PI, pre-doctoral researcher, and technician. It ranged from 0 (technician) to 4 (PI), that is, higher values correspond to higher status. We also considered type of *contracting relationship* with the CIBER research group. We included a dummy variable for whether the respondent was employed by the group, was affiliated to the group, but employed by another organization, or other contract type.

The average individual is around 42 years old; 55 per cent are female, 45 per cent male. The mean value of status is 2, indicating that many individuals are in their mid career stage (postdocs without projects as PIs); 22 per cent of the respondents are employed by CIBER, the remainder are affiliated to CIBER or have some other contracting relationship.

Individual research-related variables. We accounted for scientists' *research mobility* experience. The survey asked scientists to indicate the time (in months) that they had spent on pre-doctoral or post-doctoral research stays in a different organization from their current employer. We expressed the resulting variable in number of years. Because scientists performing more clinical research might be particularly aware of their perceived impact on non-academic beneficiary groups, we controlled for this with a set of dummies. We asked respondents whether they performed mostly basic research, clinical research, or both. We built a variable *–degree of clinical research–*, which is the average of three values: 1 (basic research), 2 (basic and clinical research) and 3 (clinical research). Next, we controlled for the respondents' distribution of working time. Specifically, we asked respondents to allocate their working time during a typical week among a set of tasks: research, teaching, patient care, administrative duties, development of relations with external colleagues, and other activities. The sum of these variables is 100 per cent. For the estimation, we used the most frequent (*% research time*) compared to the rest of the variables.

Our individuals tend to have one year of research mobility experience. The variable nature of research has a mean value of 2, indicating a medium degree of clinical orientation in the sample. Individuals allocate an average of 59 per cent of their time to research activities and 41 per cent to other activities (the remaining categories scored much lower, e.g. the second biggest is administrative duties allocated 13 per cent of their time).

Organizational variables: group and organization type. This set of variables allows us to take account of individual contexts, since organizational features are likely to impact scientists' attitudes and actions (Duberley et al., 2006). First, our models control for previous academic and technological experience of the PI of the research group to which the respondent belongs. Recent research shows that the PI plays a lead role in orienting the research group's scientific interests and contributions (Boehm and Hogan, 2014). We operationalized the potential influence of the PI with two additional control variables. The first (*PI academic papers*) indicates the number of the PI's published academic papers. We also recovered patent data from PATSTAT to derive the number of the PI's patent applications submitted during the period 1998-2010 *(PI patent applications)*. We added group *size*, measured as the total number of scientists in the same research group as the respondent. To control for organizational effects, we included four dummy variables: university, hospital/clinic, public research organization and other type of organization, this last being the reference category.

In this sample, the typical group PI has published 56 papers (0.56 in Table 1 because the variable is divided into 100 for reasons of scale) and patented 1 invention. The average group includes 18-19 members. The distribution by type of organization is as follows: 32 per cent hospitals, 31 per cent university, 27 per cent PROs and 10 per cent private and other research organizations.

Institutional variables: sub-field and region. We include a set of control variables to account for differences in the respondent's scientific sub-field. We use nine dummies to identify *CIBER programme*. As stated above, each CIBER programme focuses on a different biomedical sub-field, ranging from obesity (CIBER-EHD) to diabetes and metabolic diseases (CIBER-DEM). We expect that the CIBER field might have an impact on perceived beneficiary impact, due to the divergent institutional logics provided by each scientific sub-field (Dunn and Jones, 2010). Finally, the location of our sample of research groups is concentrated in Spain's two largest cities: Madrid and Barcelona. To account for potential geographical effects, we include a dummy variable *region* (1 = Madrid or Barcelona, 0 = any other location).

The largest CIBERs are in the field of bioengineering, biomaterials and nanotechnology, followed by neurodegenerative diseases, and 63 per cent of respondents are located in Madrid or Barcelona.

4 Results

Table 6 reports the results of the linear regressions. We cluster observations by research groups to guarantee the independence of the error terms. Odd models include only the control variables for each dependent variable; even models include personality traits and motivations. By comparing the r-squares, we can see a substantial increase in the predictive power of the even models (Wald tests consistently indicate the increase is significant).

{Table 6 here}

The coefficients of most variables do not change their significance after inclusion of the psychological variables. Age does not have a significant impact on any beneficiary type, which is in line with other research (Boardman and Ponomariov, 2009). Being female has a negative influence on the impact on industry, but not the academic community or patients. This negative effect is consistent with previous studies (Azagra-Caro et al., 2006; Boardman and Ponomariov, 2009). Status is positively associated with an orientation to the academic community, but not to industry or patients, a natural consequence of the incentives for promotion within academia (Bozeman and Gaughan, 2007). Type of contractual relationship with the CIBER has no significant effect and numbers of published papers and patents invented by the group's PI do not affect beneficiary types. The larger the group size, the lower the perceived effect on industry, suggesting that smaller research groups tend to target firms as beneficiaries. Dummies for affiliation to a CIBER programme are significant for both orientation to industry and patients, but not academia, suggesting that these sub-fields pursue similar academic objectives, but vary in their focus on other stakeholders. Location in one of the two main regions in terms of agglomeration does not affect perceived impact of research.

Another set of control variable estimated coefficients shows a change in significance with the inclusion of psychological variables. The results confirm a positive association between stays abroad and academic and industry orientation, only if the psychological variables are included in the equation (Models 2 and 4). The initial lack of significance when psychological variables are excluded may be because the benefits of mobility for scientific production are not clear (Fernandez-Zubieta et al., 2013). However, the final significant coefficients confirm that for a given motivation a personality traits, there is a positive association between stays abroad and industrial orientation, probably due to the fact that researchers choose to move to more prestigious academic environments and learn from their host organization about how to combine academic and industrial agendas (Azagra-Caro et al., 2006). The more clinical the research, the lower the perceived impact on the academic community and the higher the perceived impact on industry and patients; but the effect of clinical research on industry is not significant after accounting for psychological characteristics. A higher proportion of time available for research increases the perceived impact on the academic community and industry as beneficiaries, but this effect for the academic community disappears with the inclusion of the psychological variables (Model 2). Organizational type has no impact on academic researchers or industry, but does affect patients once we account for the influence of psychological variables (Model 6). This last result is due to the significantly lower propensity for universities and public research organizations to devote efforts to patients (compared to hospitals and private research organizations).

These changes in the effects of research mobility, clinical research, share of research time and institutional type, indicate that the inclusion of psychological motivations and traits is important to control for the importance of individual research-related variables for academic and industrial (not socio-demographic or supra-individual) orientation, and for the importance of a supra-individual variable (organization type) for an orientation to patients.

For motivations, our results show that all types (intrinsic, extrinsic, prosocial) have positive effects on most beneficiaries of research: academia, industry and patients (Models 2, 4 and 6), although there are two exceptions. The first is the non-significant effect of intrinsic motivation on conducting research with a likely impact on industry where extrinsic and prosocial motivations are the drivers. This might be because researchers acknowledge outside support for academic-industry interaction, and acknowledge its social value, but prefer not to be involved in its complex costs and benefits (Welsh et al., 2008). The second exception is the non-significant effect of extrinsic motivation on perceived impact on patients, where only intrinsic and prosocial motivations matter. This might be because external support for patient-oriented research can become a source of conflict in the biomedical sector, where companies try to influence researchers from a very early stage (Lieb and Koch, 2013) and industry-sponsored research leads to more secrecy and pro-industry scientific results (Bekelman et al., 2003).

In contrast with the general positive effect of motivations on beneficiaries, only three out of the big five personality traits affect beneficiary type (openness to experience, extraversion and conscientiousness) and only one of them affects each beneficiary type at a time. Correlations between personality traits are low (see Table 2), so many individuals score high in only one trait and, consequently, will be unable to address different audiences, all else remaining constant. Two personality traits (agreeableness and neuroticism) have no influence on beneficiary types. Compared to the typical complex pattern of the effect of the big five on other phenomena (see Section 2.5), this suggests a simpler, univocal relationship, perhaps because ordering individual preferences for one type of audience or another is a less complex problem. Our findings reveal also that many of the barriers usually found in the literature on academics' interaction with industry, and openness to patients, are deeply rooted in stable personal characteristics, which situate scientists in an *a priori* condition irrespective of organizational or institutional influences.

For the three specific relationships due to personality traits, the results show that openness to experience, extraversion and conscientiousness have a respective positive impact on the academic community, industry and patients as the main beneficiaries. This confirms Hypotheses 1 to 3. A very recognizable feature of a scientist, being curious and open-minded (i.e. open to experience), increases biomedical scientists' perceived impact on academic community. In order to address external communities, the scientist needs to be extrovert and eager to engage in commercial activities, or conscientious, which endows the willingness to devote time to non-routine tasks such as caring about patients. This latter finding, in the context of the already mentioned lower importance of patient-related research for universities and public research organizations, suggests that even in such unfavourable organisational contexts, it is possible to find individuals who are able to overcome the obstacles.

Hypothesis 4 predicts a positive effect of conscientiousness on perceived impact on the academic community. Returning to Model 2, we see that this hypothesis is not confirmed, since the results show no such significant effect. It might be an idiosyncrasy of our sample that the average biomedical researcher scores high for conscientiousness (see section 3.3), whereas the literature generally does not characterize researchers as being overly conscientious (Lounsbury et al., 2012).

5 Conclusions

Analysis of the societal impact of science in terms of beneficiaries should be of interest to policymakers. Increasingly, scientific advancements are evaluated in light of their societal impact, and bridging the "relevance gap" has become a policy priority (Nightingale and Scott, 2007). In the biomedical field, this debate surrounds the translational research paradigm, which advocates for a closer dialogue between basic science producers and potential beneficiaries of its results, such as patient representatives and industry actors. However, medical progress depends heavily on advancements in basic research (Contopoulos-Ioannidis et al., 2003). At its nascent stage, biomedical research is pursued in contexts where potential application of research results is still a distant goal. It is at this stage also that scientists have most of the decision rights over the orientation of their research projects (Tartari and Breschi, 2012). Thus, exploring the extent to which scientists are concerned about other groups in their research activities is highly pertinent. We set out to clarify the main perceived beneficiaries of biomedical research from the scientist's viewpoint. As pointed out by organizational psychology scholars (Belle, 2014; Grant and Campbell, 2007), raising awareness about the impact of one's work on beneficiary groups is associated with increased levels of performance and dedication, and results in extra efforts to reach these perceived beneficiary groups.

Our survey data reveal that respondents discern the potential impact of their research activities over three specific beneficiary groups: academic community, industry, and patients and clinical staff. Building on this categorization, we explored whether observed heterogeneity could be predicted by the psychological characteristics of scientists. In addition to individual, organizational and institutional variables, including scientists' motivations and personality traits improved the predictive power of our models. In particular, our results suggest that the greater the scientist's intrinsic, extrinsic and prosocial motivations, the greater is their awareness of the effects of their research on all beneficiary groups. We observed also that psychological traits predict perceived beneficiary impact. Specifically, we found that scientists scoring high for openness to experience have a greater subjective awareness of their perceived impact on academic peers; those scoring high for extraversion are more likely to be aware of their impact on industrial actors; and those scoring high for conscientiousness will be more prone to put more weight on their perceived impact on patients and clinical staff.

From a policy perspective, our results make a number of contributions to directors of research and policymakers keen to encourage science with wider application. It seems clear that policy initiatives to involve non-academic actors into the research process need to be tailored. Explicit consideration of heterogeneous preferences and personality traits seems to indicate that, *ceteris paribus*, not all scientists are equally equipped to achieve impact on multiple stakeholders from their research agendas. Thus, policies based on one-size-fits-all incentives may be only partially effective. The additional explanatory power of psychological differences, shown by our results, provides information on how to design more targeted policies. For instance, our findings suggest that policies promoting the mobility of researchers as a way to raise awareness about industrial actors' needs should be considered. The positive effect of mobility experience on perceived beneficiary impact on industry appears to hold only for certain psychological profiles. Similarly, the apparent relationship between the amount of time devoted to scientific research and consideration of academic peers as the primary beneficiaries of scientific activity, is less clear when psychological characteristics are included. Policymakers need to be aware of these issues, and scientific hiring policies should take account of the fact that certain psychological profiles may be better suited to incorporating societal needs into the research process. Further research is needed along these lines. Future research could analyse the fit between various psychological profiles and the strategic objectives of particular labs or research groups.

Our findings suggest also that policymakers should bear in mind the key role of motivation as a way to boost scientists' perceived impact on diverse beneficiary groups. Thus, we can see opportunities for interventions aimed at shaping the current motivational structures, as a way to increase scientists' perceived beneficiaries. Our results show a non-significant relationship between scientists' intrinsic motivation and perceived impact on industry, and between their extrinsic motivation and impact on patients. Thus, research could advance our understanding of this relationship and assess its generalizability, for instance, by developing qualitative studies of cases where scientists driven by intrinsic motivation have been successfully engaged with industrial actors, or where prosocial motives predict a higher interest in reaching industrial actors.

This study has some limitations. We rely mainly on survey data to build our variables. Although we collected information on a large number of researchers, and self-reported data is common in motivational and psychological studies, we acknowledge the limitations associated with this approach. Future research should use secondary sources (e.g. involvement in patenting or in meetings with patients) to proxy for perceived beneficiary impact. We acknowledge also that scientific careers are intertwined with the individual's organization which would justify an analysis of interactions between psychology and group/institution. However, because the current paper is a first attempt to introduce psychology into analysis of research beneficiaries, we think that this would overly complicate our study, although it might be an interesting extension to our work.

Acknowledgements

Mabel Sánchez-Barrioluengo contributed by resolving some methodological doubts, Pablo D'Este provided invaluable support for this project and Alfredo Yegros-Yegros helped build some variables. Earlier versions were presented at a 2015 seminar at Grenoble School of Management; the Workshop 'Recent Advances in the Study of Science and Technology Dynamics' at the University of Utrecht; and the DRUID15 Conference on the Relevance of Innovation. We thank participants for their comments. We acknowledge financial support from the Spanish Ministry of Economy and Competitiveness (ECO2011-28749).

References

Allport, G.W., 1937. Personality: a psychological interpretation. Holt, Oxford, England.

Ankrah, S.N., Burgess, T.F., Grimshaw, P., Shaw, N.E., 2013. Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit. Technovation 33, 50–65. doi:10.1016/j.technovation.2012.11.001

Arar, N.H., Nandamudi, D., 2012. Advancing Translational Research by Enabling Collaborative Teamwork: The TRACT Approach. Journal of Research in Interprofessional Practice and Education 2.

Arvanitis, S., Kubli, U., Woerter, M., 2008. University-industry knowledge and technology transfer in Switzerland: What university scientists think about co-operation with private enterprises. Research Policy 37, 1865–1883. doi:10.1016/j.respol.2008.07.005

Azagra-Caro, J.M., Archontakis, F., Gutiérrez-Gracia, A., Fernández-de-Lucio, I., 2006. Faculty support for the objectives of university–industry relations versus degree of R&D cooperation: The importance of regional absorptive capacity. Research Policy 35, 37–55. doi:10.1016/j.respol.2005.08.007

Azagra-Caro, J.M., Aznar-Márqez, J., Blanco, J.M., 2008. Interactive vs. non-interactive knowledge production by faculty members. Applied Economics 40, 1289–1297. doi:10.1080/00036840600771338

Azagra-Caro, J.M., Mas-Verdú, F., Martinez-Gomez, V., 2012. Forget R&D–pay my coach: young innovative companies and their relations with universities, in: Technology Transfer in a Global Economy. Springer, pp. 13–34.

Baldasaro, R.E., Shanahan, M.J., Bauer, D.J., 2013. Psychometric Properties of the Mini-IPIP in a Large, Nationally Representative Sample of Young Adults. Journal of Personality Assessment 95, 74–84. doi:10.1080/00223891.2012.700466

Barrick, M.R., Mount, M.K., 1991. The big five personality dimensions and job performance: a meta-analysis. Personnel psychology 44, 1–26.

Bekelman, J.E., Li, Y., Gross, C.P., 2003. Scope and impact of financial conflicts of interest in biomedical research: a systematic review. Jama 289, 454–465.

Belle, N., 2014. Leading to Make a Difference: A Field Experiment on the Performance Effects of Transformational Leadership, Perceived Social Impact, and Public Service Motivation. Journal of Public Administration Research and Theory 24, 109–136. doi:10.1093/jopart/mut033

Bellé, N., 2013. Experimental evidence on the relationship between public service motivation and job performance. Public Administration Review 73, 143–153.

Berings, D., De Fruyt, F., Bouwen, R., 2004. Work values and personality traits as predictors of enterprising and social vocational interests. Personality and Individual Differences 36, 349–364. doi:10.1016/S0191-8869(03)00101-6

Boardman, C., Ponomariov, B.L., 2009. University researchers working with private companies. Technovation 29, 142–153. doi:10.1016/j.technovation.2008.03.008

Boehm, D.N., Hogan, T., 2014. “A jack of all trades”: the role of PIs in the establishment and management of collaborative networks in scientific knowledge commercialisation. J Technol Transf 39, 134–149. doi:10.1007/s10961-012-9273-8

Bonaccorsi, A., Secondi, L., Setteducati, E., Ancaiani, A., 2012. Participation and commitment in third-party research funding: evidence from Italian Universities. J Technol Transf 39, 169–198. doi:10.1007/s10961-012-9268-5

Bornmann, L., 2013. What is societal impact of research and how can it be assessed? a literature survey. J Am Soc Inf Sci Tec 64, 217–233. doi:10.1002/asi.22803

Bornstein, S.R., Licinio, J., 2011. Improving the efficacy of translational medicine by optimally integrating health care, academia and industry. Nature medicine 17, 1567–1569.

Bozeman, B., Gaughan, M., 2007. Impacts of grants and contracts on academic researchers' interactions with industry. Research policy 36, 694–707.

Caspi, A., Roberts, B.W., Shiner, R.L., 2005. Personality Development: Stability and Change. Annual Review of Psychology 56, 453–484. doi:10.1146/annurev.psych.55.090902.141913

Cattell, R.B., 1946. Description and measurement of personality. World Book Company, Oxford, England.

Coleman, J.S., 1994. Foundations of social theory. Harvard University Press.

Coller, B.S., 2008. Translational research: forging a new cultural identity. Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine 75, 478–487. doi:10.1002/msj.20064

Collins, F.S., 2011. Reengineering translational science: the time is right. Science translational medicine 3, 90cm17–90cm17.

Contopoulos-Ioannidis, D.G., Ntzani, E.E., Ioannidis, J.P.A., 2003. Translation of highly promising basic science research into clinical applications. The American Journal of Medicine 114, 477–484. doi:10.1016/S0002-9343(03)00013-5

Costa, P.T., McCrae, R.R., 1992. Normal personality assessment in clinical practice: The NEO Personality Inventory. Psychological Assessment 4, 5–13. doi:10.1037/1040-3590.4.1.5

Costa, P.T., McRae, R.R., 1985. NEO Personality Inventory–Form R.

Dasgupta, P., David, P.A., 1994. Toward a new economics of science. Research policy 23, 487–521.

Deci, E.L., Ryan, R.M., 2000. The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. Psychological Inquiry: An International Journal for the Advancement of Psychological Theory 11, 227. doi:10.1207/S15327965PLI1104_01

Deci, E.L., Ryan, R.M., 1985. Intrinsic motivation and self-determination in human behavior. Springer.

De Fuentes, C., Dutrénit, G., 2012. Best channels of academia–industry interaction for long-term benefit. Research Policy 41, 1666–1682. doi:10.1016/j.respol.2012.03.026

Delgado Rodríguez, M., 2012. CIBERESP: un instrumento para la promoción y la difusión de la investigación de excelencia española. Gaceta Sanitaria 26, 393–394.

D'Este, P., Perkmann, M., 2011. Why do academics engage with industry? The entrepreneurial university and individual motivations. The Journal of Technology Transfer 36, 316–339. doi:10.1007/s10961-010-9153-z

Donnellan, M.B., Oswald, F.L., Baird, B.M., Lucas, R.E., 2006. The mini-IPIP scales: tiny-yet-effective measures of the Big Five factors of personality. Psychol Assess 18, 192–203. doi:10.1037/1040-3590.18.2.192

Donovan, C., 2011. State of the art in assessing research impact: introduction to a special issue. Research Evaluation 20, 175–179. doi:10.3152/095820211X13118583635918

Duberley, J., Cohen, L., Mallon, M., 2006. Constructing Scientific Careers: Change, Continuity and Context. Organization Studies 27, 1131–1151. doi:10.1177/0170840606064105

Dunn, M.B., Jones, C., 2010. Institutional logics and institutional pluralism: The contestation of care and science logics in medical education, 1967–2005. Administrative Science Quarterly 55, 114–149.

Etzkowitz, H., Webster, A., Gebhardt, C., Terra, B.R.C., 2000. The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. Research Policy 29, 313–330. doi:10.1016/S0048-7333(99)00069-4

Eysenck, H.J., 1971. Relation between intelligence and personality. Perceptual and Motor Skills 32, 637–638.

Eysenck, H.J., 1950. Dimensions of Personality. Transaction Publishers.

Fehrler, S., Kosfeld, M., 2014. Pro-social missions and worker motivation: An experimental study. Journal of Economic Behavior & Organization 100, 99–110. doi:10.1016/j.jebo.2014.01.010

Feist, G.J., 2012. Predicting interest in and attitudes toward science from personality and need for cognition. Personality and Individual Differences 52, 771–775. doi:10.1016/j.paid.2012.01.005

Feist, G.J., 2006. The past and future of the psychology of science. Review of General Psychology 10, 92–97. doi:10.1037/1089-2680.10.2.92

Feist, G.J., 1998. A Meta-Analysis of Personality in Scientific and Artistic Creativity. Pers Soc Psychol Rev 2, 290–309. doi:10.1207/s15327957pspr0204_5

Felin, T., Foss, N.J., 2005. Strategic organization: a field in search of micro-foundations. Strategic Organization 441 –455. doi:10.1177/1476127005055796

Fernandez-Zubieta, A., Geuna, A., Lawson, C., 2013. Researchers' Mobility and its Impact on Scientific Productivity (SSRN Scholarly Paper No. ID 2244760). Social Science Research Network, Rochester, NY.

Fleurence, R., Selby, J.V., Odom-Walker, K., Hunt, G., Meltzer, D., Slutsky, J.R., Yancy, C., 2013. How the patient-centered outcomes research institute is engaging patients and others in shaping its research agenda. Health Affairs 32, 393–400.

Furnham, A., Swami, V., Arteche, A., Chamorro-Premuzic, T., 2008. Cognitive ability, learning approaches and personality correlates of general knowledge. Educational Psychology 28, 427–437. doi:10.1080/01443410701727376

George, J.M., 2009. The illusion of will in organizational behavior research: Nonconscious processes and job design. Journal of Management.

George, J.M., Zhou, J., 2001. When openness to experience and conscientiousness are related to creative behavior: An interactional approach. Journal of Applied Psychology 86, 513–524. doi:10.1037/0021-9010.86.3.513

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M., 1994. The new production of knowledge: The dynamics of science and research in contemporary societies. Sage Publications, Inc, Thousand Oaks, CA, US.

Goldberg, L.R., 1999. A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. Personality psychology in Europe 7, 7–28.

Goldberg, L.R., 1981. Language and individual differences: The search for universals in personality lexicons. Review of personality and social psychology 2, 141–165.

Goldsmith, R.E., Freiden, J.B., Eastman, J.K., 1995. The generality/specificity issue in consumer innovativeness research. Technovation 15, 601–612. doi:10.1016/0166-4972(95)99328-D

Grant, A., 2007. Relational Job Design And The Motivation To Make A Prosocial Difference. Academy of Management Review 32, 393–417. doi:10.5465/AMR.2007.24351328

Grant, A.M., 2012. Leading with Meaning: Beneficiary Contact, Prosocial Impact, and the Performance Effects of Transformational Leadership. ACAD MANAGE J 55, 458–476. doi:10.5465/amj.2010.0588

Grant, A.M., 2008a. Does intrinsic motivation fuel the prosocial fire? Motivational synergy in predicting persistence, performance, and productivity. Journal of Applied Psychology 93, 48–58. doi:10.1037/0021-9010.93.1.48

Grant, A.M., 2008b. The significance of task significance: Job performance effects, relational mechanisms, and boundary conditions. Journal of Applied Psychology 93, 108–124. doi:10.1037/0021-9010.93.1.108

Grant, A.M., Berry, J.W., 2011. The Necessity of Others is the Mother of Invention: Intrinsic and Prosocial Motivations, Perspective Taking, and Creativity. Academy of Management Journal 54, 73–96. doi:10.5465/AMJ.2011.59215085

Grant, A.M., Campbell, E.M., 2007. Doing good, doing harm, being well and burning out: The interactions of perceived prosocial and antisocial impact in service work. Journal of occupational and organizational psychology 80, 665–691.

Grant, A.M., Campbell, E.M., Chen, G., Cottone, K., Lapedis, D., Lee, K., 2007. Impact and the art of motivation maintenance: The effects of contact with beneficiaries on persistence behavior. Organizational Behavior and Human Decision Processes 103, 53–67. doi:10.1016/j.obhdp.2006.05.004

Grant, A.M., Sumanth, J.J., 2009. Mission possible? The performance of prosocially motivated employees depends on manager trustworthiness. Journal of Applied Psychology 94, 927–944. doi:10.1037/a0014391

Grant, A.M., Wrzesniewski, A., 2010. I won't let you down… or will I? Core self-evaluations, other-orientation, anticipated guilt and gratitude, and job performance. Journal of Applied Psychology 95, 108–121. doi:10.1037/a0017974

Gray, J.A., 1987. The psychology of fear and stress (2nd ed.), Problems in the behavioural sciences, Vol. 5. Cambridge University Press, New York, NY, US.

Haeussler, C., Colyvas, J.A., 2011. Breaking the Ivory Tower: Academic Entrepreneurship in the Life Sciences in UK and Germany. Research Policy, Special Section on Heterogeneity and University-Industry Relations 40, 41–54. doi:10.1016/j.respol.2010.09.012

Hobin, J.A., Deschamps, A.M., Bockman, R., Cohen, S., Dechow, P., Eng, C., Galey, W., Morris, M., Prabhakar, S., Raj, U., Rubenstein, P., Smith, J.A., Stover, P., Sung, N., Talman, W., Galbraith, R., 2012. Engaging basic scientists in translational research: identifying opportunities, overcoming obstacles. J Transl Med 10, 1–14. doi:10.1186/1479-5876-10-72

Hogg, M.A., Terry, D.I., 2000. Social identity and self-categorization processes in organizational contexts. Academy of management review 25, 121–140.

Howard, G.S., 1994. Why do people say nasty things about self-reports? Journal of Organizational Behavior 15, 399–404. doi:10.1002/job.4030150505

Judge, T.A., Higgins, C.A., Thoresen, C.J., Barrick, M.R., 1999. The Big Five Personality Traits, General Mental Ability, and Career Success Across the Life Span. Personnel Psychology 52, 621–652. doi:10.1111/j.1744-6570.1999.tb00174.x

Kasemir, B., 2003. Public participation in sustainability science: a handbook. Cambridge University Press.

Kaye, J., Curren, L., Anderson, N., Edwards, K., Fullerton, S.M., Kanellopoulou, N., Lund, D., MacArthur, D.G., Mascalzoni, D., Shepherd, J., others, 2012. From patients to partners: participant-centric initiatives in biomedical research. Nature Reviews Genetics 13, 371–376.

Lam, A., 2011. What motivates academic scientists to engage in research commercialization: "Gold", "ribbon" or "puzzle"? Research Policy 40, 1354–1368. doi:10.1016/j.respol.2011.09.002

Lieb, K., Koch, C., 2013. Medical Students' Attitudes to and Contact With the Pharmaceutical Industry: A Survey at Eight German University Hospitals. Deutsches Ärzteblatt International 110, 584.

Link, A.N., Siegel, D.S., Bozeman, B., 2007. An empirical analysis of the propensity of academics to engage in informal university technology transfer. Industrial and Corporate Change 16, 641–655.

Lounsbury, J.W., Foster, N., Patel, H., Carmody, P., Gibson, L.W., Stairs, D.R., 2012. An investigation of the personality traits of scientists versus nonscientists and their relationship with career satisfaction. R&D Manage 42, 47–59. doi:10.1111/j.1467-9310.2011.00665.x

Lyall, C., Bruce, A., Firn, J., Firn, M., Tait, J., 2004. Assessing end-use relevance of public sector research organisations. Research policy 33, 73–87.

Marcati, A., Guido, G., Peluso, A.M., 2008. The role of SME entrepreneurs' innovativeness and personality in the adoption of innovations. Research Policy 37, 1579–1590. doi:10.1016/j.respol.2008.06.004

Martin, B.R., 2011. The Research Excellence Framework and the "impact agenda": are we creating a Frankenstein monster? Research Evaluation 20, 247–254. doi:10.3152/095820211X13118583635693

Martín-Sempere, M.J., Garzón-García, B., Rey-Rocha, J., 2008. Scientists' motivation to communicate science and technology to the public: surveying participants at the Madrid Science Fair. Public Understanding of Science 17, 349–367. doi:10.1177/0963662506067660

Maurer, T.J., Pierce, H.R., Shore, L.M., 2002. Perceived beneficiary of employee development activity: A three-dimensional social exchange model. Academy of Management Review 27, 432–444.

Mavris, M., Le Cam, Y., 2012. Involvement of patient organisations in research and development of orphan drugs for rare diseases in europe. Molecular syndromology 3, 237–243.

McCrae, R.R., Costa Jr, P.T., 1997. Conceptions and correlates of openness to experience.

Melton, G., Weaver, A., Andrews, E., Shamatha, J., 2005. Scientists and Public Outreach: Participation, Motivations, and Impediments. Journal of geoscience education 53, 281–293.

Molas-Gallart, J., Salter, A., Patel, P., Scott, A., Duran, X., 2002. Measuring third stream activities. Final report to the Russell Group of Universities. Brighton: SPRU, University of Sussex.

Molas-Gallart, J., Tang, P., Sinclair, T., Morrow, S., Martin, B., 1999. Assessing research impact on non-academic audiences. Brighton, SPRU.

Mostert, S.P., Ellenbroek, S.P., Meijer, I., van Ark, G., Klasen, E.C., 2010. Societal output and use of research performed by health research groups. Health Research Policy and Systems 8, 30.

Moynihan, D.P., Pandey, S.K., 2007. The role of organizations in fostering public service motivation. Public administration review 67, 40–53.

Nightingale, P., Scott, A., 2007. Peer review and the relevance gap: Ten suggestions for policy-makers. Science and Public Policy 34, 543–553. doi:10.3152/030234207X254396

Olmos Peñuela, J., Benneworth, P., Castro-Martínez, E., 2014. Explaining researchers' readiness to incorporate external stimuli in their research agendas. INGENIO (CSIC-UPV).

Organ, D.W., 1994. Personality and organizational citizenship behavior. Journal of Management 20, 465–478.

Owen-Smith, J., Powell, W.W., 2001. To patent or not: Faculty decisions and institutional success at technology transfer. The Journal of Technology Transfer 26, 99–114.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., Sobrero, M., 2013. Academic engagement and commercialisation: A review of the literature on university–industry relations. Research Policy 42, 423–442. doi:10.1016/j.respol.2012.09.007

Pursell, G.R., Laursen, B., Rubin, K.H., Booth-LaForce, C., Rose-Krasnor, L., 2008. Gender Differences in Patterns of Association Between Prosocial Behavior, Personality, and Externalizing Problems. J Res Pers 42, 472–481. doi:10.1016/j.jrp.2007.06.003

Rasmussen, E., Mosey, S., Wright, M., 2014. The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures. Research Policy 43, 92–106. doi:10.1016/j.respol.2013.06.007

Revelle, W., Wilt, J., Rosenthal, A., 2010. Individual Differences in Cognition: New methods for examining the Personality-Cognition link, in: Handbook of Individual Differences in Cognition. Springer, pp. 27–49.

Roach, M., Sauermann, H., 2010. A taste for science? PhD scientists' academic orientation and self-selection into research careers in industry. Research Policy 39, 422–434. doi:10.1016/j.respol.2010.01.004

Roccas, S., Sagiv, L., Schwartz, S.H., Knafo, A., 2002. The Big Five Personality Factors and Personal Values. Pers Soc Psychol Bull 28, 789–801. doi:10.1177/0146167202289008

Rothaermel, F.T., Agung, S.D., Jiang, L., 2007. University entrepreneurship: a taxonomy of the literature. Industrial and Corporate Change 16, 691–791.

Ryan, R.M., Connell, J.P., 1989. Perceived Locus of Causality and Internalization: Examining Reasons for Acting in Two Domains. Journal of Personality and Social Psychology 57, 749–761.

Salter, A.J., Martin, B.R., 2001. The economic benefits of publicly funded basic research: a critical review. Research policy 30, 509–532.

Sánchez-Barrioluengo, M., 2014. Articulating the "three-missions" in Spanish universities. Research Policy 43, 1760–1773.

Sauermann, H., Cohen, W., Stephan, P., 2010. Doing well or doing good? The motives, incentives and commercial activities of academic scientists and engineers, in: DRUID Summer Conference 2010, London.

Sauermann, H., Roach, M., 2014. Not all scientists pay to be scientists: PhDs' preferences for publishing in industrial employment. Research Policy 43, 32–47. doi:10.1016/j.respol.2013.07.006

Shaver, P.R., Brennan, K.A., 1992. Attachment Styles and the "Big Five" Personality Traits: Their Connections with Each Other and with Romantic Relationship Outcomes. Pers Soc Psychol Bull 18, 536–545. doi:10.1177/0146167292185003

Spaapen, J., van Drooge, L., 2011. Introducing "productive interactions" in social impact assessment. Research Evaluation 20, 211–218. doi:10.3152/095820211X12941371876742

Stern, S., 2004. Do Scientists Pay to Be Scientists? Management Science 50, 835–853. doi:10.1287/mnsc.1040.0241

Ta-Cheng, H., 1997. Capability development and management of R&D professionals in a developing context, Taiwan. Technovation 17, 569–596. doi:10.1016/S0166-4972(97)00047-3

Tartari, V., Breschi, S., 2012. Set them free: scientists' evaluations of the benefits and costs of university–industry research collaboration. Ind Corp Change 21, 1117–1147. doi:10.1093/icc/dts004

Tartari, V., Perkmann, M., Salter, A., 2014. In good company: The influence of peers on industry engagement by academic scientists. Research Policy 43, 1189–1203. doi:10.1016/j.respol.2014.02.003

van der Weijden, I., Verbree, M., van den Besselaar, P., 2012. From bench to bedside: The societal orientation of research leaders: The case of biomedical and health research in the Netherlands. Science and Public Policy 39, 285–303. doi:10.1093/scipol/scr003

van Rijnsoever, F.J., Hessels, L.K., Vandeberg, R.L.J., 2008. A resource-based view on the interactions of university researchers. Research Policy 37, 1255–1266. doi:10.1016/j.respol.2008.04.020

Walsh, J.P., Cohen, W.M., Cho, C., 2007. Where excludability matters: Material versus intellectual property in academic biomedical research. Research Policy 36, 1184–1203.

Walsh, J.P., Hong, W., 2003. Secrecy is increasing in step with competition. Nature 422, 801–802.

Welsh, R., Glenna, L., Lacy, W., Biscotti, D., 2008. Close enough but not too far: Assessing the effects of university–industry research relationships and the rise of academic capitalism. Research Policy, Special Section Knowledge Dynamics out of Balance: Knowledge Biased, Skewed and Unmatched 37, 1854–1864. doi:10.1016/j.respol.2008.07.010

Tables

Table 1. Descriptive statistics (N=1033)

Variable type	Variable	Mean	Standard deviation	Minimum	Maximum
Psychological	Academic community	5.40	1.28	1.00	7.00
	Industry	3.39	1.53	1.00	7.00
	Patients and clinical staff	4.41	1.43	1.00	7.00
	Intrinsic motivation	6.17	0.81	1.00	7.00
	Extrinsic motivation	3.71	1.16	1.00	7.00
	Prosocial motivation	6.02	1.02	1.00	7.00
	Openness	5.35	1.00	1.00	7.00
	Conscientiousness	5.62	1.00	1.25	7.00
	Extraversion	3.93	1.18	1.00	7.00
	Agreeableness	5.69	0.93	2.00	7.00
	Neuroticism	3.38	1.09	1.00	7.00
Socio-demographic	Age	41.62	10.39	23.00	74.00
	Gender (female)	0.55	0.50	0.00	1.00
	Status	2.09	1.13	0.00	4.00
	CIBER employee	0.22	0.42	0.00	1.00
Research-related	Mobility	1.01	1.90	0.00	17.58
	Clinical research	2.02	0.87	1.00	3.00
	% research time	0.59	0.29	0.00	1.00
Organisational	PI papers	0.56	0.49	0.03	2.95
	PI patents	1.04	2.35	0.00	21.00
	Size	18.5	10.86	2	79
	University	0.31	0.46	0.00	1.00
	Hospital	0.32	0.47	0.00	1.00
	Public research organisation	0.27	0.45	0.00	1.00
Institutional	CIBERs				
	Biomedicine and biomaterials	0.18	0.39	0	1
	Diabetes and metabolic diseases	0.08	0.27	0	1
	Hepatic and digestive diseases	0.11	0.32	0	1
	Rare diseases	0.14	0.35	0	1
	Respiratory diseases	0.12	0.32	0	1
	Epidemiology and public health	0.09	0.28	0	1
	Neurodegenerative diseases	0.15	0.35	0	1
	Obesity and nutrition	0.06	0.23	0	1
	Mental health	0.08	0.27	0	1
	Madrid or Catalonia	0.63	0.48	0.00	1.00

Table 2 Correlations (N=1033)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	Academic com.	1.00																								
2	Industry	0.33*	1.00																							
3	Patients	0.24*	0.29*	1.00																						
4	Intrinsic mot.	0.39*	0.11*	0.22*	1.00																					
5	Extrinsic mot.	0.25*	0.22*	0.18*	0.24*	1.00																				
6	Prosocial mot.	0.32*	0.16*	0.30*	0.56*	0.23*	1.00																			
7	Openness	0.22*	0.07*	0.05	0.28*	-0.04	0.18*	1.00																		
8	Conscientiousness	0.10*	0.01	0.13*	0.09*	0.08*	0.21*	0.00	1.00																	
9	Extraversion	0.08*	0.10*	0.08*	0.12*	0.10*	0.13*	0.18*	-0.02	1.00																
10	Agreeableness	0.15*	0.04	0.13*	0.16*	-0.01	0.27*	0.25*	0.18*	0.25*	1.00															
11	Neuroticism	-0.07*	0.00	-0.01	-0.11*	0.02	-0.04	-0.18*	-0.08*	-0.10*	-0.06	1.00														
12	Age	-0.02	-0.02	0.09*	-0.06	0.11*	-0.09*	-0.05	-0.10*	-0.14*	-0.08*	0.01	1.00													
13	Gender (female)	0.03	-0.10*	-0.01	0.05	-0.09*	0.12*	-0.10*	0.19*	0.12*	0.20*	0.07*	-0.25*	1.00												
14	Status	0.11*	0.06*	0.07*	0.06*	0.09*	-0.01	0.05	-0.14*	-0.03	-0.04	0.01	0.60*	-0.25*	1.00											
15	CIBER employee	0.05	0.01	0.02	0.04	-0.11*	0.08*	0.05	0.13*	0.05	0.11*	-0.03	-0.28*	0.19*	-0.29*	1.00										
16	Mobility	0.13*	0.08*	-0.08*	0.08*	-0.06*	0.00	0.08*	-0.06	-0.06	-0.02	0.03	0.18*	-0.06	-0.10*	0.32*	1.00									
17	Clinical research	-0.16*	-0.02	0.35*	-0.07*	0.10*	-0.03	-0.05	-0.01	0.01	0.03	-0.02	0.16*	-0.04	-0.09*	0.07*	-0.21*	1.00								
18	% research time	0.12*	0.10*	-0.10*	0.18*	-0.09*	0.16*	0.09*	0.13*	0.06	0.07*	-0.08*	-0.50*	0.23*	0.29*	-0.36*	0.00	-0.35*	1.00							
19	PI papers	0.02	0.04	-0.04	0.03	0.05	0.01	0.06*	0.02	0.04	0.05	-0.04	-0.02	-0.08*	-0.04	0.06	-0.02	-0.03	-0.03	1.00						
20	PI patents	0.03	0.11*	-0.10*	0.04	0.03	0.04	0.02	0.00	-0.06*	-0.04	0.03	-0.08*	-0.03	0.04	-0.03	0.02	-0.09*	0.11*	0.21*	1.00					
21	Size	-0.08*	-0.03	-0.07*	-0.08*	0.00	-0.06*	-0.02	-0.10*	0.01	-0.06	0.00	-0.21*	-0.04	-0.14*	-0.08*	0.00	0.07*	0.00	0.12*	0.13*	1.00				
22	University	0.03	0.02	-0.15*	0.06	0.06*	0.06	0.01	-0.09*	-0.01	-0.05	0.05	-0.04	0.00	-0.04	0.04	0.03	-0.25*	0.05	-0.01	0.14*	0.16*	1.00			
23	Hospital	-0.08*	-0.04	0.22*	-0.07*	0.03	-0.04	-0.07*	0.04	0.00	-0.02	0.00	0.20*	-0.11*	-0.04	0.10*	-0.10*	0.43*	-0.40*	0.06	-0.20*	-0.08*	-0.46*	1.00		
24	PRO	0.02	0.00	-0.08*	0.03	-0.07*	0.00	0.01	0.04	-0.02	0.06	-0.02	-0.11*	0.15*	0.09*	-0.12*	0.06	-0.13*	0.28*	-0.05	0.08*	-0.07*	-0.41*	-0.42*	1.00	
25	Madrid or Cat.	-0.02	0.00	0.01	0.01	-0.02	-0.01	-0.01	0.02	0.03	0.05	-0.07*	0.01	0.07*	0.03	0.00	0.05	0.07*	0.01	0.11*	-0.02	0.03	-0.21*	0.11*	0.10*	1.00

* p<0.05. CIBER dummies excluded for reasons of space.

Table 3 Component rotated matrix: perceived impact on beneficiaries

	Academic community	Industry	Patients and clinical staff
Academics from your own group	0.87		
Academics from your own field	0.81		
Pharma industry		0.60	
Other industries		0.83	
Other collectives		0.72	
Patients			0.87
Patients' relatives			0.82
Clinical staff			0.77
Vulnerable societal groups			0.67

Extraction method: principal component analysis. Rotation method: varimax normalization with Kaiser. Only factor loadings greater than 0.3 are displayed.

Table 4. Component rotated matrix: motivations

	Intrinsic motivation	Extrinsic motivation	Prosocial motivation
I enjoy it	0.83		
I like doing research	0.82		
I want to learn new things	0.68		
I find it funny	0.66		
I think that performing research is important	0.63		
I find it attractive	0.62		
It makes me feel good	0.60		
It helps me to obtain recognition from my academic peers		0.78	
It helps me to have a good social position		0.76	
It helps me to obtain recognition from my office colleagues		0.72	
I want to obtain a higher income		0.68	
It is what I am supposed to do		0.61	
It allows me to improve my social position		0.59	
I want to publish in high impact journals		0.52	
It is important to me doing well to others			0.85
I want to help others through my work			0.81
I am satisfied by helping others through my job			0.80

Extraction method: principal component analysis. Rotation method: varimax normalization with Kaiser. Only factor loadings greater than 0.3 are displayed.

Table 5. Component rotated matrix: personality traits

	Openness to experience	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Have a vivid imagination	0.79				
Do not have a good imagination (R)	0.79				
Have difficulty understanding abstract ideas (R)	0.61				
Am not interested in abstract ideas (R)	0.47				
Like order		0.80			
Make a mess of things (R)		0.75			
Often forget to put things back in their proper place (R)		0.68			
Get chores done right away		0.63			
Talk to a lot of different people at parties			0.76		
Am the life of the party			0.76		
Don't talk a lot (R)			0.64		
Keep in the background (R)			0.58		
Am not interested in other people's problems (R)				0.73	
Am not really interested in others (R)				0.69	
Feel others' emotions				0.60	
Sympathize with others' feelings				0.54	
Get upset easily					0.77
Have frequent mood swings					0.75
Seldom feel blue (R)					0.56
Am relaxed most of the time (R)					0.45

Extraction method: principal component analysis. Rotation method: varimax normalization with Kaiser. Only factor loadings greater than 0.3 are displayed.

Table 6 Linear regressions of the perceived impact of research on different beneficiary types

Variable type	Variable	1 Academia	2 Academia	3 Industry	4 Industry	5 Patients	6 Patients
Socio-demogrc.	Age	-0.01	-0.00	-0.01	-0.01	0.00	0.00
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Gender (female)	0.08	0.09	-0.35**	-0.37**	-0.03	-0.15
		(0.08)	(0.08)	(0.11)	(0.11)	(0.09)	(0.09)
	Status	0.18**	0.12**	0.09	0.06	0.07	0.03
		(0.05)	(0.04)	(0.06)	(0.05)	(0.05)	(0.05)
	CIBER employee	0.12	0.13	0.11	0.15	0.15	0.13
		(0.10)	(0.09)	(0.14)	(0.13)	(0.12)	(0.12)
Research-reld.	Mobility	0.05	0.05*	0.04	0.06*	-0.01	-0.00
		(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)
	Clinical research	-0.13*	-0.19**	0.14*	0.10	0.56**	0.52**
		(0.05)	(0.05)	(0.07)	(0.07)	(0.06)	(0.05)
	% research time	0.45*	0.09	0.66**	0.60**	0.30	0.01
		(0.18)	(0.16)	(0.21)	(0.22)	(0.19)	(0.19)
Organisational	PI papers	0.02	-0.06	-0.00	-0.04	-0.14	-0.18
		(0.08)	(0.07)	(0.09)	(0.09)	(0.10)	(0.10)
	PI patents	0.01	0.01	0.04	0.04	-0.01	-0.02
		(0.02)	(0.01)	(0.02)	(0.02)	(0.03)	(0.03)
	Size	-0.00	0.00	-0.01*	-0.01*	-0.00	0.00
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
	Org. type dummies	Included	Included	Included	Included	Included	Included
		Not sig.	Not sig.	Not sig.	Not sig.	Not sig.	Sig.
Institutional	CIBER dummies	Included	Included	Included	Included	Included	Included
		Not sig.	Not sig.	Sig.	Sig.	Sig.	Sig.
	Mad.&Cat. dummy	-0.05	-0.07	0.05	0.05	-0.08	-0.07
		(0.08)	(0.07)	(0.11)	(0.11)	(0.10)	(0.09)
Psychological	Intrinsic mot.		0.33**		-0.10		0.17**
			(0.07)		(0.08)		(0.06)
	Extrinsic mot.		0.23**		0.28**		0.08
			(0.04)		(0.04)		(0.04)
	Prosocial mot.		0.11*		0.17**		0.31**
			(0.05)		(0.05)		(0.05)
	Openness		0.15**		0.03		-0.03
			(0.04)		(0.05)		(0.05)
	Conscientiousness		0.04		-0.03		0.11**
			(0.03)		(0.05)		(0.04)
	Extraversion		-0.02		0.10*		0.04
			(0.04)		(0.05)		(0.04)
	Agreeableness		0.08		0.01		0.04
			(0.04)		(0.05)		(0.06)
	Neuroticism		-0.03		0.04		0.04
			(0.03)		(0.05)		(0.04)
	Constant	5.21**	0.80	3.26**	1.48*	2.98**	-0.86
		(0.37)	(0.55)	(0.43)	(0.68)	(0.36)	(0.53)
Observations		1033	1033	1033	1033	1033	1033
Clusters		319	319	319	319	319	319
F		3.43	11.37	4.39	6.48	10.95	17.23
p		0.00	0.00	0.00	0.00	0.00	0.00
R^2		0.07	0.26	0.08	0.15	0.18	0.29

* Significant at 5%. ** Significant at 1%. Standard errors in parenthesis. No multicollinearity according to variance inflation factors. Highlighted: parameters whose significance changes when psychological variables are included.