Developing indicators and typologies of frontier--potential researchers to explore impacts of the ERC's Starting Independent Researcher Grant

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Abstract

This paper describes a proposed two-stage, controlled, survey-based, research funding impact assessment methodology, developing and testing indicators and typologies of publicly-funded individual researchers more or less likely to undertake research with the potential to become regarded as frontier ('frontier-potential' researchers). A baseline stage, online survey questionnaire measurement was addressed to 381 researchers: successful applicants (grantees) to the 'first cohort' (2007 call) of the European Research Council (ERC) Starting Independent Researcher Grant (StG) scheme and a designated control group (controls) of assumed similar calibre applicants passing the ERC's apparent quality threshold (Stage 1 of its StG application process). 184 responses were received right across the ERC's original StG research domain categories (life sciences, physical sciences and engineering, and social sciences and humanities). Grantees and controls were individually characterised using a novel 22-variable researcher-profiling scheme, based on existing studies, and addressing makers of their 'demographic' features (gender, age, and relationship/dependents status), their 'approach' to research activity (risk-taking and outlier traits), and researcher 'standing' factors (knowledge and organisational career features, and research workplace resource, reputation and prestige). Matched-pairs of grantees and controls were created, to facilitate the envisaged second-stage measurement of the exact same individuals and consequent impact assessment of qualitative changes between the before and after states of the grantees, as compared to those of the originally-matched controls. Four initial typologies were created – one for researcher 'approach' (addressing cognitive mobility and apparent research novelty/risk-taking) and three for different researcher 'standing' aspects (researcher stability/independence, output productivity, and host research workplace reputation/performance). These suggested the ERC, via its 2007 StG call, selected for ostensibly more 'frontier-potential' researcher types, albeit – to a lesser extent – all types were also present for the control researchers. The survey also indicated ERC 'added value' as a new entrant into the existing European research funding landscape. Its StG was perceived to have attractive features (funding size, duration, support for research group creation, and facilitating high-risk/novel research activity). For both grantees and controls their association with the StG had also apparently caused early positive and negative impacts (including 'halo effect' attraction of additional research funds, faster promotion or tenure, greater researcher independence and risk-taking; or lost research time/focus, greater administrative burdens, and tensions arising from sudden research resource/ direction independence, respectively).

Introduction

This paper describes part of the development and initial testing of a proposed two-stage, controlled, survey-based, research funding impact assessment methodology. This methodology involved the development and initial testing, currently through a baseline stage measurement only, of indicators and typologies of publicly-funded individual researchers who may be more or less likely to undertake research with the potential to eventually become regarded as 'frontier' (hereafter called 'frontier-potential' researchers[1]).

The impetus to explore impact in the context of 'frontier-potential' researchers related to a new funding scheme explicitly aiming to support 'frontier' research – the European Research Council's (ERC) Starting Independent Researcher Grant (StG) scheme. The ERC has claimed to be 'the first European funding body set up to support investigator-driven frontier research' and that its 'sole criterion' for selecting research to fund is 'scientific excellence'.[2] In positioning its StG, launched in 2007, the ERC has noted a 'dramatic waste of research talent in Europe' due to 'insufficient opportunities for young investigators to develop independent careers' resulting in delays in the 'emergence of the next-generation of research leaders' and brain drain out of Europe.[3] The ERC's StG ostensibly addresses these problems by providing the resources and conditions for 'up-and-coming research leaders ... to establish or consolidate a proper research team and ... start conducting independent research in Europe'.[4] Such ambitions differentiate the ERC's StG from many funding schemes that have gone before in Europe, and position it amongst the very elite of existing national and European funding opportunities for researchers residing in Europe.

For this work a survey was undertaken of recipients of the 'first cohort' of StG awards from the very first 2007 call – along with a designated 'control group' of unsuccessful applicants to the same call who passed the ERC's apparent quality threshold (Stage 1 of its application process). Certain indicators of individual research attitudes and track records (labelled 'approach'), markers of related research conditions and opportunities (labelled 'standing') and some demographic factors were registered via the survey. These demographic-approach-standing (DAS) variables formed a scheme to profile and characterise the individual researcher respondents, and to create matched-pairs of grant recipients ('grantees') and control group members ('controls'). The 'approach' and 'standing' variables used to match-up these pairs were scaled to represent apparent greater or lesser 'frontier-potential' of the individual researchers. These variables were based on existing studies in the area and some novel markers. Initial typologies were created, based on a selection of certain 'approach' and several 'standing' variables, in an attempt to highlight 'frontier-potential'. Combined approach-standing typologies are still under development but will also be important, as a frontier-potential approach alone will most likely not come to fruition without conducive related research conditions and opportunities – i.e. frontier-potential 'standing' – and vice versa.

Attempting to identify 'frontier-potential' researchers was one way to try to assess the success (or not) of the ERC's StG aims and objectives. However this work's actual impact assessment of the StG will not be possible until a proposed second-stage, repeat measurement of the grantee-control matched-pairs created here is undertaken. The aggregate changes between the before (baseline stage) and after (repeat measurement) states of the grantees, and those for the initially matched controls, should then reveal impact attributable to the StG (i.e. the main remaining difference between the grantees and controls). Nevertheless this paper indicates some features of individual researchers likely to be affected by this particular funding scheme. In addition, material was included in the baseline stage survey of the 2007 call StG grantees and controls that shed light on current perceptions by individual researchers about the 'added value' of the ERC vis-à-vis other research funders. Direct questions were also asked in the survey, seeking researchers' opinions about any apparent early impacts from either

[1] 'Frontier-potential' was a deliberate label. There are inherent difficulties to identify *a priori* whether one is funding a 'frontier' researcher. There are numerous intervening social, political and institutional factors to confound the selection, conduct and eventual recognition of truly path-breaking research (e.g. see Heinze et al. 2007, Whitley 2000, Polanyi 1969).
[2] See http://erc.europa.eu/index.cfm?fuseaction=page.display&topicID=12, last accessed 24 August 2011.
[3] See http://erc.europa.eu/index.cfm?fuseaction=page.display&topicID=65, last accessed 24 August 2011.
[4] Ibid.

winning the StG or of passing its Stage 1 (in the case of the control group). Some of this data is also reported here.

It also should be noted that the present work is one part of a broader, novel methodological approach to attempt to understand better and to assess the impact and outcomes of the ERC and its funding schemes overall – the ongoing EURECIA research project.[5]

Research context and approach

During the past few decades public research funding in Europe and beyond has seen an increase in the proportions allocated via competitive, externally peer-reviewed mechanisms (Laudel 2006, Langfeldt 2001, Bourke and Butler 1999). There has been growing research interest in how such changes to public research funding organisations and their funding schemes are affecting both research content and conduct in general and more rarefied forms of 'ground-breaking' research in particular – for instance how this 'increased competition for funds' may not be leading to funding 'the best ideas' (Heinze 2008, p. 302; see also Shapira and Kuhlmann 2003).

Studies in these – and related – areas address a mix of complex individual and institutional characteristics and dynamics. Traits of individual researchers more or less inclined to undertake ground-breaking, 'pioneering', 'path-breaking', 'highly creative' or frontier-potential research must be considered (see Charlton 2009, Heinze and Bauer 2007). The inclinations of individuals in managing and developing their own research and academic careers are also important (see Dowd and Kaplan 2005). The influence of research organisation resources, features, strategies and policies, and research team characteristics, are important (see Heinze et al. 2009, Jordan et al. 2003). Research project portfolios and research types, motivations and approaches also play a role (see Jordan 2006) – as do the conditions, opportunities and objectives of research funding schemes aiming to support novel, path-breaking research (see Lamont 2009, Heinze 2008).

Drawing and building upon these and other aspects, the present work faced several challenges. First no clear consensus has been established about the key characteristics of 'frontier-potential' researchers and related research conditions. Second, whilst useful sets of characteristics and influences have been tested, some have only been standardised for a limited number of research fields (e.g. nanotechnology and human genetics, see Heinze et al. 2007). And yet for the 2007 StG call the ERC used three very broad research domain categories, namely: life sciences (LS), physical sciences and engineering (PE) and social sciences and humanities (SH).[6] The indicators developed in this work therefore had to be applicable across a very wide range of research fields.

Thirdly, many compounding factors and social processes can conceivably affect the production and recognition of 'frontier-potential' research as it contends with the orthodoxies of existing research and research communities (Heinze et al. 2007, Whitley 2000, Polanyi 1969). This likely remains true even when one considers the rarefied organisational and knowledge community career dynamics of high calibre researchers likely to be associated with a funding scheme as apparently prestigious as the ERC's StG.[7] This work could not address all of these potential factors affecting funding scheme impact upon individual frontier-potential researchers but nevertheless had to control for as many extraneous factors as possible.

[5] The project runs from 2009 to 2011. See http://www.eurecia-erc.net/ for details. This overall methodology cuts across various potential research funding impact areas such as: changes to research content and lines of research; effects for individual researcher careers; alterations of individuals' positions and roles within their research communities; developments with host research organisations strategies, their resources and policies; and responses by national and European research funders in terms of their practices and the funding schemes they offer. Some of these aspects are addressed here. However more comprehensive work on each is also being done separately.

[6] Later ERC StG call rounds added a new fourth domain, 'interdisciplinary'.

[7] In the work's survey 89 percent (117/132, missing=52) of respondents considered 'high reputation and prestige' to be an attractive feature of the ERC (117/132) compared to the next highest responses, which were 27 percent (34/126) for respondents' own research organisations as funders and 23 percent (28/120) for respondents' main national funding agency/ministry.

The methodology adopted – and as used in comparable forms in previous studies (e.g. see Shapira et al. 2009, NRC 2006) – centred upon creating matched-pairs of individual grantee and control researchers, to be measured and characterised at least twice at separate points in time, to help to control for as many unmeasured characteristics and dynamics as possible. This paper reports only the first-stage of this two-stage methodology (sufficient time has not yet elapsed for the second, repeat measurement to be undertaken, assuming that it may need several years for a full range of potential impacts to become measurable). Matched-pairs of 'grantees' and 'controls' were created from the baseline data collection. The methodology developed will later re-survey and re-characterise the *exact same* individuals within each grantee-control pair (as facilitated by a confidential, but non-anonymous survey approach). Any divergences over time in specified characteristics, before and after for the grantees, as compared to the before and after states of the controls, would then be attributable as *impact*. This assumes the main remaining difference between the two groups was the presence or the absence of the ERC StG, i.e. that matching particular characteristics at the baseline stage indicated both were similarly high calibre researchers, likely to experience comparable organisational and knowledge community career dynamics over time – in other words, were very similar overall except for any exceptional conditions potentially provided by the StG.

To match-pair grantees and controls like with like – and thus control not only for background dynamics between the baseline and the repeat measurements, but also for any skew in the overall distribution of responding grantees and controls – a novel three-part scheme of demographic, approach and standing characteristics of the individual researchers and their related research conditions was registered. These created a standardised 'researcher profile' for each individual respondent (grantees and controls).

The first part of this researcher-profiling scheme, 'approach', registered and characterised respondents' opinions about, and track record of, research-related activity – with a focus on outlier, atypical factors related to risk-taking, novelty and geographic and cognitive mobility, atypical funded research project track records, and outlier attitudes to job security and targeting journals to publish research outputs. These indicators were scaled to try to highlight those researchers who might undertake research with the potential to go on to become regarded as frontier. The second part, 'standing', registered and characterised personal and organisational factors related to research resources, host research organisation features and research outputs, along with features of an individual researcher's organisational career, knowledge community career, and the assumed reputation and performance of their host research organisation. Availability of research resources, researcher autonomy, team size, amount and prestige of academic service, output productivity, accolades received, and the assumed research performance and ambition of the national setting of the individuals' host research organisation were also registered. The third part of the scheme recorded certain demographic characteristics. These were gender, age bracket, and a combined measure of respondents' relationship status and dependent care responsibilities (a potential predictor of other factors, such as geographic and workplace mobility).

Grantee-control matched-pairs were created using different assumed key variables from this three-part, demographic-approach-standing (DAS) researcher-profiling scheme. Several typologies were then created from selected 'approach' variables and certain 'standing' ones.

Frontier-potential researchers: Individual, organisational and support factors

Individual factors

Frontier-potential characteristics of individual researchers were first taken to be additional and exceptional above and beyond generic, technical competencies likely to have already been mastered by early post-doctoral career stages (see Nedeva 2009) – and most likely already possessed by researchers capable of either winning an ERC StG or passing its apparent quality threshold. Such generic competencies include were taken to include identifying significant research to pursue, being able to network and disseminate research results, planning one's research career effectively, planning and monitoring research outcomes, and management skills and teamwork (ibid.; after Rowley and

McCulloch 1999). They also encompass broad sets of generic researcher skills (research design and methods, analytical, writing, literature searching, project management, ethics), philosophy of knowledge skills (how knowledge emerges, sociology and politics of knowledge creation, disciplinary and interdisciplinary ways of thinking and cultures), career management skills (what it means to be an academic, career path options, understanding life phases, credibility, asset management, financial planning and winning grants, awareness of intellectual property) and planning and communication skills (teaching and learning, influencing audiences, diplomacy, building capacity, understanding public service) (ibid.; after Lee 2009).[8]

Instead markers were sought to differentiate average scientists, who are often good citizens and employees, from researchers with additional intelligence and high creativity traits more likely to lead to path-breaking science (previously observed as inversely proportional to the status quo of perseverance and sociability traits) (Charlton 2009). Braben (2004) notes that 'pioneering' or adventurous ideas can be impeded by individuals' lack of courage and bureaucratic barriers – meaning that more maverick, creative 'dissenters' may be those who see highly innovative ideas through to the end. Such 'creative dissenter' traits are also potentially a feature of creative research teams, who can see themselves as 'winning underdogs' (see Jordan 2003 et al.; after Bennis and Biederman 1997). Often it is 'intrinsically' motivated (Vallerand et al. 1992) individuals who have an 'underlying rationale' to 'search for new and unexpected knowledge' (Heinze et al. 2007, p. 129). They may hold to a more 'entrepreneurial' career identity and take a more indifferent, 'maverick' attitude to the consequences of their path-breaking creativity for their own long-term careers (Dowd and Kaplan 2005, p. 709).

Heinze and Bauer (2007) suggest that individuals distinguished from their peers by high levels of creativity have not only 'a high level of curiosity, willingness to learn from experience, preparedness to take risks, persistence in situations of failure, high levels of energy, and distinctive goal-orientation' but also higher tolerance for 'contradictions, ambiguities, and uncertainties in their work', 'both as a result and a precondition' of these distinguishing traits (p. 814). Udwadia has suggested that an individual's cognitive abilities (intelligence, knowledge and thinking style) need be bolstered by personality/disposition factors, such as 'perseverance, high energy, hard work, curiosity, sense of self as creative, autonomy, independence of judgement, risk-taking orientation' and, as already noted above, 'intrinsic motivation' (Jordan 2003 et al., p. 31; after Udwadia 1990) in order for frontier-potential research outcomes to be realised.

Heinze et al. (2007) have explored how creativity intersects individual traits, the creative product developed and the creative process by which it is produced – i.e. not only the requisite individual traits for engaging in creative activities at play, such as 'imagination, intelligence and talent', and variable characteristics of the 'insight or discovery' (the creative product), but also processes of experimentation and risk-taking by which 'novel and unexpected outcomes are incorporated into an existing stock of knowledge and know-how via learning or socialization' (p. 128). They note that 'research judged favorably by peers is not always creative, while creative research is not always initially accepted by peers' – an inherent tension between originality, often based on 'dissent', and the 'criteria of plausibility and scientific validation' that 'encourage conformity' (ibid.; after Polanyi 1969). They conclude, 'novel and thought-provoking contributions do not always resonate positively within the scientific communities' who must be 'persuaded that the novel and unexpected contribution has value in the domain of research' (ibid., p. 129). This can occur via processes such as peer review (see Lamont 2009) acting to dampen the likelihood of frontier-potential research outcomes. Individual researchers' overall output productivity, their multidisciplinarity and knowledge network brokerage, have also been identified as factors involved in the production of highly creative work (Heinze and Bauer 2007, pp. 812–813).

[8] Exceptional performance on any of these factors may still be possible – a point noted by Boyatzis (2008) in highlighting the roles of emotional and social intelligence as differentiating between the performance levels of individuals who share any particular threshold of traditional intelligence.

For the individual researcher 'approach' component of this work, psychology measures of motivation and creativity characteristics were not used. Instead evidence of such traits as manifest in observable vehicles such as research activity and output features were sought. These included: a measure of the perceived risk and novelty of individual researchers' funded research projects; their workplace and country mobility and their mobility across intellectual fields (as proxies for geo-cultural and cognitive brokerage capacity); their apparent indifference to job security; and the atypicality of their reported approaches to targeting journals for publication and their funded research project track record. A measure of output productivity was also included within the work's 'standing' component.

Organisational factors

Most publicly-funded researchers work in environments where they undertake a range of organisational career and knowledge community career tasks and activities. These can include teaching, supervision and academic service within their host research organisations, along with interactions with the members of their own research discipline/field through a variety of mechanisms (e.g. research projects, publications, conferences) (Dill 1982, p. 261). These generic workloads were explored within the 'standing' component of the DAS researcher-profiling scheme developed for this work.

Research organisation influences on frontier-potential researchers however go beyond workload factors. Individual researcher characteristics and traits cannot be considered in isolation. At the same time Heinze et al. (2009) have noted that '[m]any important questions remain about what creative scientific accomplishments area, how we can identify them, in which organizations they occur most often, and which institutional factors are influential in shaping cutting-edge research environments' (p. 610). For the fields of nanotechnology and human genetics, they have identified the following factors as positively correlated with high productivity of creative research: small group size with coherent research programmes and group leaders with strong time commitment to research activity (research team/group level); access to a complementary variety of technical skills, stable research sponsorship, timely access to extramural skills and resources (research organisation level); and flexible institutional sponsorship, which can be better than competitive research council funding (institutional level) (ibid., pp. 610–612; after Andrews 1979). Heinze et al. have also highlighted the importance of 'human resources, instrumentation and funding' (ibid., p. 613), and that 'highly productive research units can be distinguished by the significance they attach to hiring talent' (ibid.; after Dill 1985) and a plurality of research leadership, so that a 'diversity of research strategies and richness in ideas' is maintained when hiring new recruits (ibid.; after Hage 2006).

Separately Jordan et al. (2003) have composed an entire bibliography of research environment attributes that foster excellent research: *conceptual* and *strategic* approaches (goal-attainment, clear goals, research emphasis, organisation by problems rather than disciplines, strategic stakeholders, systems, competing values, accountable research-led leadership using open and participative management who are open to multi-disciplinarity); *performance* factors (the role of people, the role of leadership and openness of leadership style, the role of research management, and the role of organisational performance and its measurement, continuous development of mastery of one's own research field, and evolving new competencies); *group* and *leadership* factors (superb people, positive climate, distinctive culture, strong leadership, amity and cooperation among people in groups, optimism, appropriateness of fit between people and tasks, intrinsic motivation to do good work, high autonomy over research direction, pressure from peers, having the right colleagues to work with, participative governance, decentralisation, good communication, accessible human resources, good research group composition, appropriate rewards and career development, appropriate recruitment/selection procedures, good interaction with teaching and access to intelligent students); *resource* factors (funds, time, exceptional scientific talent of appropriate ages, and career stages, well-trained and developed technicians, well-resourced labs, equipment and facilities, advanced computer and library services, good other support systems); and *positioning* of the research field (understanding peer's research strategies and research gaps, collaboration patterns, understanding the research's field evolution and environment – such as how new developments extend, exploit or disrupt existing science or technology paths and trajectories – openness to shifts of research line, and understanding the structural and cultural contexts of research).

These studies serve to highlight the need to consider: group and laboratory sizes; individuals' perceptions of the resources, reputation and performance of their host research organisation workplaces; and some indication of how individual researchers' rate the recruitment strategies and policies of their research workplace. Some but not all of these factors were included in the 'standing' component of the DAS model developed and used here (others will be explored by later work).

Research support factors

Studies have also explored how to fund frontier-potential type research – and how to characterise research activities to identify the kind of research being funded. Heinze (2008) has highlighted a tension for not only to research managers and research funders but also science policy-makers attempting to support ground-breaking research. He notes that exploring 'new research frontiers' is strongly associated with 'returns that are uncertain, distant, and often negative', so that 'exploration of new research paths is often discouraged', and comparatively safer investments are more likely to be made to support 'the refinement and extension of existing competences, technologies, and paradigms' where returns are 'positive, proximate, and often predictable' (p. 302). Heinze has also noted that funding duration is important. Short-term funding is likely to support risk-averse, exploitation strategies leading to proximate and predictable outcomes. Long-term funding might encourage more high-impact, explorative mode activity. Additionally institutional funding (likely to be longer term) instead of competitive funding of individuals or dispersed collaborative activity (often shorter term) more likely leads to riskier research ventures (ibid., pp. 304–306).

Lamont (2009) has separately explored research funding peer review and highlighted a bias towards evaluating developed, advanced proposals more favourably than early-stage ones, as they inherently appear more 'specific, complete and "elegant"', 'even when such decisions are at odds with a funding program's explicit objectives (such as to support fieldwork)' (pp. 162–163).

Individuals and research organisations may also be working on *portfolios* of research projects and activity at any one time. To unpack this additional complexity Jordan (2006) has cautioned against a 'one-size-fits-all' approach. She posits that all research relates to a 'task environment', 'knowledge world' or 'state of the art' that maps 'how much is known in a problem area', 'what is considered to be an important scientific concern or requirement' and therefore what scale and scope of research people chose to undertake (ibid., p. 178). Jordan notes research *strategy* choices are made about what kind of scientific advance will be attempted within a given research project, related to a possibility space defined by the known 'existence of modular and architectural innovations, and how radical the change is for various parties involved (the innovator, the user, those supporting innovators and suppliers to the innovator)' (ibid.; after Afuah and Bahram 1995). There are also apparent research *scale* trade-offs related to the breadth, depth and reach of the desired research outcomes, with significant resource implications for: the number of variables, experiments, people-hours and equipment needed for the research; the coverage of these variables (e.g. temperature range, geographic area); how extreme the conditions to be explored are (e.g. special, expensive instruments or locations); and how many disciplines, fields or problems area are involved (ibid., p. 179). From these two dimensions – strategic choices of intended outcomes and research scale to be tackled – Jordan has produced a four-category typology of research: *being new*, a radical scientific advance, but with a small research scale (e.g. small number of variables and/or coverage of them, limited treatment of extreme conditions, and limited multi-disciplinarity); *being first*, a radical advance combined with a larger research scale/scope; *being better*, an incremental advance but with a large scale/scope; and *being sustainable*, an incremental, small scale/scope advance (ibid., pp. 180–181). This typology stresses the importance of considering the type of research being undertaken, the research project's size and complexity, its strategic management, and the intended outcomes.

Several markers of these issues were included in the present research design.[9] More will be explored during its envisaged second-stage, repeat measurement. This will be particularly important to do given that previous research funding scheme evaluations have noted research project portfolio-related impacts. This was found in an evaluation reviewed by Heinze (2008), and originally undertaken by

[9] Others were dealt with in a separate part of the EURECIA project, specifically addressing research organisations.

Melin and Danell 2006, of a prestigious funding scheme for highly talented junior scientists run by the Swedish Foundation for Strategic Research. Melin and Danell (2006) looked at 20 funded and 20 non-funded scheme applicants. The non-funded, control group were reportedly 'unable to pursue the research questions they would have liked to pursue' with 'proper focus and direction', were 'forced constantly to hunt for new funds thereby losing a considerable share of their working time' and unable to 'engage in risky projects' – even though most had accessed 'other funding channels' (Heinze 2008, p. 305; after Melin and Danell 2006, pp. 709–710). Four years after the funding decision, the grantees and controls were similar on 'productivity and research quality' measures and yet grantees 'showed a much more homogenous performance profile' than the controls (ibid.). Grantees had also been 'able to enhance and strengthen their research profile' whereas for controls this had been 'more difficult and less certain' a process (ibid.; after Melin and Danell 2006, pp. 705–706).

Separately Shapira et al. (2009) have also looked at a review of the National Research Council (NRC 2006) evaluation of the Markey Scholars programme (which provided long-term financial support to outstanding, young researchers in the biomedical sciences in the United States). This NRC evaluation looked at grantees and two matched categories of non-grantees – 'those who were "top ranked" and whose applications were given high rankings, and those considered "competitive" and whose applications received slightly lesser rankings' (Shapira et al. 2009, p. 4). The first 'control group' category were evaluated to be similar to the grantees 'on measures such as faculty position or publication success' but the grantees 'were more apt to have been at top universities, received tenure and been promoted, and received more research grants' (ibid.).

It is also worth noting certain evaluations of early stage, high-risk industry R&D funded by the Advanced Technology Program[10] (ATP) of the US National Institute of Standards and Technology (NIST 2006, NIST 2005, NIST 2003; see also Kerwin and Campbell 2007, Feldman and Kelley 2001). These have noted some similar impacts as Shapira et al., Heinze, Melin and Danell above. Also using a grantee and control group-based methodology, these evaluations confirmed that non-funded projects as drifting towards lower risk, non-funded projects ending up smaller in scope and scale that originally planned, and that grantee companies attracted unexpected, additional research funding by virtue of having received a prestigious grant – a so-called 'halo effect' (NIST 2003; see also Feldman and Kelley 2001). They also showed a delayed, but long-term more durable impact from funded projects as opposed to non-funded ones (ibid.; see also NIST 2005) – based on a sequential model of the timing of inputs, outputs, outcomes then impacts from ATP funding (see NIST 2006).[11]

These studies suggested the following impacts and effects for grantees might be observed after the second-stage, repeat measurement envisaged by the present work: greater risk-taking and research novelty levels for grantees, within a stronger, more homogenous research profile; attraction of additional funding ('halo' effect) – although this may also be present for the controls; differing impacts taking place at different times and for different stakeholders (e.g. academics and non-academics), and likely related to the type of research being undertaken; grantees being hosted at apparently better research workplaces (in terms of reputation and performance) perhaps with associated employment contract length conditions and promotion prospects. It might similarly be expected that control group respondents may be pursuing similar research to that proposed in their StG applications, but via less than ideal, alternative funding sources, resulting in lost time, effort and focus, and perhaps a diversified and/or weakened overall research profile.[12]

[10] ATP supports US innovation via 'competitively awarded funding to companies pursuing early-stage high-risk Research and Development' (NIST 2003). Although it involves industrial R&D, the early-stage and high-risk aspects made it relevant to study here.

[11] A survey of ATP applicants in 2004 (Kerwin and Campbell 2007) also looked at overall chance of project success to gauge risk-taking levels – i.e. the percentage risk of achieving minimum and more significant project goals (i.e. chance of project success) – and a variety of administrative and technical aspects related to the grant, including whether grantees would re-apply to the scheme in future (a measure of its enduring appeal).

[12] On a methodological note, depending on how long the baseline measurement is undertaken after the point of the allocation of the ERC StG, some these potential impacts and effects may already be apparent.

Demographic-approach-standing (DAS) researcher-profiling scheme

Drawing upon these studies, a three-part scheme was developed to profile the ERC StG 2007 call's grantee and control controls in order to register these individuals' demographic characteristics, some markers of their 'approach' to research, and measures of their prestige or 'standing' in their organisational and knowledge community careers, and the performance and reputation of their research workplaces. A 22 variable, demographic-approach-standing (DAS). It is shown in Table 1 (overleaf).

All of the variables were scaled relative to the overall distribution of responses (i.e. grantees and controls together). It is envisaged that the same will be done for the research's proposed second-stage, repeat measurement. This should have a dual advantage. First it provides self-contained scales relevant to the response set. Second it provides for a dynamic baseline, tracking the evolution of both the grantees' and control groups' characteristics over time. In other words, while 'high' at the baseline measurement and at the repeat measurement might not necessarily represent the same *absolute* value, it should nevertheless indicate *relatively* high performance relative to the backdrop of the overall response set throughout. This allows divergences between the two measurement points to be somewhat normalised.

However a known disadvantage is that the DAS variable values (e.g. 'low', 'high') make sense only relative to this particular set of 2007 StG call respondents. For instance, it cannot be known, without registering the characteristics of different groups of researchers using the same approach, how 'low' corresponds to the performance levels of any other external, alternative population of researchers (albeit the absolute values for each characteristic underpinning the DAS variables are known and so could be contrasted where similar data is available for other researcher groups).[13]

Several of the variables (as highlighted in the table) were scaled relative to respondents' specific ERC domain (i.e. LS, PE or SH). This was done when the overall response distributions for a variable did not capture ERC domain-specific variance.

Research questions and assumptions

Research questions

The main research question for this work was: What changes to frontier-potential research-related, individual researcher characteristics are attributable as impacts of the ERC's first cohort, 2007 StG call? In the absence of the second-stage, repeat measurement this question cannot be answered. Therefore secondary research questions were framed as: Can individual researchers' 'approach' and 'standing' features be measured by a survey-based approach? Can they be measured consistently across different research fields? Can they be scaled to highlight likely frontier-potential researcher related features? Can matched-pairs of grantees and controls (i.e. those with certain matching DAS variable values) be created to facilitate an impact assessment using the later repeat measurement? Can typologies of the researchers 'approach' and 'standing' features be created? What do they suggest regarding the types of researchers funded and not funded by the ERC via its 2007 StG call?

[13] This point is important to stress: 'low' for this particular set of respondents might actually be considered as moderate or even high performance when measured against a different population of researchers, e.g. say those who are below the performance levels associated with winning (or passing the quality threshold) of an ERC StG.

Category	Variable name	Description	Values
Demographic	*D1. Gender*	-	1=Female, 2=Male
	*D2. Age bracket**	Respondent's reported age as compared to the response distribution for their own ERC domain	1=Below average, 2=Average, 3=Above average
	D3. Relationship/dependents status	Combined measure of respondent's reported long-term relationship and dependent caring responsibilities	1=Low, 2=Medium, 3=High
Approach	*A1. Geographic and workplace mobility*	Combined measure of number of countries, and research workplaces worked in, during respondent's entire study and research career to date	1=Low, 2=Medium, 3=High
	A2. Cognitive mobility	Combined measure of reported number of significant changes of intellectual field during respondent's entire study and research career to date, and atypicality of respondent's study track record (UG, PG, PhD and more advanced degrees)	1=Low 2=Medium 3=High 4=Very high
	*A3. Perceived research novelty and risks***	Combined measure of perceived novelty and risk of respondent's StG application, with reported research output success and applicability risks for their most important research project during past two years	1=Low, 2=Medium, 3=High
	A4. Job security indifference	Reported job security increase after respondent's most recent research workplace move	1=Low, 2=High
	A5. Atypicality of project funding track record	Divergence from typical pattern in overall respondent set for number of respondent's research projects supported by national funding	1=Low, 2=High
	A6. Atypicality of journal targeting approach	Divergence from typical pattern when choosing in which journal to publish own research outputs (journal reputation and impact factor considered important but not essential)	1=Low, 2=High
Standing	***Organisational career standing***		
	S1. Ability to raise needed research resources	Combined measure of respondent's opinion on absence of internal and external research resource constraints, including those for essential international conferences and research visits	1=Low, 2=High
	*S2. Time for research**	Percentage of work time available for research, compared to own ERC domain, and whether lack of research time was a reported constraint	1=Low, 2=High
	S3. Long-term research direction independence	Reported research direction freedom and job security sufficient for long-term research activity	1=Low, 2=Medium, 3=High
	S4. Personal funding situation	Opinion of own funding amount for most important research project of the past two years compared to peers and actual amount (in Euros) compared to overall respondent set	1=Low, 2=Medium, 3=High
	S5. Own team size growth	Growth in proportion own research team represents of the respondent's overall laboratory/department size, after most recent research workplace move	1=Low, 2=High
	Knowledge community career standing		
	S6. Amount of academic service tasks undertaken	Combined measure of amount of professional associations joined, reviewing and editorial activities undertaken, funding and expert panels served on, conferences organised, and fellowships received, compared to the distribution for the overall response set	1=Low, 2=Medium, 3=High
	S7. Prestige of academic service	Opinion on how prestigious respondent's reportedly most important academic service is perceived to be by peers	1=Low, 2=High
	*S8. Number of research collaborators**	Absolute, and relative (self-reported, relative to peers), number of regular research collaborators	1=Low, 2=High
	S9. Output productivity	Overall output productivity (self-reported, relative to peers)	1=Low, 2=High
	S10. Number of accolades	Combined measure of number of patents (direct or indirect), prizes/special awards, and prestigious fellowships (or equivalent) compared to the overall response set	1=Low, 2=High
	*S11. Article acceptance rate**	Percentage of articles submitted in the past two years to respondent's own 'first choice' journal finally accepted, compared to own ERC domain	1=Low, 2=High
	Assumed standing of workplace		
	S12. Perceived workplace reputation and performance	Combined measure of respondent's opinions on whether their research workplace is the best place in the world to do their research, and has an outstanding international reputation, and a ranking of its scientific performance	1=Very low, 2=Low, 3=Medium, 4=High, 5=Very high
	*S13. Assumed research performance/ambition of national setting^*	Proxy classification based on nation's GERD as a percentage of GDP in 2008, number of FTE researchers and 2008, and national success rates (up to 2010) in both 'starting' and 'advanced' ERC grant applications	1=Low, 2=Medium, 3=High

Table 1. Overview of the 22 variable, demographic-approach-standing (DAS) scheme used to profile the first cohort (2007 call) StG grantees and controls. [*=Variable scaled for ERC domain specifics (i.e. LS, PE or SH); **=Sub-variables scaled by ERC domain; ^=Non-survey data supplied by Dietmar Braun, within the EURECIA project, covering 93 percent (167/180, missing=4) of respondents' reported current countries of residence.]

Assumptions
The assumptions underpinning the 22-variable DAS scheme to profile the researcher respondents developed in this work were that there are different kinds of individual researcher, undertaking different kinds of research, in different research workplace settings with differing research and non-research workload conditions, with varying levels of access to internal and external research-related resources, producing differing research outputs via various outlets, and positioned differently in their respective knowledge communities. It was also assumed that a frontier-potential research 'approach' alone would not result in frontier-potential research outputs unless certain opportunities or enabling conditions were also present – i.e. conducive 'standing' factors.

Demographic factors *might* affect researchers' chances of winning the StG and their access to enabling conditions. However being awarded the StG cannot alter demographic factor but could not be altered by receipt of the StG. It was also assumed that while 'approach' *might* indicate researchers more or less predisposed to undertaking frontier-potential research, and affect the types of funding they secure, it was not likely to be altered by receiving the StG. Instead it was assumed that this characteristic is already established or latent in the researchers – and would be expressed via conducive funding and related conditions. 'Approach' was therefore assumed to be an independent variable, similar to 'demographic'. 'Standing' was the aspect taken to be the dependent variable. In addition to affecting the chances of researchers being able to carry out certain kinds of research, and their chances of receiving certain kinds of research funding, it seemed most likely to be affected by receiving the StG.

Survey design and response matters

Survey design
The online survey questionnaire used to register the 22 DAS variables for the individual researcher respondents had 86 questions across seven survey sections (see Table 2 below).[14]

Survey conduct and response matters
The survey population was individual researchers who had applied for an ERC StG then either received it or passed Stage 1 of the evaluation process. The sample was the first cohort who applied when the StG launched in 2007. The sample of StG recipients – the 'grantees' – was 276 people. The sample size of people who had passed Stage 1 for the 2007 StG call – the 'controls' – was 105.[15] The sample covered 32 nationalities.[16]

The online survey questionnaire ran for three months.[17] The overall response rate was 48 percent (184/381). The grantee response rate was slightly higher (50 percent, 138/276) than that for the control group (44 percent, 46/105). 75 percent of the response set was grantees; 25 percent, controls. 39 percent of the overall responses were from LS (as compared to 41 percent LS from the original sample), 43 percent were PE (as per the sample) and 17 percent were SH (sample, 16 percent). 29 percent of respondents were female; 71 percent male.[18] Respondents came from 19 countries, and 19 different nationalities.[19] Respondents' ages varied from 31 to 46, with the majority falling into a 37–40 year old age bracket. Just over three-quarters (107/141) had tenure or equivalent open-ended or permanent employment contract length conditions. 87 percent (110/127) were the principal investigator of their most important, recent research project.

[14] Only two questions differed between the grantee and control respondents. These concerned consequences of and responses to the control group respondents not receiving the StG. Several duplicate and control questions were included, enabling a number of the DAS variables to be based on either a combination of measures – or on responses from questions with the most suitable distribution of responses.
[15] 23 of the 299 StG 2007 recipients were removed from the sample either because they had declined any use of their data or had otherwise unusable contact details. 20 of the 125 person control group were similarly removed.
[16] Background data and contact details for the sample were provided by the ERC, with respondents' informed consent.
[17] From mid-December 2010 to mid-February 2011.
[18] This was a similar gender breakdown to the original sample for the grantees. However the gender breakdown in the control sample was not known, due to limitations in the data provided by the ERC.
[19] The missing 13 nationalities represented only 6% of the original sample's potential respondents.

Survey section	Summary of section question content and characteristics registered
1. About You	Gender, age, relationship/dependent details, educational qualifications, geographical mobility, intellectual field mobility, reason for most significant intellectual and geographic moves, current country of residence, track record (number and types) of academic services
2. Your Research	Research project funding track record, most important recent (past two years only) research project features (name, duration, team size, budget), reason why project was the 'most important', time spent on work activities (research, teaching, supervision, admin), standardised career stage scale, and current promotion plans
3. Your Workplaces	Workplace mobility, details of current and previous workplace features, perceptions of current workplace performance, recruitment strategies and reputation, apparent workload constraints and research-related resources at current workplace
4. Research Funders	Perceived attractive features of ERC and other national and European research funders, perceived main evaluation criterion used by ERC and other research funders when deciding whether to fund research
5. Your Collaborators	Absolute and relative number of regular research collaborators, types of regular research collaborators (excellent researchers outside own lab/dept, excellent researchers outside own country, global leaders of research field, excellent industrial researchers, policy/government stakeholders, charity/foundation stakeholders)
6. Your Outputs	Number, types and importance of research outputs (single- and multi-authored journal articles, books, policy reports, other), output productivity (self-reported, relative to peers), number of accolades received (patents, prizes/special awards, prestigious fellowships), features of two most important recent (past two years only) research outputs, names of two most important journals in own research area (and why they are important), personal selection strategies for journal-based outputs, average percentage acceptance rate of own submissions to 'first choice' journals (past two years only)
7. Your ERC Grant Application	Prior submission of ERC grant application idea to another research funder, alternative ways of funding that project idea, changes made to project idea after not getting grant (control group only), research content features of ERC proposal, attractive features of ERC grants, perceptions about ERC application process (fairness, feedback quality), research workplace and other support received for ERC application (admin, intellectual), overall impressions about ERC application, overall perceived career effect of ERC application/grant, final impressions about the ERC's grant schemes (recommend to others, apply again)

Table 2. Section titles and summary content of the online survey questionnaire sections of questions addressed to the first cohort (2007) StG grantees and control group of applicants who passed Stage 1 of the StG application process.

Question completion rates were lower for open questions but were around 70 to 80 percent on average. The distribution of responses by ERC domain (LS, PE or SH), by specific ERC peer review panel (e.g. PE4), by country of residence, by nationality, by gender and by age were all checked and found to be well matched to the characteristics of the original sample. The responses were therefore taken to have an acceptable level of significance.

Baseline stage results 1: Matched-pairs and typologies

The table below (Table 3) summarises some of overall features registered and the observed differences between the grantee and control group respondents, as characterised by the DAS researcher-profiling scheme.

Overall the grantees ranked higher than the controls for most of variables (D2, A2, A4, A5, S1, S2, S3, S4, S6, S7, S9, S10, S11, S12 and S13). However the control group respondents ranked slightly higher for several interesting factors, namely: geographic and workplace mobility (A1) – i.e. a proxy for exposure to different research and cultural settings; perceived research novelty and risks (A3) – i.e. a combined measure of risk-taking and novelty in the respondents' StG application and most important, recent research project; atypicality of journal approach (A6) – i.e. an atypical downplaying of motivations such as journal reputation and impact factor; own team size growth (S5) – i.e. growth in the proportion the respondent's research team represents of the overall lab/dept size; and number of research collaborators (S8) – i.e. measuring the absolute and relative number of the respondents' regular research collaborators.

Category	Variable name	Registered features and differences
Demographic	*D1. Gender*	Proportionally more males in the control group than in the grantee group; SH had the most even gender balance (52% female; 48% male), PE the least (19%/81%)
	D2. Age bracket	There were more younger control group respondents, suggesting either the ERC selected older and/or more advanced researchers for the 2007 StG or younger and/or less experienced researchers were less likely to get the 2007 StG
	D3. Relationship/dependents status	LS had the most combined long-term relationships and dependent caring duties (78% 'high'), SH the least – suggesting SH respondents were (slightly) less settled
Approach	*A1. Geographic and workplace mobility*	Controls had proportionally more 'high' geographic and workplace mobility (i.e. had worked in 4–6 countries and 5 or more research workplaces)
	A2. Cognitive mobility	The grantees were more cognitively mobile than the controls, i.e. more had significantly changed intellectual field 3 or more times and had an atypical number of UG, PG, PhD or more advanced degrees
	A3. Perceived research novelty and risks	Controls mainly had a 'medium' value; the grantees had higher proportions of 'low' and 'high' values than the controls – suggesting larger numbers of both risk-taking and risk-averse outliers amongst the grantee group
	A4. Job security indifference	Proportionally more grantees had 'high' for this measure, i.e. had gone from temporary (fixed contract length) to temporary contract conditions, or from permanent to temporary terms after their most recent research workplace move
	A5. Atypicality of project funding track record	Proportionally more grantees had 'high' for this measure, indicating fewer 'main national funder' supported projects in their research project track record
	A6. Atypicality of journal targeting approach	Proportionally more grantees had 'high', indicating they were less concerned with journal reputation and impact factor than typical for most respondents
Standing	***Organisational career standing***	
	S1. Ability to raise needed research resources	Proportionally more grantees had 'high', suggesting greater current research resource sufficiency than the controls
	S2. Time for research	Proportionally more grantees had 'high' than the controls
	S3. Long-term research direction independence	Proportionally more grantees had 'high', suggesting greater long-term research autonomy and flexibility
	S4. Personal funding situation	Proportionally more grantees had 'high'
	S5. Own team size growth	Controls had proportionally more 'high', indicating more emphasis on growth
	Knowledge community career standing	
	S6. Amount of academic service tasks undertaken	SH respondents had proportionally more 'high' responses than either PE or LS (42% versus 27% for both, respectively)
	S7. Prestige of academic service	Proportionally more grantees had 'high', suggesting greater activity and/or more opportunities to undertake such activities
	S8. Number of research collaborators	Controls had proportionally more 'high', suggesting more collaborative activity
	S9. Output productivity	Proportionally more grantees had 'high'
	S10. Number of accolades	Proportionally more grantees had 'high'
	S11. Article acceptance rate	There were no major differences between grantees and controls (although there were differences by country grouping, indicating lower acceptance rates associated with higher assumed research performance/ambition national settings, S13 below)
	Assumed standing of workplace	
	S12. Perceived workplace reputation and performance	Proportionally more grantees had 'very high' or 'high' – and overall this was the most significant difference between the grantee and control group respondents
	*S13. Assumed research performance/ambition of national setting^*	SH respondents had the lowest proportion of 'high' (14%); LS and PE respondents were similar (30%); suggesting fewer SH respondents overall were from the highest performance/ambition countries (in this response set)

Table 3. Abridged summary of the registered features and differences of the 184 grantee and control group respondents to the online questionnaire survey, categorised under the 22 variable DAS scheme.

The implication here appears to be that the ERC, only considering its 2007 StG, did fund a cohort of researchers with a range of frontier-potential characteristics. However there is some evidence that at the same time it did not fund some younger, apparently more risk-taking, in some respects more collaborative, researchers with various outlier/atypical characteristics.

Grantee-control matched pairs and their features

A range of DAS variables were tested to attempt to make matched-pairs of grantee and control respondents. Matched-pairings were only attempted between grantees and controls from the same ERC domain (i.e. LS, PE or SH). This was to try to control for research field-specific differences as much as possible. The maximum number of matched variables was eight (i.e. one 'demographic', two 'approach' and five 'standing' variables). The lowest number of matched variables was five (one demographic, one approach, three standing). These matching variables were used because they were

strongly positively correlated with other DAS variables (so could act as a rough proxy for broader matching).

The marker representing perceived research workplace reputation and performance (S12) was found to be the main significant difference the grantee and control group respondents. Overall, the grantee respondents were reportedly in better research workplaces than the controls. In addition to having implications for the 2007 StG call's selection processes and/or apparent early impacts from the 2007 StG (see below) this meant S12 *had* to be matched for *all* pairs. It would not otherwise be possible to confirm that grantees in high performing research workplaces were matched with controls in similarly high performing workplaces. Any registered impacts following the work's envisaged second-stage, repeat measurement would therefore be subject to bias in that the most important distinguishing characteristic of the two respondent groups had not been controlled for at the baseline stage.

19 grantee-control, matched-pairs were finally created, covering 18 percent of the total response set (34/184 respondents).[20] There were eight LS grantee-control pairs, nine PE grantee-control pairs and two LS grantee-control pairs. Four of the grantee-control pairs were female-female pairings (all within the LS ERC domain). The remaining matched-pairs were male-male pairings. Some accommodation was made to ensure pairings in every ERC domain, the presence of both female-female and male-male pairs, and sufficient variety in the observed values for the reduced set of DAS variables used. The overall possible, observed and missing variety accounted for by the final set of 19 pairs is shown in Table 4 below:

Variable	**Possible value variety**	**Observed variety**	**Missing variety**
D1. Gender	Female, Male	Female, Male	-
D2. Age bracket	Below average, Average, Above average	Average	Below average, Above average
A2. Cognitive mobility	Low, Medium, High, Very high	Low, Medium, High	Very high
A3. Perceived research novelty and risks	Low, Medium, High	Low, Medium	High
S0. Researcher stability/independence*	Low, Medium, High, Very high	Low, Medium	High, Very high
S2. Time for research	Low, High	Low, High	-
S3. Long-term research direction independence	Low, Medium, High	Low, Medium	High
S7. Prestige of academic service	Low, High	Low	High
S9. Output productivity	Low, High	Low, High	-
S12. Perceived workplace reputation and performance	Very low, Low, Medium, High, Very high	Very low, Low, Medium, High	Very high

Table 4. Observed versus possible variety in the grantee-control matched pairs created from a reduced number of assumed 'key' DAS variables. [*=S0 was a composite variable created from S1, S3 and S4 to assist the pairing process. It is taken to be one proxy for the combined current research resource sufficiency and longer-term research direction independence of the respondent.]

Following the envisaged second-stage, repeat measurement of this work, the *exact same* individuals within these 19 pairs would be re-surveyed and re-characterised, using the same DAS researcher-

[20] In detail the 19 grantee-control pairs covered 33 percent of the control group respondents (15/46), 14 percent of the grantees (19/138), 18 percent of LS respondents, 20 percent of PE respondents, and nine percent of SH respondents.

profiling scheme. A qualitative assessment would then be made of the respective changes in the DSA characteristics within the full set of before and after grantees, as compared to the respective changes of the before and after states of the controls. The positive or negative, aggregative qualitative changes observed for the grantees overall, compared to those for the originally matched controls overall, should – considering all other things bar the presence/absence of the StG equal – then represent the attributable changes or impact from the StG.

The approach adopted here also allows for ERC domain-specific differences to be observed (i.e. within LS, PE or SH-related research fields) by exploring changes only seen in one domain but not in the others. This could potentially highlight ERC domain-specific impacts from the StG. Furthermore, even though the respondents have only been matched on a reduced number of the full set of DAS variables, the values for the remaining ones are still known. Therefore qualitative assessment of observed changes for this broader set of variables, for before and after grantees and for before and after controls, is also possible.

Initial frontier-potential researcher typologies

Four initial typologies were created from the results of profiling the respondents using the DAS variables – one for researchers' frontier-potential related 'approach' characteristics, and three for frontier-potential 'standing' characteristics.

The first of these is shown below (Table 5). It addresses researcher 'approach' via cognitive mobility (A2) and perceived research novelty and risks (A3). For this initial 'approach' typology, low-to-medium cognitive mobility was taken to be a 'settled' researcher 'approach'; high-to-very high was taken to be an intellectually 'nomadic' 'approach'. Low-to-medium perceived research novelty and risks (shortened here to novelty/risk-taking) was taken to be a 'moderate' novelty/risk-taking 'approach', whereas 'high' was labelled as a 'radical' one. The ostensibly most 'frontier-potential' combination here (nomadic-radical) was labelled 'maverick', i.e. an extreme outlier, highly atypical researcher 'approach' (evidenced by the fact that only five percent of an otherwise presumably quite rarefied cadre of researchers fell into this category).

			A3. Novelty/risk-taking		
			Low	Medium	High
			MODERATE		RADICAL
A2. Cognitive mobility	Low	SETTLED	Settled-moderate **62.3%** G = 57.5%, C = 77.8%		Settled-radical **8.8%** G = 9.2%, C = 7.4%
	Medium				
	High	NOMADIC	Nomadic-moderate **23.7%** G = 27.6%, C = 11.1%		Nomadic-radical ('maverick') **5.3%** G = 5.7%, C = 3.7%
	Very high				

Table 5. An 'approach' typology (A2 and A3). [G=grantee, C=control; overall 'n'=114, missing=70; grantee 'n'=87, missing=51; control 'n'=27, missing=19]

All four of these individual researcher 'approach' types were found in both respondent groups. However the vast majority (62 percent) of researchers from both groups fell into the 'settled-moderate' type. Considerably more controls did so than grantees (78 percent and 58 percent, respectively). There were also proportionally more grantees than controls in all of three remaining, tentatively more 'frontier-potential' types (i.e. 'settled-radical', 'nomadic-moderate', and 'nomadic-radical').

A suggestion here seems to be that the ERC – strictly when considering its 2007 StG call, first cohort – selected for more 'nomadic' and 'radical' type researchers to receive its funding. A possible outcome *might* be more frontier-potential research activity. However as all types were also present in the control group[21] the control researchers may also have frontier-potential characteristics and/or capacity (although whether such potential will be realised without StG funding conditions will be a matter for investigation following the work's envisaged repeat measurement).

The first of three initial 'standing' typologies created is shown below (Table 6). This combined a measure of the respondent's composite current research resource sufficiency and longer-term research direction independence (S0, created from strongly positively correlated variables S1, S3 and S4) with their self-reported output productivity relative to research field peers (S9). Low-to-medium researcher stability/independence was labelled 'dependent'; high-to-very high as 'independent'. 'Low' self-reported output productivity was labelled 'unprolific'; 'high' as 'prolific'.[22]

S0. Researcher stability/independence			S9. Output productivity	
			Low	**High**
			UNPROLIFIC	**PROLIFIC**
	Low	**DEPENDENT**	Dependent-unprolific **56.8%** G = 51.7%, C = 72.4%	Dependent-prolific **12.7%** G = 13.5%, C = 10.3%
	Medium			
	High	**INDEPENDENT**	Independent-unprolific **22.9%** G = 25.8%, C = 13.8%	Independent-prolific **7.6%** G = 9.0%, C = 3.4%
	Very high			

Table 6. The first of three 'standing' typologies (S0 and S9). [G=grantee, C=control; overall 'n'=118, missing=66; grantee 'n'=89, missing=49; control 'n'=29, missing=17]

All four 'standing' types were observed in both respondent groups. The majority of respondents (57 percent) fell into the 'dependent-unprolific' type. Similarly to the 'approach' typology, considerably more controls fell into this ostensibly less 'frontier-potential' type than grantees (72 percent versus 52 percent, respectively). Once again there were proportionally more grantees than controls in all three remaining types ('dependent-prolific', 'independent-unprolific', and 'independent-prolific').

There may be a number of potential effects from this situation. First, the majority of StG 2007 grantees were registered as being in less independent, less productive 'standing' settings. These conditions might conceivably be altered by the funding amount, duration and other opportunities of the StG (as suggested by apparent early effects from the StG, see below). This may result in transitions where grantees become more independent, more productive researchers. Second, once again (and strictly for the 2007 StG cohort) the ERC appears to have selected for more independent, more productive researchers. At the same time, as all four types were again observed in the control group, so at least some of these individuals may have similar 'frontier-potential' research capacity.

The second of the three initial 'standing' typologies created is shown in Table 7. Here the same researcher stability/independence marker (S0) was this time combined with respondents' self-reported assessment of their research workplace's reputation and performance (S12). The scales for

[21] Additionally the underlying source data also showed that 3.7% of controls, compared to 2.3% of grantees, had the apparently most 'frontier-potential' values of 'very high' for A2 and 'high' for A3.
[22] It should be stressed, as noted above, that these are *relative* terms, scaled against this work's specific distribution of responses. An 'unprolific' researcher here may well be quite productive if judged against a different set of peers.

S0 remained the same. Very low-to-medium for S12 was taken to be a 'normal' research workplace; high-to-very high was taken to be 'elite'. Researchers falling into the 'independent' researcher stability/independence type and yet based in 'normal' research workplaces seem to be so-called 'pockets of excellence' – i.e. high performing individuals in lower performing research workplace settings.

<table>
<tr><td rowspan="6">S0. Researcher stability/independence</td><td colspan="2"></td><td colspan="5">S12. Workplace reputation/performance</td></tr>
<tr><td colspan="2"></td><td>Very low</td><td colspan="2">Low</td><td>Medium</td><td>High</td><td>Very high</td></tr>
<tr><td colspan="2"></td><td colspan="3">NORMAL</td><td colspan="2">ELITE</td></tr>
<tr><td>Low</td><td rowspan="2">DEPENDENT</td><td colspan="3" rowspan="2">Dependent-normal

54.9%
G = 50.5%, C = 69.0%</td><td colspan="2" rowspan="2">Dependent-elite

14.8%
G = 15.1%, C = 13.8%</td></tr>
<tr><td>Medium</td></tr>
<tr><td>High</td><td rowspan="2">INDEPENDENT</td><td colspan="3" rowspan="2">Independent-normal
('pocket of excellence')

17.2%
G = 18.3%, C = 13.8%</td><td colspan="2" rowspan="2">Independent-elite

13.1%
G = 16.1%, C = 3.4%</td></tr>
<tr><td>Very high</td></tr>
</table>

Table 7. Second 'standing' typology (S0 and S12). [G=grantee, C=control; overall 'n'=122, missing=62; grantee 'n'=93, missing=45; control 'n'=29, missing=17]

There were some interesting data underlying this second 'standing' typology. First, there were no 'very high' stability/independence researchers in either 'very low' or 'low' research workplace reputation/performance settings. This appears to set a lower limit on the 'pockets of excellence' (for this specific response set at least). The highest performing researchers were in 'medium' reputation/performance settings – no lower. Second, there were no control group respondents in several of the highest S0/highest S12 categories.[23]

All four types were again observed in both respondent groups. The majority of researchers from both respondent groups (55 percent) were again in the top-left quadrant, i.e. here the 'dependent-normal' type. And yet again, more of the controls fell into this type than did grantees (69 percent versus 51, respectively). There were once again proportionally more grantees than controls in all three remaining types ('dependent-elite', 'independent-normal', and 'independent-elite') – but most markedly so for the 'independent-elite' type (16 percent of grantees versus only 3 percent of controls).

A third and final 'standing' typology combined output productivity (S9) with research workplace reputation/performance (S12). This is shown in Table 8 below. For this typology once more all four 'standing' types were again found in both respondent groups. The majority of respondents (58 percent) were found to be the 'unprolific-normal' type – and, once again, proportionally far more controls than grantees fell into this type (75 percent versus 53 percent, respectively). There were also more grantees than controls for all three remaining types ('unprolific-elite', 'prolific-normal', and 'prolific-elite') –most notably so for the 'productive-elite' type (24 percent of grantees versus 11 percent of controls). Similar to the second 'standing' typology, it seemed reasonable to label additionally the 'prolific-normal' type as a 'pocket of excellence'.

Results for this third 'standing' typology further suggested the ERC's StG could have particular impacts for grantees. 53 percent of grantees were reportedly in the 'productive-normal' type. These researchers might be affected by the long-term intensity and focus conceivably possible from the large sum of money and long duration available via the StG – in addition to the potential for the high

[23] Namely, medium S0/very high S12; high S0/high and very high S12; and very high S0/very high S12.

apparent reputation/prestige of the StG (see below) to either improve or even change completely their research workplace setting or conditions (e.g. by relocating or being headhunted to a different research workplace, or by negotiation or promotion at their current research workplace).

			S12. Workplace reputation/performance				
			Very low	Low	Medium	High	Very high
			NORMAL			ELITE	
S9. Output productivity	Low	UNPROLIFIC	Unprolific-normal **57.7%** G = 52.9%, C = 75.0%			Unprolific-elite **20.8%** G = 23.5%, C = 10.7%	
	High	PROLIFIC	Prolific-normal ('pocket of excellence') **13.1%** G = 13.7%, C = 10.7%			Prolific-elite **8.5%** G = 9.8%, C = 3.6%	

Table 8. Third 'standing' typology (S9 and S12). [G=grantee, C=control; overall 'n'=130, missing=54; grantee 'n'=102, missing=36; control 'n'=28, missing=18]

As with the two above 'standing' typologies, the ERC, strictly for the 2007 StG call cohort measured here, appears to have selected for more productive researchers in more elite workplace settings. Nevertheless, once more at least some of the researchers from the control group were also reportedly in similar conditions as the grantees so may have similar frontier-potential capacity.

Baseline stage results 2: Apparent ERC 'added value' and early StG impacts

Responses to additional questions in the survey indicated the ERC was already perceived to have some 'added value' as a new entrant into the existing European research funding landscape. They also suggested some early StG impacts for both grantees and controls. These two areas are briefly discussed below.

Apparent ERC 'added value'

Survey respondents were asked to highlight attractive features of the ERC and a range of other local, national and European research funders.[24] Responses indicated the ERC was already perceived to distinguish itself from other research funders by having appropriate grant sizes, having a high reputation and prestige (even at this early stage only three or four years into its operation), by enabling novel or innovative research, and by helping significant research findings to be achieved via its funding levels and conditions. At the same time, it was perceived to share other key characteristics with comparable funders, such as high quality peer review and enabling international collaboration.

Further evidence of the apparent 'added value' of the ERC as an emerging player came from survey question responses indicating that – for the specific 2007 StG cohort at least – the majority of StG research proposals submitted to the ERC were for mainly new work that had not been submitted to any other funder, and that represented significant or complete changes of the applicant's research line. Moreover many respondents felt there was no equivalent alternative funder available to approach to fund such work. Additionally the control group, who did not get the StG, largely *did* have to make substantial changes to the scope and scale of their originally proposed research idea, in the absence of

[24] Alongside the ERC these were their own research workplace funding options, their main national funding agency/ministry, the European Science Foundation, the Framework Programme, industrial funding, charity/foundation funding, and any other funding source they wished to name.

ERC funding. Specific attractive features of ERC StG were also reported as being the opportunity to build a research group, the total sum of money and its duration, the encouragement to undertake risky and interdisciplinary projects, and high reputation.

There were some less positive findings however. First, mobility – although enabled by the portability condition of the ERC StG – was neither seen to be a very attractive feature nor was heavily utilised. Additionally, some respondents were unhappy with levels of bureaucracy and administrative reporting related to the StG.[25] Interestingly still others reported difficulties and tensions remaining in their original workplace due to the sudden resource independence and research direction freedom provided by the StG. They were perceived to have outgrown their research workplace and some even had to leave to establish themselves elsewhere to pursue their intended StG-related research.

Apparent early StG impacts

The baseline stage data provided some indication of apparent early impacts for recipients of the ERC StG – and for the control group. These included: increased reputation; attracting additional research funds (i.e. the 'halo' effect mentioned above); significant learning about proposal writing and funding interviews; being able to start a research group, being promoted or receiving tenure faster than normal; having increased short-term and long-term flexibility over how to pursue their own research, how to use research resources and how to manage (or re-negotiate) their various workloads; improved international visibility; and overall a greater ability to do novel research, take risks and produce high-quality, high-impact outputs.

Apparent positive, early impacts therefore seemingly clustered around: resource-related impacts (money, time, people, equipment); symbolic impacts (increased reputation, prestige, visibility, networking, a quality hallmark leading to additional funding); and impacts on organisational career and knowledge community career norms (atypical promotion experiences and atypical independence or autonomy over research content, workload and general autonomy). Overwhelmingly, the survey respondents – both grantees and controls – reported very positive views about the effect of their StG grant/application to date and about the ERC. However there was some evidence – confirming views from some previous studies, noted above – that control group respondents were already faring worse than the grantees in terms of research direction stability and apparent research risk-taking levels.

Concluding remarks

The work presented in this paper attempted to develop a set of variables indicative of individual researcher's frontier-potential research-related 'approach' and 'standing', based on existing studies in the area, and concerning individual, organisational and research support factors.

The methodology presented was part of a proposed two-stage, controlled, impact assessment methodology to explore the potential effects and impacts of the ERC's StG – based on responses from the 'first cohort' of grant recipients and quality-threshold screened applicants (serving as a control group). At present, only the first-stage, baseline measurement has been taken, registering 'demographic', 'approach' and 'standing' characteristics using an online questionnaire survey-based approach. The baseline stage responses were checked and found to be consistent with the original sample of potential respondents, indicating an acceptable degree of significance to the results.

Values for the novel demographic-approach-standing (DAS) model were scaled relative to the set of responses garnered – and bespoke to each ERC domain (LS, PE or SH), as necessary to control for research field-specific differences. Using a reduced, representative set of the 22 DAS variables, 19 matched-pairs of grantees and controls were created – producing pairs in each of the three ERC domains and providing for variety of gender (male-male and female-female pairs) and other researcher characteristics. Once the methodology's envisaged second-stage, repeat measurement has

[25] Some respondents also complained about new or increased line management-type responsibilities accruing from being able to start or expand their own research group via the StG.

been taken, divergences between the before and after states of grantees, and those of their originally control group respondents, should be registered by re-surveying and re-characterising the *exact same* individual researchers, using the same DAS researcher-profiling scheme. It will then be possible to make a qualitative assessment of the kinds of effects and impacts resulting from the StG. Other changes should also be possible to register, by exploring the before and after values for the remaining DAS variables, separately for both the grantees and the controls, not used for the pairing process.

Four initial typologies – one for 'approach' and three for 'standing' were created from the baseline stage data provided by the survey. These showed that the ERC – strictly in terms of the StG 2007 call only – apparently selected for a range of 'approach' and 'standing' characteristics ostensibly representing greater likelihood of 'frontier-potential' research outcomes. Proportionally more grantees than controls fell into all of the more 'frontier-potential' types. At the same time, similar type control group respondents were observed for all four typologies, suggesting 'frontier-potential' research capacity also present in the control group. Whether or not this capacity will be realised remains an open question at this point, to be answered following the research's proposed second-stage measurement. Additionally, combined 'approach-standing' typologies need to be developed, as these two components are likely to operate in combination not isolation. These combined typologies may yet reveal further insights about the grantee and control cohorts studied here – and shed more light on additional potential effects of the ERC's funding decisions for its StG 2007 call.

Additional survey questions, not directly related to the DAS variables, matched-pairs and typologies, also revealed 'added value' to the ERC as a new element within the existing European research funding landscape. Its StG was reported to have value in terms of its duration, size, and enabling conditions, such as supporting the creation of independent research groups and facilitating more ambitious and novel research activity.

Further analysis and synthesis of the work's baseline stage data and conceptual development is envisaged. Finally, it is likely that further consideration of key research workplace factors (e.g. such as those highlighted by Jordan 2006 and Jordan et al. 2003) will be designed into the research's proposed second-stage, repeat measurement.

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References

Afuah, A.N. and N. Bahram (1995), 'The hypercube of innovation', *Research Policy*, **24**, 51–76.

Andrews, R. (ed.) (1979), *Scientific Productivity: The Effectiveness of Research Groups in Six Countries*, Cambridge: Cambridge University Press.

Bennis W. and P.W. Biederman (1997), *Organizing Genius: The Secrets of Creative Collaboration*, Reading, MA: Addison-Wesley.

Bourke, P. and L. Butler (1999), 'The efficacy of different modes of funding research: Perspectives from Australian data on the biological sciences', *Research Policy*, **28**, 489–499.

Boyatzis, R.E. (2008), 'Competencies in the 21st century', *Journal of Management Development*, **27** (1), 5–12.

Braben, D.W. (2004), *Pioneering Research: A Risk Worth Taking*, Hoboken, New Jersey: Wiley-Interscience.

Charlton, B.G. (2009), 'Why are modern scientists so dull? How science selects for perseverance and sociability at the expense of intelligence and creativity', *Medical Hypothesis*, **72**, 237–243.

Dill, D. (1985), 'Theory versus practice in the staffing of R&D laboratories', *R&D Management*, **15**, 227–241.

Dill, D. (1982), 'The structure of the academic profession: Towards a definition of ethical issues', *The Journal of Higher Education*, **53** (3), 255–267.

Dowd, K.O. and D.M. Kaplan (2005), 'The career life of academics: Boundaried or boundaryless?', *Human Relations*, **58** (6), 699–721.

Feldman, M.P. and M.R. Kelley (2001), 'Winning an award from the Advanced Technology Program: Pursuing R&D strategies in the public interest and benefiting from a halo effect', Washington DC: US Department of Commerce, National Institute of Standards and Technology (NISTIR-6577).

Hage, J. (2006), 'Radical innovation and institutional change: French biomedicine, 1888–1919', in *Annual Meeting of the American Association for the Advancement of Science*, 17 February.

Heinze, T. (2008), 'How to sponsor ground-breaking research: A comparison of funding schemes', *Science and Public Policy*, **35** (5), 302–318.

Heinze, T., P. Shapira, J. Rogers and J. Senker (2009), 'Organizational and institutional influences on creativity in scientific research', *Research Policy*, **38**, 610–623.

Heinze, T. and G. Bauer (2007), 'Characterizing creative scientists in nano-S&T: Productivity, multidisciplinarity, and network brokerage in a longitudinal perspective', *Scientometrics*, **70** (3), 811–830.

Heinze, T., P. Shapira, J. Senker and S. Kuhlmann (2007), 'Identifying creative research accomplishments: Methodology and results for nanotechnology and human genetics', Scientometrics, 70 (1), 125–152.

Jordan, G. (2006), 'Factors influencing advances in basic and applied research: Variation due to diversity in research profiles', in Hage, J. and M. Meeus (eds), Innovation, Science, and Institutional Change, Oxford: Oxford University Press, 173–195.

Jordan, G., L.D. Streit and J. Matiasek (2003), 'Attributes in the research environment that foster excellent research: An annotated bibliography', SAND report 2003–0132, Albuquerque, NM: Sandia National Laboratories.

Kerwin, J. and S. Campbell (2007), 'Findings from the Advanced Technology Program's Survey of ATP applicants 2004', Washington, DC: US Department of Commerce, National Institute of Standards and Technology, Economic Assessment Office (and Westat), July (NIST GCR 07-908).

Lamont, M. (2009), *How Professors Think: Inside the Curious World of Academic Judgment*, Cambridge, MA and London: Harvard University Press.

Langfeldt, L. (2001), 'The decision-making constraints and processes of grant peer review, and their effects on the review outcome', *Social Studies of Science*, **31** (6), 820–841.

Laudel, G. (2006), 'The art of getting funded: How scientists adapt to their funding conditions', *Science and Public Policy*, **33** (7), 489–504.

Lee, A. (2009), *Helping New Postgraduates*, Maidenhead, UK: Mc Graw Hill/Open University Press.

Melin, G. and R. Danell (2006), 'The top eight percent: Development of approved and rejected applicants for a prestigious grant in Sweden', *Science and Public Policy*, **33** (10), 702–712.

National Institute of Standards and Technology [NIST] (2006), 'Measuring ATP impact: 2006 report on economic progress', Washington, DC: US Department of Commerce, Technology Administration, Economic Assessment Office (GCR 06-899).

National Institute of Standards and Technology [NIST] (2005), 'Survey of ATP applicants 2002: ATP Funds High-Risk and Long-Term R&D Projects', factsheet series, Washington, DC: US Department of Commerce, Technology Administration, Economic Assessment Office, June (NIST GCR 05-876).

National Institute of Standards and Technology [NIST] (2003), 'Survey of ATP applicants 2000', factsheet series, Washington, DC: US Department of Commerce, Technology Administration, June (NIST GCR 03-847).

National Research Council [NRC] (2006), Evaluation of the Markey Scholars Program, Washington, DC: The National Academies Press.

Nedeva, M. (2009), 'Researchers and their competencies', unpublished technical paper within the EURECIA research project, Manchester, UK: University of Manchester, Manchester Institute of Innovation Research.

Polanyi, M. (1969), *Knowing and Being*, Chicago: Chicago University Press.

Rowley, J. and A. McCulloch (1999), 'Developing research capacity: moving on', *Scottish Journal of Adult and Continuing Education*, **5** (2), 106–116.

Shapira, P. and S. Kuhlmann (eds) (2003), *Learning from Science and Technology Policy Evaluation*, Cheltenham, UK: Edward Elgar.

Shapira, P., J. Youtie and J. Rogers (2009), 'Blind matching versus matchmaking: Comparison group selection for highly creative researchers', CREA Project working paper, Atlanta: Georgia Institute of Technology.

Udwadia, F.E. (1990), 'Creativity and innovation in organizations: Two models and managerial implications', *Technological Forecasting and Social Change*, **38**, 65–80.

Vallerand R.J., L.G. Pelletier, M.R. Blais, N.M. Briere, C. Senecal and E.F. Vallieres (1992), 'The academic motivation scale: A measure of intrinsic, extrinsic and amotivation in education', *Educational and Psychological Measurement*, **52**, 1003–1017.

Whitley, R. (2000), *The Intellectual and Social Organization of the Sciences*, 2nd edition, Oxford: Oxford University Press.