

What really matters for successful research environments? A realist synthesis

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CONTEXT Research environments, or cultures, are thought to be the most influential predictors of research productivity. Although several narrative and systematic reviews have begun to identify the characteristics of research-favourable environments, these reviews have ignored the contextual complexities and multiplicity of environmental characteristics.

OBJECTIVES The current synthesis adopts a realist approach to explore what interventions work for whom and under what circumstances.

METHODS We conducted a realist synthesis of the international literature in medical education, education and medicine from 1992 to 2016, following five stages: (i) clarifying the scope; (ii) searching for evidence; (iii) assessing quality; (iv) extracting data, and (v) synthesising data.

RESULTS We identified numerous interventions relating to research strategy, people, income, infrastructure and facilities (IIF), and collaboration. These interventions

resulted in positive or negative outcomes depending on the context and mechanisms fired. We identified diverse contexts at the individual and institutional levels, but found that disciplinary contexts were less influential. There were a multiplicity of positive and negative mechanisms, along with three cross-cutting mechanisms that regularly intersected: time; identity, and relationships. Outcomes varied widely and included both positive and negative outcomes across subjective (e.g. researcher identity) and objective (e.g. research quantity and quality) domains.

CONCLUSIONS The interplay among mechanisms and contexts is central to understanding the outcomes of specific interventions, bringing novel insights to the literature. Researchers, research leaders and research organisations should prioritise the protection of time for research, enculturate researcher identities, and develop collaborative relationships to better foster successful research environments. Future research should further explore the interplay among time, identity and relationships.

Medical Education 2018; 52: 936–950
doi: 10.1111/medu.13643



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INTRODUCTION

Research environments matter. Environmental considerations such as robust cultures of research quality and support for researchers are thought to be the most influential predictors of research productivity.^{1,2} Over 25 years ago, Bland and Ruffin¹ identified 12 characteristics of research-favourable environments in the international academic medicine literature spanning the period from the mid-1960s to 1990 (Box 1). Although these characteristics are aspirational in flavour, how they interplay to influence research productivity within increasingly complex institutional structures is not yet known. Indeed, although existing reviews have begun to help us better understand what makes for successful research environments, this research has typically ignored the contextual complexities and multiplicity of environmental characteristics^{1,3–7} and has focused on narrow markers of productivity such as the quantity of research outputs (e.g. ref.⁷) The current realist synthesis, therefore, aims to address this gap in the research literature by reviewing more recent literature (1992–2016) and exploring the features of successful research environments in terms of which interventions work, for whom, how and in what circumstances.

Box 1 Characteristics of successful research environments¹

- 1 Clear organisational research goals
- 2 Research productivity as a priority and at least equal priority to other activities
- 3 A robust research culture with shared research values
- 4 A positive group climate
- 5 Participative governance structures
- 6 Non-hierarchical and decentralised structures
- 7 Good communication and professionally meaningful relationships between team members
- 8 Decent resources such as people, funding, research facilities and time
- 9 Larger group size, moderately established teams and diversity
- 10 Rewards for research success
- 11 Recruitment and selection of talented researchers
- 12 Research-oriented leaders with research expertise and skill

The contextual background for understanding successful research environments

Against a backdrop of the mass production of education, reduced government funding for research and ‘new managerialist’ cultures in higher education,^{8,9} increased scrutiny of the quantity and quality of research, the research environments in which research is produced and the impacts of research has become inevitable.¹⁰ Indeed, in higher education institutions (HEIs) globally, research productivity is being measured as part of individual researcher and research group key performance indicators.⁷ In many countries, such as Australia, Hong Kong, New Zealand and the UK,¹¹ HEI research is measured on a national scale through government-led research assessments. Such research measurement has contributed to the allocation of funding to universities and differentiation of universities in the competitive marketplace, with some solidifying their institutional identities as ‘research-intensive’ and others emphasising their relative ‘newcomer-to-research’ status (e.g. previously ‘teaching-intensive’ universities).^{9,12,13} Such institutional differentiation also parallels that of individual academics *within* universities, who are increasingly encouraged to take either ‘research-active’ or ‘education-focused’ career pathways.^{8,9} It is these broader national and institutional constraints that inevitably impact on research environments at the level of units, centres, departments and schools *within* universities (the level of ‘research environment’ that we focus on in this paper). Table S1 provides definitions of key terms.

Key features of research environments identified in previous reviews

Evans defines a research environment as including: ‘shared values, assumptions, beliefs, rituals and other forms of behaviour whose central focus is the acceptance and recognition of research practice and output as valued, worthwhile and pre-eminent activity.’¹⁴ Previous reviews have tended to focus on interventions aimed at individual researchers, such as research capacity building,^{4,5,7} and with individual-level outcomes, such as increased numbers of grants or publications.^{4,5,7} These reviews have typically concluded that research capacity-building interventions lead to positive research outcomes.^{4,5,7} Furthermore, the reviews have identified both individual and institutional enablers to research. Individual enablers included

researchers' intrinsic motivation to conduct research.^{6,7} Institutional enablers included peer support, encouragement and review,⁷ mentoring and collaboration,^{4,5} research leadership,^{5,6} institutional structures, processes and systems supporting research, such as clear strategy,^{5,6} protected time and financial support.⁵ Although these reviews have begun to shed light on the features of successful research environments, they have significant limitations: (i) they either include studies of low to moderate quality^{4,5} or fail to check the quality of studies included,⁷ and (ii) they do not explore what works for whom and under what circumstances, but instead focus on what works and ignore the influence of the context in which interventions are implemented and 'how' outcomes come about. Indeed, Mazmanian et al.⁴ concluded in their review: '... little is known about what works best and in what situations.'

Conceptual framework: a realist approach

Given the gaps in the research literature and the importance of promoting successful research environments for individuals' careers, institutional prestige and the knowledge base of the community, we thought a realist synthesis would be most likely to elucidate how multiple complex interventions can influence success. Realism assumes the existence of an external reality (a real world), but one that is filtered (i.e. perceived, interpreted and responded to) through human senses, volitions, language and culture.¹⁵ A realist approach enables the development and testing of theory for why interventions may or may not work, for whom and under what circumstances.¹⁶ It does this through recognising that interventions do not directly cause outcomes; instead, participants' reactions and responses to the opportunities provided by the intervention trigger outcomes. This approach can allow researchers to identify causal links in complex situations, such as those between interventions and the contexts in which they work, how they work (mechanisms) and their outcomes.¹⁷ Although the context-mechanism-outcome (CMO) approach is not necessarily linear, it can help to provide explanations that privilege contextual variability.¹⁸

Aligned with the goals of realist research, this synthesis aims to address the following research question: What are the features of successful research environments, for whom, how and in what circumstances?

METHODS

We followed five stages of realist synthesis: (i) clarifying scope; (ii) searching for evidence; (iii) assessing quality; (iv) extracting data, and (v) synthesising data.¹⁹ Our methods also follow the RAMESES (*realist and meta-narrative evidence synthesis: evolving standards*) reporting guidelines.²⁰

Clarifying the scope

We first clarified the scope of our realist synthesis by identifying relevant interventions based on the Research Excellence Framework (REF) 2014 environment assessment criteria. The REF is a national exercise assessing the quality of research produced by UK HEIs, its impact beyond academia, and the environment that supports research. The assessment criteria indicated in the REF2014 environment template included the unit's *research strategy*, its *people* (including staffing strategy, staff development and research students), its *income, infrastructure and facilities* (IIF), as well as features of *collaboration*.²¹ These guided our search terms (see stage 2 below). We chose to use these quality markers as they informed the UK national assessment exercise, upon which other national exercises are often based. In addition, these criteria were explicit, considered and implementable, and were developed through consensus. Like other realist syntheses,^{18,22,23} ours considered a multiplicity of different interventions rather than just one and some of the papers we reviewed combined multiple interventions.

Based on previous reviews,^{1,4,5,7} our initial programme theory speculated that interventions aligned to having an explicit research strategy, staff development opportunities, funding and establishing research networks would be effective for creating successful research environments (Fig. 1 gives further details of our initial programme theory).

Searching for empirical evidence

We devised search terms as a team and refined these iteratively with the help of a health librarian experienced in searching. We split the research question into three key concepts: (i) research environment; (ii) discipline, and (iii) research indicator (i.e. positive or negative). We then used

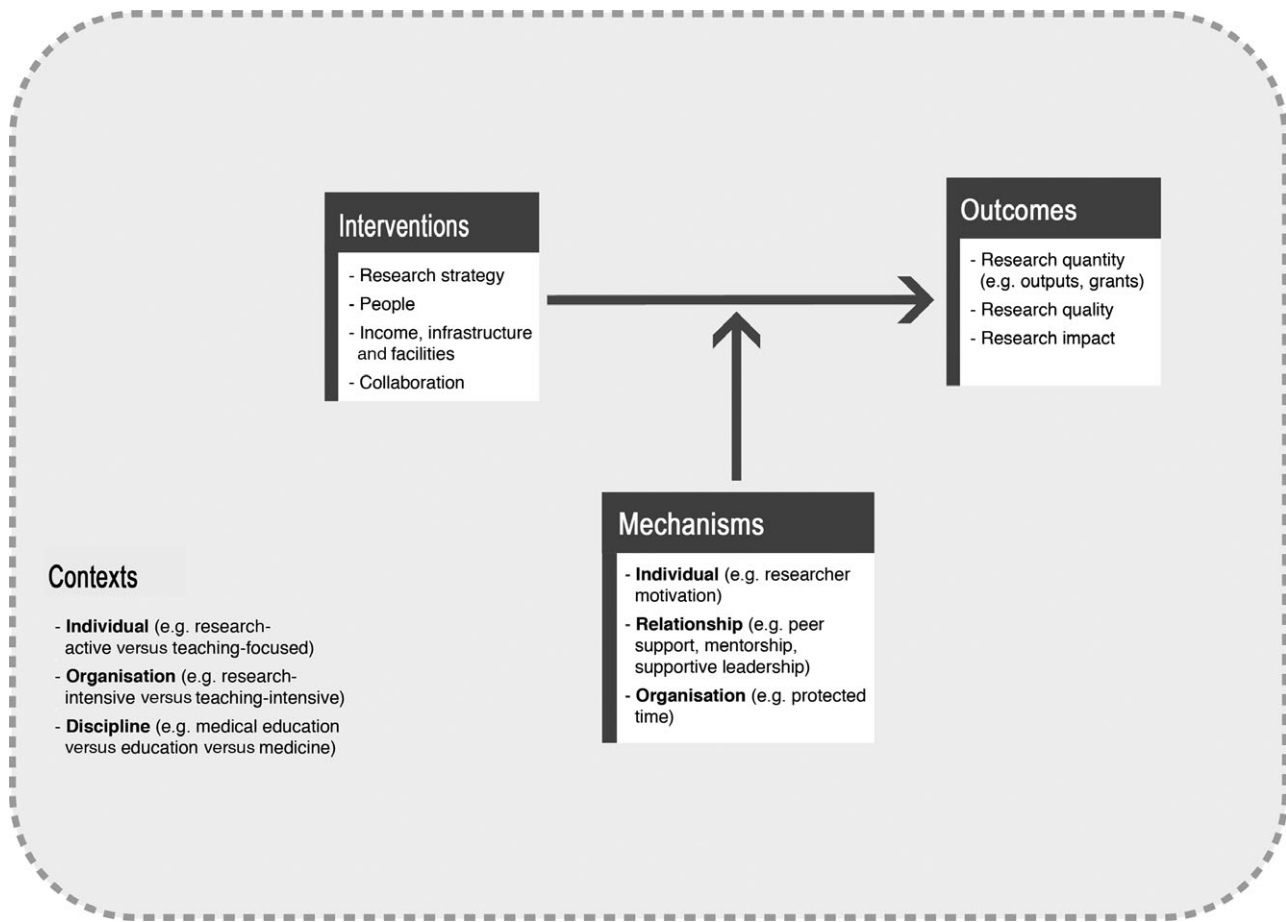


Figure 1 Initial programme theory

variations of these terms to search the most relevant databases including MEDLINE, ProQuest, Scopus, CINAHL (Cumulative Index to Nursing and Allied Health Literature) and Web of Science. Table S2 illustrates the MeSH terms and provides a selection of key terms utilised in the database searches.

We were interested in comparing research cultures across the disciplines of medical education, education and medicine for two key reasons. Firstly, the discipline of medical education consists of a rich tapestry of epistemological approaches including biomedical sciences, social sciences and education, and medicine.^{24,25} Secondly, there have been disciplinary arguments in the literature about whether medical education should be constructed as medicine or social science.^{24,26}

We agreed various inclusion and exclusion criteria with respect to topic, recentness and type of article (Table S3), as well as refined criteria to include contextual parameters (Table S4). We chose 1992 as the start date for our search period as 1992 saw the

first published literature review about productive research environments in the academic medicine literature.¹

Study selection

The first top-level search elicited 8527 journal articles across all databases. Once duplicate results had been removed, and ‘topic’ and ‘recentness’ study parameters reinforced, 420 articles remained. The searching and selection process is summarised in a PRISMA (*preferred reporting items for systematic reviews and meta-analyses*) diagram (Fig. 2). Three research assistants and one of the authors (PESC) initially assessed relevance by reviewing abstracts using preliminary inclusion criteria. If any ambiguities were found by any of the reviewers, abstracts were checked by one of the other two researchers (RA and CER). Where divergent views existed, researchers discussed the reasons why and agreed on whether to include or exclude. A 10% sample of these 420 abstracts were double-checked by an additional two researchers,

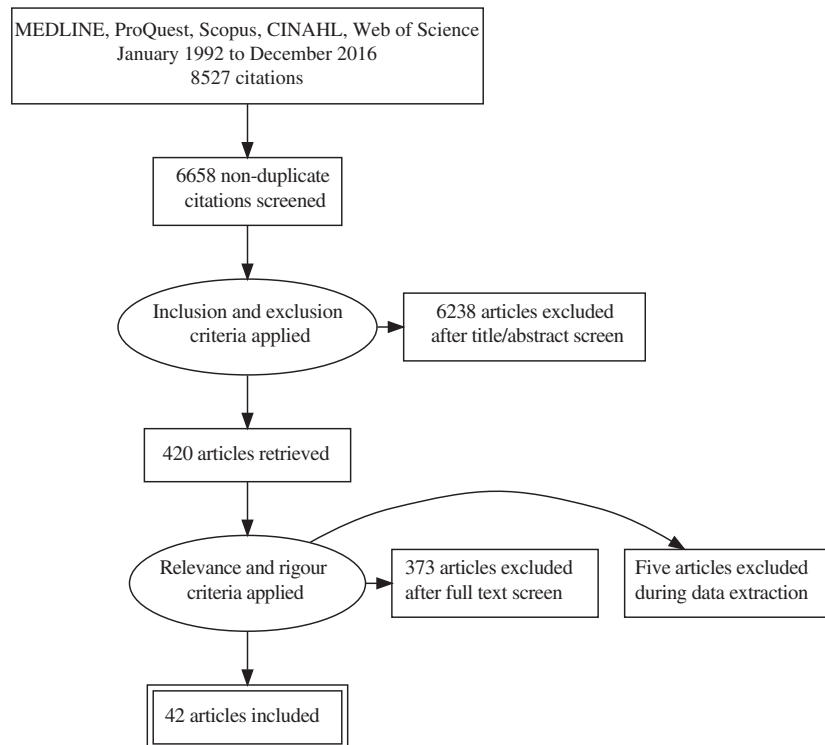


Figure 2 PRISMA flow diagram of the selection process

including a number of articles previously excluded, for quality control purposes.

Assessment of quality

We assessed the journal articles for relevance *and* rigour.²⁰ We defined an article's *relevance* according to 'whether it can contribute to theory building and/or testing'.²⁰ Following the relevance check and 'type' exclusions to original research papers, 100 articles remained, which were then assessed for rigour. Although we chose to narrow down to original research, we kept relevant articles such as systematic reviews and opinion pieces to inform the introduction and discussion sections of this paper.

We defined *rigour* as determining 'whether the method used to generate the particular piece of data is credible and trustworthy'.²⁰ We used two pre-validated tools to assess study quality: the Medical Education Research Study Quality Instrument (MERSQI) to assess the quality of quantitative research,^{27,28} and the Critical Appraisal Skills Programme (CASP) qualitative checklist for qualitative and mixed-method studies.²⁹ Both tools are used to consider the rigour of study design, sampling, type of data, data analysis and outcomes/

findings, and have been employed in previous reviews.^{23,30}

Following the quality assessment, 47 articles remained and were then subjected to data extraction and synthesis. Five papers were excluded as they did not contribute to our theory building or lacked CMO configurations (CMOCs). We kept notes of the reasons for excluding studies and resolved doubts through discussion (Fig. 2).

Data extraction

Two data-rich articles containing multiple CMOCs were inductively and deductively (based on the initial programme theory) coded by all of us to ensure consistency. We then discussed any similarities and differences in our coding. As is inherent in the challenges of realist approaches, we found differences in our identifications of CMOCs, which often related to how one particular component (e.g. time) could be an outcome at one moment and a mechanism the next. This alerted us to overlapping constructs, which we then explored as we coded remaining papers. To collect data across all remaining papers, we extracted information relating to: study design, methods and sample size; study setting; intervention focus;

contexts of the intervention; mechanisms generated in the results, and outcomes. The key CMOCs in all 42 articles were identified primarily from the results sections of the papers. The process of data extraction and analysis was iterative with repeated discussion among the researchers of the demi-regularities (i.e. patterns of CMOCs) in relation to the initial programme theory and negotiations of any differences of opinion.

Data synthesis

Finally, we interrogated our data extraction to look for patterns across our data/papers. We used an interpretative approach to consider how our data compared with our initial programme theory in order to develop our modified programme theory.

RESULTS

Characteristics of the studies

The 42 papers represented the following disciplines: medical education ($n = 4, 10\%$);^{31–34} education ($n = 18, 43\%$),^{35–52} and medicine ($n = 20, 48\%$).^{53–72} There were 26 (62%) qualitative studies, 11 (26%) quantitative studies and five (12%) mixed-methods studies (Table S5). The studies were from countries across the globe, including Australia ($n = 10, 24\%$), the USA ($n = 7, 17\%$), the UK ($n = 6, 14\%$), Canada ($n = 4, 10\%$), South Africa ($n = 4, 10\%$), Denmark ($n = 2, 5\%$), Turkey ($n = 2, 5\%$) and others ($n = 7, 17\%$) (e.g. Belgium, China, Germany, New Zealand and the Philippines). The research designs varied but common approaches included qualitative interviews, surveys, documentary/bibliographic analysis, case studies and mixed-methods studies. Study participants included academics, teachers, health care professionals, senior directors, PhD students, early-career researchers (ECRs) and senior researchers. Table S6 lists the individual contexts, interventions, mechanisms and outcomes identified from individual papers.

Extending our initial programme theory

A key finding from our realist synthesis was that the same interventions fired either positive or negative mechanisms leading to positive or negative outcomes, respectively, depending on context. Surprisingly, the CMOCs were mostly consistent across the three disciplines (i.e. medical education, education and medicine) with local contexts seemingly interplaying more strongly with

outcomes. Therefore, we present these disciplinary contexts here as merged, but we highlight any differences by disciplinary context where relevant.

Having a *research strategy* promoted a successful research environment when it enabled appropriate resources (including time) and valuing of research; however, it had negative consequences when it too narrowly focused on outputs, incentives and rewards. In terms of *people*, individual researchers needed to be internally motivated and to have a sense of belonging, and protected time and access to capacity-building activities in order to produce research. Lack of knowledge, researcher identity, networks and time, plus limited leadership support, acted as mechanisms leading to negative research outcomes. The presence of *III* was overwhelmingly indicated as necessary for successful research environments and their absence was typically detrimental. Interestingly, a few papers reported that external funding could have negative consequences because short-term contracts, reduced job security and the use of temporary junior staff can lead to weak research environments.^{40,67,71} Finally, *collaboration* was crucial for successful research mediated through trusting respectful relationships, supportive leadership and belongingness. Poor communication and competitive cultures, however, worked to undermine collaboration, leading to isolation and low self-esteem, plus decreased research engagement and productivity. Table 1 highlights illustrative CMOCs for each intervention extending our initial programme theory.

Key cross-cutting mechanisms: time, identity and relationships

As Table 1 shows, the same intervention can lead to positive or negative outcomes depending on the particular contexts and mechanisms triggered. This highlights greater complexity than is evident at first glance. Cross-cutting these four interventions were three mechanisms that were regularly identified as critical to the success (or not) of a research environment: time; researcher identities, and relationships. We now present key findings for each of these cross-cutting mechanisms and discuss how their inter-relations lead to our modified programme theory (Fig. 3). Note that although we have tried to separate these three mechanisms for ease of reading, they were often messily entangled. Table 2 presents quotes illustrating the way in which each mechanism mediates outcomes within particular circumstances.

Table 1 Positive and negative context–mechanism–outcome configurations (CMOCs) for each intervention

Intervention	Positive CMOCs	Negative CMOCs
Research strategy	The institution and leaders (C) must appropriately resource (time and money), measure, strategise and share expertise (M) to support collective research engagement, team productivity and collaboration (O) ^{32–34,36,38,43,44,46–49,51,58,64,66,70,71} e.g. ‘Encouraging faculty members to obtain advanced degrees as well as providing them with a conducive and enabling environment for research are important policy decisions that have to be considered by the school administration’ ⁴⁴	Within research cultures of incentives and rewards (C), narrow strategic focus on outputs (I) can operate as a demoralising disincentive (M) decreasing research productivity (O) ^{38,40,46,47,64} e.g. ‘The instrumentalist emphasis on quantity of research output and compliance with quality measures operated as a demoralising disincentive that curtailed, rather than improved, productivity for many’ ⁴⁶
People	Research learners, ECRs and practitioner-researchers (C) require passion/motivation/commitment (M) feeling empowered, enabled and supported in their development over time (M); need protected time (M); incentives (M); networks (M) and access to capacity building activities (M) and sense of belonging (M) to increase their outputs, grant applications, and publications (O) ^{34,35,40,44,47,48,51,52,58,62,66,68,71,72} e.g. ‘for the majority of women interviewed their high performance in research was generated by their passion and commitment to the work and this was generally reported to be a far more significant motivating factor than organisational imperatives’ ⁴⁰	For practitioner researchers and academics (C) lack of researcher identity (M), limited research knowledge and skills (M), lack of time (M), lack of incentives (M) and networks (M), and limited support (M) leads to reduced research engagement and productivity (O) ^{34,37,40,48,49,52,56,62} e.g. ‘Primary care practitioners lack the research skills/training and protected time to bid for or undertake research. As one dentist stated, “There is a feeling that you have to be an academic to do research. . . The system is set up to deliver primary care, not to do research”’ ⁵⁶
Income, infrastructure (I) and facilities	Within university (C), research grants and incentives (I), research infrastructure and space (I) leads to increased self-efficacy, confidence (M) among faculty members and improved university status and recognition (M) leading to increased research productivity (O), more grants (O) and improved quality (O) ^{33,34,36,44,48,60–62,68} e.g. ‘We got [income from the Research Assessment Exercise 2008]. . . we’ve been able to use that money and people have felt the benefit quite a lot. . .’ ⁴⁸	In university and industry settings, lack of funding and access to resources leads to lack of time for development as a researcher (M) and greater job insecurity (M), leading to weak research environments, reduced engagement, poor-quality research (O) and reduced productivity (O) ^{32,33,35,36,47,53,56,58,60,63,65–68,70,71} e.g. ‘owing to the lack of extramural funding, other important factors such as protected time for research and extra funding for travel costs to scientific meetings were not provided’ ⁶³
Collaboration	For all researchers (C) having trusting/respectful/sustained relationships (M), supportive leadership and belongingness (M) leads to great research productivity; better quality research; involvement in research activities; sustained research careers; and thriving research cultures (O) ^{31,34,38,39,41–44,49,51,57,60,66,67} e.g. ‘Research networks and supportive interactions with others, including supervisors and research mentors, are widely regarded as essential both during and after doctoral study, particularly in the early stages of an academic career and the formation of an academic identity ’ ⁴⁸	Within universities (C), poor communication (M), competitive cultures (M), and limited opportunities for collaboration (M), lead to isolation, alienation and low self-esteem (M), and poorer long-term relationships (M) resulting in decreased research engagement and productivity (O) ^{35,39,41,43,46,48,66,70} e.g. ‘There’s a sort of separation between the people that are involved in the research and it’s the main part of what they do, and us that have teaching as their main responsibility. . . so it’s not always easy to see yourself as any kind of researcher ’ ⁴¹

CMOCs indicated in bold highlight the three cross-cutting themes of time, identity and relationships.
ECRs = early-career researchers.

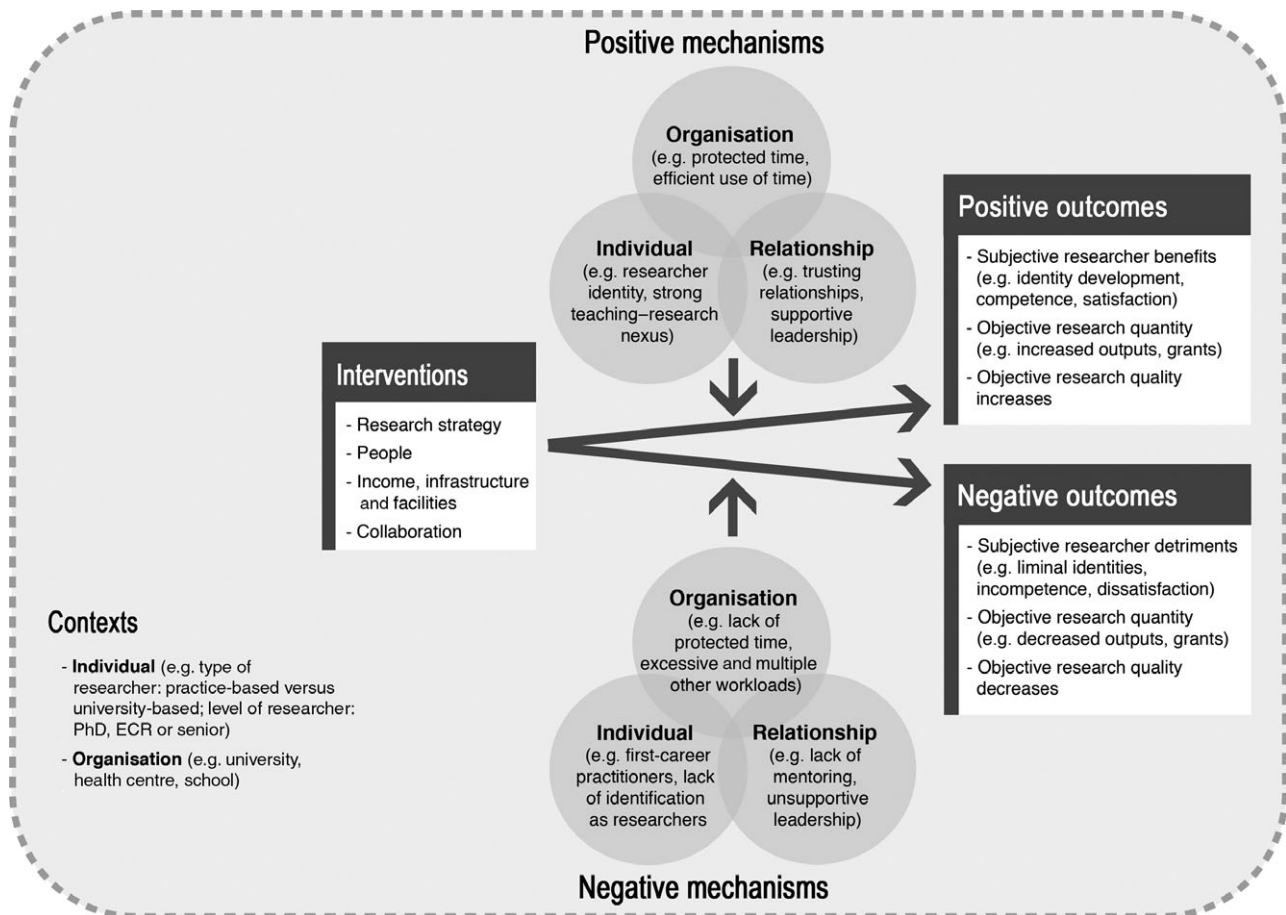


Figure 3 Modified programme theory. ECR = early-career researcher

Time

Time was identified as an important mechanism for mobilising research outcomes across our three disciplines. Time was conceptualised severally including as: protected time; workload pressures influencing time available; efficient use of time; flexible use of time; making time, and time in career. The two most commonly considered aspects were protected time and workload implications. Protected time was largely talked about in the negative across a variety of contexts and disciplines, with *lack of protected time* leading to lack of researcher engagement or inactivity and reduced research productivity.^{32,35–37,41,44,47–49,61–63,67} Also across a variety of contexts and disciplines, and acting as a positive mechanism, *available protected time* was found to lead to increased research productivity and active research engagement.^{31,36,40,48,49,63,65} With regard to workload, limitations on the time available for research imposed by excessive other workloads led

to reduced research activity, lower research productivity, poor-quality research and reduced opportunity to attend research training.^{40,41,47–49,60,67} Juggling of multiple responsibilities, such as clinical, teaching, administrative and leadership roles, also inhibited research productivity by diminishing the time available for research.^{35,40,49} The alignment of research with other non-research work was described as driving efficiencies in the use of time leading to greater research productivity (Table 2, quote 1).

Identity

Identity was also an important mechanism for mobilising research outcomes across our three disciplines. Interpretations included personal identities (e.g. gender), professional identity (e.g. as a primary practitioner or a primary researcher), and social identity (e.g. sense of belongingness). Researcher identity was often referred to in relation to first-career practitioners (and therefore second-

Table 2 Time, identity and relationships as cross-cutting mechanisms mediating successful research environments

Quote no.	Mechanism	Quote
1	Time: efficient use of time	'I never say I need more time because you could use that as an excuse for anything. . . But I think support in terms of being quite smart at aligning research activity to other activity you're involved in is quite important' ⁴⁸
2	Identity: internal motivation	'[For teacher researchers] inherent satisfaction and reward from research, rather than external praise and feedback, was certainly an indication of moving towards a research identity' ⁴¹
3	Relationships: leadership	'From an institutional perspective, much depends on the perceived value of research and how it is actively supported by management, for example, in terms of study leave, time allocated for research and the impact of financial savings' ⁴³
4	Time and identity	'I say personal determination and resilience is a big factor because there are people who have been given some time and have then not delivered. . . I mean some of them are keen, they will say they have got no time and you know that is an interesting question about whether you make time or whether you have to wait for time to be given to you' ⁴³
5	Identity and leadership	'...research leadership as a "process through which academic values and identities are constructed, promoted and maintained". Leadership is, therefore, central to establishing a healthy and vibrant research culture' ⁴⁸
6	Time and relationships	'We recognise that the sense of community developed over time would not have been possible without mutual trust and respect. This has been instrumental in creating a safe environment for both academic and personal development, and has in turn made it "possible to share problems without feeling uncomfortable". Without a sense of trust it would also have been impossible for us to become more confident both in ourselves, as emerging academics, and in our work' ⁷²

career researchers). Sharp et al.⁴⁸ defined these as participants recruited into higher education not directly from doctoral study but on the basis of their extensive 'first-order' knowledge and pedagogical expertise. These were also practitioners conducting research in schools or hospitals. Identities were also referenced in relation to early, mid-career or senior researchers. Academic staff working in academic institutions needed to develop a sense of researcher identity, belongingness, self-efficacy for research and autonomy to increase their satisfaction, competence and research activity.^{39,40,44,46,51,67} For first-career practitioners (i.e. teachers, doctors), the research needed to be highly relevant and aligned to their primary identity work in order to motivate them.^{53,59,62,65} This alignment was described as having a strong research-teaching nexus.^{40,48} Linked to this concept was the need for first-career practitioners to see the impact of research in relation to their primary work (e.g. patient- or student-oriented) to facilitate motivation and to develop a researcher identity (Table 2, quote 2).^{36,37,41,49,53,54,67} Where research was seen as irrelevant to primary identity work (e.g.

English language teaching, general practice), there was research disengagement.^{37,48,52,59,67}

Relationships

For all researchers and across our three disciplines, relationships were important in the mediating of successful research environments.^{31,34,38,39,41-44,57,60,66,67} Positive research relationships were characterised by mutual trust and respect,^{40-43,54,66,72} whereas others described them as friendships that take time to develop.⁵¹ Mutually supportive relationships seemed to be particularly relevant to ECRs in terms of developing confidence, self-esteem and research capacity and making identity transitions.^{35,43,48,58,67} Relationships in the form of networks were considered to improve the quality of research through multicentre research and improved collaboration.^{33,60} Supportive leadership as a particular form of relationship was an important mechanism in promoting a successful research environment. Supportive leaders needed to monitor workloads, set the vision, raise awareness of the value of research, and provide positive role-

modelling, thereby leading to increased productivity, promoting researcher identities and creating thriving research environments (Table 2, quote 3).^{31,34,37,38,40,41,43,44,46,48,49,53,55,62} Research leadership, however, could be influenced negatively by the context of compliance and counting in current university cultures damaging relationships, creating a loss of motivation, and raising feelings of devalue. Indeed, the failure of leaders to recognise researcher identities led to negative research productivity.^{36–38,43,46,48,49}

Intersections between time, identity and relationships within successful research environments

Time and identity

Time and identity intersected in interesting ways. Firstly, time was a necessary enabler for the development of a researcher identity.^{37,38,41,48,49,54,59,61,63,65,67,69} Secondly, those who identified as researchers (thus holding primary researcher identities) used their time efficiently to favour research activity outcomes despite a lack of protected time.^{35,43} Conversely, for other professors who lacked personal determination and resilience for research, having protected time did not lead to better research activity.⁴³ This highlights the fact that time alone is insufficient to support a successful research environment, and that it is how time is utilised and prioritised by researchers that really matters (Table 2, quote 4).

Identity and relationships

Interventions aimed at developing researcher identity consistently focused on relationship building across the three disciplines. The interventions that supported identity transitions into research included formal research training,^{44,48,52,68} mentoring,^{41,48,57,65,72} writing groups,⁷² and collaboration with peers and other researchers,^{39,41,43} operating through multiple mechanisms including relationships. The mechanisms included self-esteem/confidence, increased networks, external recognition as a researcher, belongingness, and self-efficacy.^{35,41,43–45,52,57,72} Furthermore, our data suggest that leadership can be an enabler to the development of a researcher identity. In particular, leadership enabled research autonomy, recognition and empowerment, and fostered supportive mentoring environments, leading to researcher identity development and research productivity (Table 2, quote 5).^{34,38,46,48}

Time and relationships

Relationships were developed and sustained over time (Table 2, quote 6). Across the three disciplines, the role of leaders (managers, directors, deans) was to acknowledge and raise awareness of research, and then to prioritise time for research against competing demands, leading to effective research networks, cohesion and collaboration.^{31,34,38,43,46,48–50,53,55,70} Second-career PhD students who did not invest time in establishing relationships with researchers in their new disciplines (as they already had strong supportive networks in their original disciplines) found that they had limited research networks following graduation.⁴⁸

DISCUSSION

Summary of key findings

Our initial programme theory was based on previous literature reviews^{1,4–7} and on the REF2014 criteria.^{10,21} However, we were able to develop a modified programme theory on the basis of our realist synthesis, which highlights novel findings in terms of what really matters for successful research environments. Firstly, we found that key interventions led to both positive (subjective and objective) and negative (subjective and objective) outcomes in various contexts. Interestingly, we did not identify any outcomes relating to research impact despite impact nowadays being considered a prominent marker of research success, alongside quantitative metrics such as number of publications, grant income and h-indices.²¹ Secondly, we found that disciplinary contexts appeared to be less influential than individual, local and institutional contexts. Finally, our modified programme theory demonstrates a complex interplay among three cross-cutting mechanisms (time, researcher identity and relationships) as mechanisms underpinning both successful and unsuccessful research environments.

Key findings and comparisons with the existing literature

Our research supports the findings of earlier reviews^{1,5–7} regarding the importance of having a clear research strategy, an organisation that values research, research-oriented leadership, access to resources (such as people, funding, research

facilities and time), and meaningful relationships. However, our research extends these findings considerably by flagging up the indication that a clear linear relationship, whereby the presence of these interventions will necessarily result in a successful research environment, does not exist. For example, instituting a research strategy can have negative effects if the indicators are seen as overly narrow in focus or output-oriented.^{38,40,46,47,64} Similarly, project money can lead to the employment of more part-time staff on fixed-term contracts, which results in instability, turnover and lack of research team expertise.^{40,67,71}

Our findings indicate that the interplays among time, identity and relationships are important considerations when implementing interventions promoting research environments. Although time was identified as an important mechanism affecting research outcomes within the majority of papers, researcher identity positively affected research outcomes even in time-poor situations. Indeed, we found that identity acted as a mechanism for research productivity that could overcome limited time through individuals efficiently *finding* time to prioritise research through their motivation and resilience.^{35,43} Time was therefore more than just time spent doing research, but also included investment in developing a researcher identity and relationships with other researchers over time.^{37,38,41,48,49,54,59,61,63,65,67,69} Relationship-building interventions were also found to be effective in supporting difficult identity transitions into research faced by ECRs and those with first-career practitioner backgrounds. Supportive leadership, as a particular form of relationship, could be seen as an enabler to the provision of protected time and a reasonable workload, allowing time for research and for researcher identity formation.^{34,38,46,48} Indeed, our realist synthesis findings highlight the central importance of researcher identity and thus offer a novel explanation for why research environments may not flourish even in the presence of a research strategy, resources (e.g. time) and valuing of research.

Researcher identity is complex and intersects with other identities such as those of practitioner, teacher, leader and so on. Brew et al.^{39,73,74} explored researcher identification and productivity by asking researchers if they considered themselves to be 'research-active' and part of a research team. Those who identified as researchers prioritised their work differently: those who were highly productive prioritised research, whereas those in the low-

productivity group prioritised teaching.⁷³ Interestingly, highly productive researchers tended to view research as a social phenomenon with publications, presentations and grants being 'traded' in academic networks. Brew et al.³⁹ explain that: '...the trading view relates to a self-generating researcher identity. Researcher identity develops in the act of publication, networks, collaborations and peer review. These activities support a person's identification as a researcher. They also, in turn, influence performance measures and metrics.' Although the relationships among identity, identification and productivity are clearly complex, we explored a broader range of metrics in our realist synthesis than just productivity.

Methodological strengths and limitations

This is the first study to explore this important topic using realist synthesis to better understand the influence of context and how particular interventions lead to outcomes. We followed RAMESES²⁰ guidelines and adopted a rigorous team-based approach to each analytic stage, conducting regular quality checks. The search was not exhaustive as we could have 'exploded' the interventions and performed a comprehensive review of each in its own right (e.g. mentoring). However, for pragmatic reasons and to answer our broad research questions, we chose not to do this, as suggested by Wong et al.²⁰ Although all members of the team had been involved in realist syntheses previously, the process remained messy as we dealt with complex phenomena. The messiness often lies in untangling CMOCs and identifying recurrent patterns in the large amounts of literature reviewed.

Implications for education and research

Our findings suggest that interventions related to research strategy, people, IIF and collaboration are supported under the 'right' conditions. We need to focus on time, identity and relationships (including leadership) in order to better mobilise the interventions to promote successful research environments.

Individuals need to reflect on how and why they identify as researchers, including their conceptions of research and their working towards the development of a researcher identity such that research is internally motivated rather than just externally driven. Those who are second-career researchers or those with significant teaching or practitioner roles could seek to align research with

their practice while they establish wider research networks.

We recommend that research leaders support individuals to develop their researcher identity, be seen to value research, recognise that research takes time, and provide access to opportunities promoting research capacity building, strong relationships and collaboration. Leaders, for example, may introduce interventions that promote researcher identities and build research relationships (e.g. collaborations, networking, mentoring, research groups etc.), paying attention to the ways in which competitive or collaborative cultures are fostered. Browne et al.⁷⁵ recently recommended discussions around four categories for promoting identity transition: reflection on self (values, experiences and expectations); consideration of the situation (circumstances, concerns); support (what is available and what is needed), and strategies (personal strategies to cope with change and thrive). With the professionalisation of medical education,⁷⁶ research units are increasingly likely to contain a mixture of first- and second-career researchers, and our review suggests that discussions about conceptions of research and researcher identity would be valuable.

Finally, organisations need to value research and provide access to resources and research capacity-building activities. Within the managerialist cultures of HEIs, compliance and counting have already become dominant discourses in terms of promotion and success. Policymakers should therefore consider ways in which HEIs recognise, incentivise and reward research in all its forms (including subjective and objective measures of quantity, quality and impact) to determine the full effects of their policies on research environments.

Future research would benefit from further exploration of the interplay among time, identities and relationships (including leadership) in different contexts using realist evaluation.⁷⁷ Specifically, as part of realist approaches, longitudinal audio-diaries⁷⁸ could be employed to explore researcher identity transitions over time, particularly for first-career practitioners transitioning into second-career researchers.

Contributors: RA and CER were responsible for the conception of the synthesis. All authors contributed to the protocol development. RA and PESC carried out the

database searches. All authors sifted for relevance and rigour, analysed the papers and contributed to the writing of the article. All authors approved the final manuscript for publication.

Acknowledgements: we thank Andy Jackson, Learning and Teaching Librarian, University of Dundee, Dundee, UK, for his advice and help in developing our literature searches. We also thank Laura McDonald, Paul McLean and Eilidh Dear, who were medical students at the University of Dundee, for their help with database searches and with sifting papers for relevance and rigour. We would also like to thank Chau Khuong, Australian Regenerative Medicine Institute, Monash University, Melbourne, Victoria, Australia, for her work in designing Figs 1 and 3.

Funding: none.

Conflicts of interest: none.

Ethical approval: not required.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. Definitions of key terms.

Table S2. MeSH terms and a selection of key terms utilised in the database searches.

Table S3. Inclusion and exclusion criteria with respect to topic, recentness and type of article.

Table S4. Refined inclusion and exclusion criteria to include contextual parameters.

Table S5. Studies by type: qualitative, quantitative and mixed-methods.

Table S6. Contexts, interventions, mechanisms and outcomes identified in individual studies.

Received 19 January 2018; editorial comments to authors 12 March 2018; accepted for publication 16 May 2018