

Varieties of collaboration: On the influence of funding schemes on forms and characteristics of international collaborative research projects (ICRPs)

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Abstract

This article discusses characteristics and forms of international collaborative research projects (ICRPs) and provides conceptual considerations as well as initial empirical insights on the impact of funding conditions on ICRPs in the social sciences and external project funding. Specifically, by presenting a German case study of funding formats in two national funding institutions and the funding tools of the European Commission in Horizon 2020. The findings draw on desk-research and a review of research on the relationship between funding and international research collaboration. The analysis used a conceptual perspective, that understands research projects as temporary organisations, to discuss characteristics of international collaborative research projects and to provide a descriptive analysis of the funding conditions for ICRPs. The article systematises different forms of ICRPs and suggest differentiating them along their variety by four ICRP attributes: size, geographical distance, funding structures and funding formats. The discussion section elaborates on implications for future research and practice.

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1 | INTRODUCTION

International collaborative research is a widespread and growing mode of knowledge production, as implied e.g., by the steadily increasing number of co-authored publications over the past 50 years (Huang, 2015). The so-called “collaborative turn” (Olechnicka et al., 2019, p. 176) and “research collaboration revolution” (Bozeman & Youtie, 2020, p. 3) is transforming scientific knowledge production and related practices. Comparatively higher collaboration rates have been observed in STEM+ fields (science, technology, engineering, mathematics, and medicine) than in the social sciences (Gazni & Didegah, 2011). Nevertheless, the social sciences show significant annual growth rates for international co-publications in recent years (Helmich et al., 2018) and international collaborative research has also become an increasingly relevant form of research in the social sciences. Furthermore, international collaborative research has a high reputation both within and outside the scientific community and has been increasingly promoted by science policies, and by national and international funding agencies and foundations in the last few decades (Olechnicka et al., 2019).

Recent developments take place in a context of increasing dependence of research on competitive external grant funding from national and supranational councils (Bozeman & Boardman, 2014; Heinze, 2008). Conducting collaborative research today means to a considerable extent to design, launch, and carry out research projects—an important way to organise research, institutionalised across all disciplines, research topics, and types of research (Besio, 2009; Torka, 2009). The shift towards competitive grant funding has consequences for both international research collaboration as well as universities. International collaborations are increasingly removed from traditional research organisations, which at the same time increasingly view international collaborations as an organisational performance indicator (Heinze, 2008). This is also changing the nature of collaboration and increasingly shifting it from informal collaborations without funding or with institutional funding to formal collaborations with project funding (Georghiou, 1998). An essential requirement to obtain funding is to construct research processes in the form of a project, characterised by defined goals and tasks, a limited duration, short-term planning and often with specifically dedicated resources (Torka, 2018).

International collaborative research projects (ICRPs) are at the intersection of both outlined developments—the increasing importance of international collaboration and competitive grant funding. But we still know little about this form of international collaboration that differs from both traditional organisations as well as virtual teams, scientific laboratories, and invisible colleges (Sonnenwald, 2003), and particularly about the relationship between competitive grant funding and ICRPs. We currently see a “team science revolution” (Bozeman & Youtie, 2020, p. 2) and ICRPs have become a crucial unit of research productivity but their role in actual research practices is still quite unsettled. Previous research on research projects in STEM+ fields (Rogers & Bozeman, 2001) has seen them primarily as a key focus of managers and evaluators in line with bureaucratic accounting schemes that do not represent actual work practices. However, the role of externally funded research projects might be different in the social sciences. In STEM+ fields, where research often centres around a device, instrument, or development projects, externally funded projects might just be a fluid resource flow and source of steady income. For the social sciences, however, they are often an enabler of research in the first place.

In this article we focus on the relationship between funding opportunities and forms of ICRPs, arguing that different types of funding lead to considerable variations in the constellations of such projects. We focus specifically on externally funded international collaborative projects in the social sciences because they represent a particular blind spot. While bibliometric research and the more qualitatively oriented Science of Team Science has intensely investigated the constellations of team research in STEM fields and its dynamics and outcomes (Bozeman & Youtie, 2020; Chen et al., 2019), hardly any research exists on such research in the social sciences (Wöhlert, 2020). However, research in the social sciences differs in cognitive aspects from STEM+ fields, particularly in their contextuality, and may accordingly differ in collaboration practices, which is why we see a significant research gap here (e.g., Kyvik & Larsen, 1997; Mauthner & Doucet, 2008; Torka, 2018).

To start filling this gap, we discuss funding schemes as a decisive context dimension that shapes international collaboration efforts of researchers in the social sciences. Next, a more differentiated view on the variety of forms of ICRPs in the social sciences is outlined. The main research question is: *How do funding schemes influence the forms and characteristics of international collaborative research projects?* The question is responded to by analysing the funding schemes of three major public funding institutions available for social scientists in Germany.

The article is structured as follows. First, we review research on the relationship between funding and international research collaboration. Second, we introduce our main conceptual perspective on research projects as temporary organisations and discuss their characteristics. Third, we describe the methodology of our study: a desk-research investigation of funding formats and resulting collaboration constellations. Fourth, we summarise the funding conditions for ICRPs in Germany and use them as a case study for the illustration of their different forms. Subsequently, in the discussion section, we systematise the identified forms and suggest four conceptual specifications, based on the variety in the size and geographical distance of such projects, and on the variety in their funding structures and formats. In the conclusion, we discuss our findings and their implications for theory and practice.

2 | THE STATE OF RESEARCH ON THE INFLUENCE OF RESEARCH FUNDING ON INTERNATIONAL RESEARCH COLLABORATION

International research collaboration became an object of investigation in the 1960s and has developed both in quantity and quality since. The growth and differentiation of this extensive body of research is captured in literature reviews from each decade (Bozeman & Boardman, 2014; Bozeman et al., 2013; Bukvova, 2010; Chen et al., 2019; Katz & Martin, 1997; Subramanyam, 1983; Wöhlert, 2020). They show that we already have extensive knowledge on the motives for collaboration, the actors involved, the factors that promote collaboration, and especially the extent of collaboration and its effects, and its benefits and costs. Early on, the literature also focused on the impact of research funding for research collaboration (Beaver & Rosen, 1979; Heffner, 1981; Katz & Martin, 1997), arguing that collaboration is influenced by research funding. Various empirical studies focused on the nexus of funding and research collaboration in the past two decades, this nexus has also been a significant science policy issue in the past decades.

Studies focusing on the relationship between funding and collaboration are mostly based on bibliometric data. They are typically single country studies and focus on STEM fields because it is easier to cover the collaboration patterns for those fields sufficiently, through international journal databases. In sum, these studies show a two-directional relationship between funding and collaboration. Research grants positively influence collaboration among researchers, since research often depends on the availability of resources provided through grants. At the same time, previous research collaboration improves the likelihood for obtaining financial support and winning research grants (e.g., Adams et al., 2005; Bozeman & Corley, 2004; Lee & Bozemann, 2005). The relationship between funding and collaboration productivity and impact is not yet fully clear and has not been sufficiently explored, particularly in its international dimension. For example, Defazio et al. (2009) show that funding does not lead directly to more productive and impactful collaborations. Rather, there is a chain of effects, funding spurs collaboration during the funding period and more productive collaboration and impactful co-authorships in the post-funding period. Additionally, Jeong and Choi (2015) and Jeong et al. (2014) point to attentional resources that interact with funding on the side of the quantity of resource input variables, as well as the quality of resources (e.g., academic excellence) that affect international research collaboration. In opposite directionality, Ebadi and Schiffauerova (2013) argue that team size and research excellence influence the ability to obtain funds.

Studies that investigate the impact of funding policies on collaboration intensity and collaboration networks are many and are mostly based on funding data in combination with bibliometric data, or individual level data from surveys. Those studies show that the funding (e.g., of funding programs at the EU level, or related national funding

schemes) helped to increase collaboration intensity both within and among EU members states and non-EU partners. International collaborative research has thrived during the 20 past years, drawing on funding from different programs and sources. However, some barriers to collaboration (e.g., distance, language, or national barriers) seem to persist, and the interaction effects and synergies between supranational (EU) and national funding cannot be clearly distinguished (see, e.g., Cuntz & Peuckert, 2015; Hoekman et al., 2013; Mattsson et al., 2010). Also, geographical collaboration patterns differ significantly between disciplines and fields, but most studies have been devoted to the investigation of STEM+ fields (STEM plus medicine) (Chen et al., 2019; Wöhlert, 2020).

More recent research tackles the above-mentioned interaction effects between funding and collaboration based on funding acknowledgements in journal articles. Funding acknowledgements, included into bibliometric records from 2008 onwards, allow to track co-authored papers that have been funded by research grants (Rigby, 2011). Studies have focused on STEM+ disciplines due to the better coverage of bibliometric data for STEM fields, leaving out the social sciences so far. Such research illustrates that research funding has positive short term and long-term effects on international research collaboration and the impact of co-authored work (Morillo, 2019; Ubfal & Maffioli, 2011). One reason might be that funding agencies increasingly require collaboration as a condition to apply for funding, which can explain the increase in collaboration measured by the number of co-authors right after project funding. However, the studies also show a mid- and long-term increase in collaboration, productivity, and impact of the funding after researchers have finished their funded project and have published the research outcomes related to the projects.

Overall, research in the three thematic areas sketched above mainly applies to bibliometric studies that measure collaboration only partially via co-authorships and exclude other forms of collaboration (Laudel, 2002). A part of the above-mentioned studies capture research projects only in a very truncated way (via funding acknowledgement) (Rigby, 2011). This also equates all research projects as alike and does not allow us to analyse and compare the outcomes of diverse types of projects. Meanwhile, the above-mentioned research implies a relationship between research grants, research productivity, and between the characteristics of a collaboration and the likelihood of obtaining research funding.

The literature review shows that we still know little about the relationship between research funding, team demography and dynamics, and outcomes of such collaborative research. As Larédo and Mustar (2000) argued already 20 years ago, the relationship between research funding and actual outputs is neither direct nor linear, but we must investigate the conditions under which the research takes place. Nevertheless, the scarce qualitative studies that investigate ICRPs mention funding only in passing or as a scarce resource (e.g., Bammer, 2008; Hara et al., 2003; Pischke et al., 2017). One exception (although focusing on domestic collaboration) here is the study by Porac et al. (2004), who suggest that project funding fosters productive and successful collaborative research even in cases when the project demography might hamper team performance.

What we see so far, is a “monolithic treatment” of international collaborative research projects (Jordan, 2006, p. 173), namely a one-type-fits-all perspective that limits the opportunities to discern differences in the outcomes to research projects across several types of projects. The study on which we report provides key insights for further research, by providing a more detailed analysis of project funding conditions as a relevant contextual factor for the formation and implementation of ICRPs. Specifically, we provide analysis that supports more systematic and comparative studies on the collaboration conditions, dynamics, costs and outcomes.

3 | INTERNATIONAL COLLABORATIVE RESEARCH PROJECTS AS TEMPORARY ORGANIZATIONS

In this section we introduce some auxiliary working definitions for the international and collaborative dimension of research and conceptualise research projects as temporary organisations.

First of all, we define a research collaboration as *international* when researchers are involved, whose primary employment affiliations are located in different countries (see e.g., Anderson, 2011). This definition is not without critique, because collaborations between scholars from different countries differ in their institutional distance (see e.g., Boschma, 2005), and they can also take place among scholars with different nationalities located in the same country or the same institution (see e.g., Sørensen & Schneider, 2017). Despite the critique and associated fuzziness, different countries serve as a proxy for the internationality of research projects in our analysis.

Second, we define research collaboration as a temporary social process in which scholars pool their complementary skills and expertise and become functionally interdependent, in order to attain a research goal and to produce knowledge together (Bozeman et al., 2013; Hagstrom, 1965; Laudel, 2002). In a broad sense, collaboration can incorporate various activities such as the division of labour, service collaboration, provision of access to research requirements, consultation and critique. Moreover, it can lead to joint outputs such as co-authored publications or research grant applications (Jeong et al., 2014; Katz & Martin, 1997; Kwiek, 2018). A lot of collaboration manifests in informal activities and only partly takes the form of formalised collaboration through international collaboration agreements, support programs, by sharing large research facilities (Georghiou, 1998), or collaborative research projects.

Third, we define collaborative research projects, international and national, as voluntary, substantially autonomous, self-governed social entities based on mutual interest and shared goals of multiple individuals—who perceive themselves, and are seen by others, as a team (Wang & Hicks, 2015). They can vary from fluid ad hoc teams with unstable memberships and ill-defined boundaries to stable research projects based on shared goals (e.g., as part of a research proposal), more stable memberships, and project funding (López-Yáñez & Altopiedi, 2015; Wang & Hicks, 2015). We focus on projects that receive external funding and are based on a proposal that explicates the goal of research and the tasks of the project; defines a work plan (including methods and resources), qualifications of the project leader(s) and the composition of the project team; includes a time schedule and justifies a joint budget plan or pools resources from different funding sources.

In conceptualizing ICRPs, we built on research that aimed at theorising organisations (Jordan, 2006) and focused on the diversity of research and how it is managed. Besides research tasks and activities, such research has sought to understand research strategies and structural dimension of research projects. We integrate both dimensions into a conceptualisation of ICRPs as temporary organisations (see e.g., Bakker, 2010; Burke & Morley, 2016; Lundin & Söderholm, 1995) because research projects differ from regular organisations and other forms of collaboration—e.g., virtual teams, scientific laboratories, invisible colleges (Sonnenwald, 2003). Temporary organisations are established to accomplish an ex-ante determined task with a predetermined termination point, and they differ from traditional non-temporary organisations in four key dimensions: tasks, team, time, and context (Bakker, 2010; Burke & Morley, 2016; Lundin & Söderholm, 1995). According to this literature, time is a decisive dimension for temporary organisations in that such organisations, in contrast to non-temporary organisations, have a built-in termination mechanism. Figure 1 illustrates the four key dimensions of ICRPs and associated characteristics.

The *team* dimension addresses the demography and diversity of the team. Geographically dispersed research teams typically consist of team members speaking different languages and coming from countries with differing academic or disciplinary styles, cultural norms, and practices (e.g., Jeong et al., 2014; Rambur, 2009; Wagner, 2005). Such teams often choose English as the language for communication and publications, which puts team members in different social positions within the team according to their language skills (e.g., DeHart, 2017; Olson et al., 2008; Pischke et al., 2017). The larger the project size (i.e., the more members from different countries are involved), the more complex and challenging the coordination and project management (including leadership) can be (e.g., Bammer, 2008; Brew et al., 2013; Jordan, 2006). Another aspect of the team dimension is social team dynamics including attitudinal factors like motivation and trust-building. Conflicts and diverging interests are experienced comparatively more often in ICRPs (e.g., Dusdal & Powell, 2021; Hara et al., 2003; Hoffman et al., 2014). Furthermore, career stages and hierarchies are part of the team demography and related

Team	Task	Time	Contexts
<ul style="list-style-type: none"> ▪ Team demography and diversity (e.g., cultural, disciplinary, career stages) ▪ Project and publication language(s) ▪ Research coordination and management (incl. leadership) ▪ Social team dynamics (incl. trust, motivation, conflict, power relations) ▪ Collaboration experience and frequency ▪ Communication management and exchange (incl. ICTs) 	<ul style="list-style-type: none"> ▪ Goals and complexity of research, tasks, and envisioned outputs (incl. data access, collection, and exchange) ▪ Character of research and advancement of knowledge ▪ Research capacity and scale (incl. budget and workforce) ▪ Division of labor and interdependence (incl. coordination of tasks, strategies of knowledge integration) ▪ Publication and dissemination strategies 	<ul style="list-style-type: none"> ▪ Project duration, schedule, and time capacities ▪ Work plan (work packages, deadlines and milestones, Gantt chart planning) ▪ Coordination, communication and networking routines, frequencies, and costs ▪ Built-in termination and (linear) time conception ▪ Communication across time zones 	<ul style="list-style-type: none"> ▪ Funding policies and conditions ▪ Research integrity and ethics ▪ Modes of research governance (e.g., institutional, national, EU) ▪ Quality evaluation and measurement of success ▪ Promotion of early career researchers (e.g., graduate education, post-doctoral training) ▪ Legal and normative aspects

FIGURE 1 Dimensions and characteristics of international collaborative research projects as temporary organisations

Source. Authors.

power relations among researchers might affect the social team dynamics (e.g., Dusdal & Powell, 2021; Hoffman et al., 2014; Kosmützky, 2018b). Research revealed that collaboration experience and repeated collaborations lead to fewer start-up costs than new collaborations; and entail greater certainty, trust, and collaboration skill or readiness (e.g., Dahlander & McFarland, 2013; Fiore, 2008; Hara et al., 2003). Also, communication processes need to be managed and routines need to be developed, including the use of information and communication technologies (e.g., Bikard et al., 2015; Falk-Krzesinski et al., 2011; Stokols et al., 2008).

The *task* dimension is determined by the goals and complexity of the research (including its uncertainty and ambiguity level); the work tasks and envisaged outputs; and aspects related to data access, collection, and exchange (e.g., Jordan, 2006; Kyvik & Larsen, 1997; Rambur, 2009). It is also determined by the character of research (e.g., inter/disciplinary; basic or application orientation) and aims regarding the advancement of knowledge (small incremental advancement, or large radical advancements) (e.g., Brew et al., 2013; Jordan, 2006; Porac et al., 2004). Furthermore, the task dimension is influenced by the research capacity (incl. resources in terms of budget and workforce), the scale of the project (e.g., Goddard et al., 2006; Jordan, 2006; Jordan et al., 2005); how labour is divided and the interdependence of tasks, so that team members can work independent from one another. This division of labour also requires strategies for knowledge integration and for joint publication and dissemination strategies (Mauthner & Doucet, 2008; Olson et al., 2008; Salazar et al., 2012).

The *time* dimension encompasses project duration, schedules, and time capacities calculated in the form of work packages, deadlines, milestones, Gantt chart planning, as well as coordination and communication costs (including traveling and digital exchanges) (e.g., Stokols et al., 2008). Geographically dispersed temporary organisations tend to invest less time in the social team dimension and focus more on the task dimension because of built-in termination and the related linear time concept—despite their high communication and networking needs and costs (Cummings & Kiesler, 2005, 2007; Hinds & Bailey, 2003; Shrum et al., 2007). Additionally, communication in teams dispersed across different time zones is particularly challenging (Bammer, 2008; Dusdal & Powell, 2021; Hoffman et al., 2014).

Finally, the *context* dimension includes the different institutional and national contexts that are carried into the project by individual project members due to different international higher education and science systems, or

organisational settings (e.g., research or teaching universities, research institutes). Different contexts are shaped by differing values, norms, and standards of research integrity and ethics, legal and normative aspects, governance, quality measurement, or by different promotion of early career researchers (Anderson, 2011; Bohnhorst et al., 2011; Bosch & Titus, 2009; De Vries et al., 2011; Lakić et al., 2015). ICRPs can be *melting pots* of cultural, national, and organisational contextual differences, and this complexity can make it difficult to achieve a common ground of understanding (Brew et al., 2013; Dusdal & Powell, 2021; Kosmützky, 2018b).

The conditions of ICRPs may differ significantly depending on the nature of tasks, team composition, time, and diversity of contexts, and can influence team performance, collaboration, team members' expectations to practices used and the research process, and thus, also the research results (Kosmützky, 2018a). Research so far has not investigated those correlations. This article contributes accordingly by providing an analysis of project funding conditions as a relevant contextual factor for the formation and implementation of ICRPs. We propose that different types of funding lead to considerable variations in the constellations of international collaborative projects, which thus asks for a more differentiated typology of such projects.

4 | METHODOLOGY

For our study, we used a case-study design (Yin, 2014) and Germany as a case to discuss the funding criteria for ICRPs involving researchers located in Germany. We do not use the term *German researchers*, because nationality is not a necessary criterion for working at a German research institution (Sørensen & Schneider, 2017).

We regard Germany as a representative example of an EU Member State and research funding system: On the one hand, German-based researchers have access to funding schemes of the EU Horizon 2020 agenda. A feature of EU science policies is multi-level governance, since policies are developed from EU Member States' national policies, intergovernmental agreements, and supra-national regulations and funding programmes at the EU-level. Another feature is its central focus on stimulating transnational collaboration and the integration of a European research area (Mattsson et al., 2010; Olechnicka et al., 2019). On the other hand, Germany has a national public funding structure with funding schemes for researchers located in the national territory. We limited our study to one country, since the main goal of our explorative analysis was to further specify the context variable *funding conditions* and to generate analytical research questions based on which we can explore the impact of funding schemes on the forms and characteristics of ICRPs.

By German research institutions we refer to all institutions in which social researchers can carry out research (e.g., universities, universities of applied sciences, non-university research institutes etc.). Funding institutions usually name institutions eligible for funding in their respective funding programs and guidelines. We limited our perspective to public funding (i.e., funding provided by public and state institutions)—since we consider it a direct reflection of national science policies and scientific collaboration policies (Olechnicka et al., 2019).

As described in section 2, funding schemes can be the (financial, but also thematic or strategic) stimulus for the formation of projects and collaboration can be a prerequisite for successful grant application. They increasingly form the structural framework within which ICRPs can be realised, by providing the financial resources to carry out collaborative research. At the same time, we assume that they shape the formation and implementation of projects (section 3), by defining conditions for the provision of those resources in their guidelines.

Given the nature of funding schemes, we regard the following five funding criteria as relevant conditions in the formation of ICRPs:

1. Overall, funding is structurally provided and distributed in different ways, e.g., by only one funding institution for all country partners, multi-nationally/separately by national funding institutions for respective country partners, or only for some country partners, but not for others.
2. Funding schemes have different availabilities, e.g., they can be one-time funding opportunities with limited application deadlines, opportunities in the form of recurring calls, or ongoing opportunities with no time limitations—thus affecting the time dimension of projects.

3. Funding can either be tied to thematic agendas, or response-oriented and thus open to all thematic areas and topics—thus affecting the task dimension of projects.
4. Funding can shape the size of projects, by setting limitations to the number of eligible country partners, or by requiring a minimum number of country partners—thus affecting the team dimension of projects.
5. Funding can be limited in its geographical scope, by only allowing for the participation and funding of a specific set of countries—thus affecting the context dimension of projects.

Studies on sources and formats of competitive research grant funding have shown that properties of funding schemes (e.g., exceptional research, exploratory research, thematically focused research) promote specific kinds of research (e.g., Laudel & Gläser, 2014; Wagner & Alexander, 2013). We have for this reason decided to define ICRPs based on funding properties set by funding schemes (e.g., by funding distribution structure, funding availability and thematic agendas). Project size is relative and differs according to disciplines and research fields (e.g., Jordan, 2006), but research has shown that major discoveries and creative accomplishments occur more likely in smaller teams (e.g., Heinze et al., 2009). We therefore suggest to also define ICRPs based on the project size as it is requested in funding schemes. Finally, research has shown that geographical and institutional distance influence collaboration (e.g., Pond et al., 2007). Therefore, we suggest to also define ICRPs based on the geographical location of teams.

Funding schemes may also set limitations to the funded project duration, the provided budget(s), and the (inter)disciplinary degree of ICRPs. However, project duration is often defined in a broad time range (from... to...) in funding schemes, which does not allow us to draw conclusion on the actual durations that projects finally apply funding for. Also, in most funding schemes only the total budget limits are defined, which does not allow us to draw conclusions on the actual distribution of those budgets among the country partners. Regarding the (inter)disciplinary degree, most funding institutions emphasize an openness to all disciplines and interdisciplinary collaborations in their funding schemes. However, from the authors' own project and research experience, most national funding institutions still mainly fund disciplinary projects, while the degree of interdisciplinarity is higher in EU funded projects. Given those considerations, we do not include those criteria in the present analysis.

We included three public funding institutions: The German Research Foundation (DFG) is the central public research funding organisation in Germany. It funds research projects based on a response-oriented funding logic, and within the Individual Grants Programme all disciplines can apply for funding. A second leading public source for research project funding in Germany is the German Federal Ministry of Education and Research (BMBF), which also offers funding for international collaborative research, derived from the *Strategy for the Internationalisation of Education, Science, and Research* (BMBF, 2016). As a third possibility, German-based social scientists may compete for funding offered by the EU within the framework of the Horizon 2020 agenda, the 8th Framework Program for Research and Innovation implemented by the European Commission (EC). It offers funding for research and innovation projects and activities in the EU area and consists of three main research priorities (1) Excellent Science, (2) Industrial Leadership, and (3) Societal Challenges. The budget for Horizon 2020 is provided by all EU Member States, as part of their national contributions to the Multiannual Financial Framework.

We focused on funding schemes that are either open to or explicitly designed for researchers in the social sciences, and that offer financial support for the implementation of ICRPs. We excluded funding schemes that only support individual researchers, the development of research infrastructures or networks, applied business or client-driven research, the exchange of best practices and dissemination activities, or support actions such as training, career and knowledge-exchange formats and cross-border mobility.

We carried out a descriptive case analysis in two steps. We started by identifying funding schemes that are either open to or explicitly designed for ICRPs in the social sciences, by carrying out a website analysis of the three funding institutions and their funding schemes available between August and November 2020. Secondly, we analysed the respective funding guidelines, using the above-mentioned funding criteria as open categories for a qualitative content analysis (see Table 1).

5 | FUNDING CONDITIONS AND RESULTING PROJECT FORMS

In this section, we summarise the results of the descriptive analysis, specifying the context conditions that funding institutions and schemes define for ICRPs with their funding guidelines. We then summarize the implications for resulting project forms of ICRPs funded in those schemes.

The German DFG supports international collaborative projects in all of its funding programs, with partner agreements for some countries, joint funding programs, or special regional collaborations, for example in the D-A-CH program (DFG, 2021a), the ORA Open Research Area for the Social Sciences (DFG, 2021b), and—beyond Europe—the MEC Middle East Collaboration (DFG, 2021c).

Funding for ICRPs in most of the mentioned funding schemes is supplied only for the German partner(s) of the project, while complementary funding for other country partners is supplied by the respective national funding institutions. For the German partner, proposals must compete with all other proposals in the basic DFG Research Grants program. One exception is the MEC, which offers funding to all country partners (by providing it to the German partners who transfer it to other international partners in form of subcontracts). In D-A-CH and the MEC, funding is permanently available, while all other funding schemes have recurring funding cycles with limited calls and deadlines. DFG funding schemes follow a response-oriented funding logic with no thematic limitations. Projects funded by the outlined funding schemes result in small-sized multinational project collaborations of two to five countries. For D-A-CH, projects can consist of a minimum of one partner from Germany, Austria and Switzerland. For ORA, projects must include at least one partner from three of the eligible ORA countries Germany, France, the Netherlands, and United Kingdom, and can have associate partners from Canada, Japan, or the United States. Overall, DFG funding schemes stimulate projects with a large geographical distance among the partner countries and a strong European dimension. An exception is the MEC, which addresses collaborations between German researchers and non-European partners from Israel, Palestine and countries that neighbour Israel.

The BMBF provides program funding in particular areas for policy goals (e.g., high-tech and innovation, environment and climate, or health research), thematically focused funding lines and directives. The ministry has several bi- and multinational agreements that form the basis for bilateral scientific and technological co-operations and joint funding schemes. An example of funding for international collaborative research projects in the social sciences is the Trans-Atlantic Platform (T-AP) for the Social Sciences and Humanities (Trans-Atlantic Platform, 2021), a joint effort of national funding institutions from South America, North America, and Europe. Another example is the GIF German Israeli Foundation for Scientific Research and Development (2018), a joint program of the BMBF and the Israeli Ministry of Science and Development. In some cases, international collaborations are also funded in thematic directives without explicit international dimensions. One example is the 2018 funding directive for research projects on the thematic area Quality developments in science (QDiS), a funding line of the BMBF funding priority Research on Higher Education and Science (Bundesministerium für Bildung und Forschung, 2016).

TABLE 1 Categories for the analysis of funding guidelines

Category	Description
Funding institution(s)	Which institution(s) provide(s) the funding
Funding structure	How funding is distributed for the country partners
Funding availability	How often funding is available in the funding scheme
Thematic focus	What thematic funding logic is applied
Eligible project size	How many countries are allowed or required per ICRP
Eligible countries	Which countries can apply for funding

Source. Authors.

In the listed examples, the BMBF funds the German partner(s) of the project, while funding for other country partners is supplied by the respective national funding institutions. An exception is QDiS; here, the BMBF funds all country partners directly. Funding is available in one-time or recurring funding cycles with limited calls and deadlines. T-AP and QDiS have a thematically oriented funding logic with a specific thematic focus and support bi-national or small-sized project collaborations (with 2–5 countries). The broader geographical spectrum of the funding options allows for projects with a higher geographical distance between collaborating countries and a more international scope. Nevertheless, due to the country-specific collaboration design, the funding schemes strongly shape the geographical scope of projects. For T-AP, only researchers from Europe, North America, and South America can apply for funding; in the GIF funding scheme, only German- and Israel-based partners can collaborate.

The Horizon 2020 framework explicitly aims for a strong integration of European and international collaborations, and all priorities of Horizon 2020 are open to all scientific disciplines. Here, the European Commission has taken a stronger integrative and open approach towards disciplinary funding than earlier framework programs, labelling the social sciences a *cross-cutting* discipline in all three priorities.

In Priority 1, a funding sources for international projects are the European Research Council's (ERC) Synergy Grants (2021), and the Future and Emerging Technologies (FET) programme, which supports collaborative innovation research across disciplines on radically new, high-risk ideas (European Commission, 2020a). Priority 2 allocates project funding for the theme *Leadership in Enabling and Industrial Technologies* (LEIT, European Commission, 2019). The most popular funding source for ICRPs with social science involvement is Priority 3 on Societal Challenges (SC), which reflects the policy priorities of the Europe 2020 strategy and addresses societal challenges such as health, demographic change, environment and sustainability, energy, climate, transport, societal inclusion, or security (European Commission, 2020b). The listed Horizon 2020 funding options are open to all disciplines, and in all of them (except for the Synergy Grants), funding for research projects is possible under the heading *Research and Innovation Actions* (RIA).

In the introduced funding schemes, the European Commission provides the funding for all collaborating country partners, who are required to submit a joint proposal. Funding is available in repeated funding cycles with limited calls and deadlines. While Synergy Grants have a response-oriented funding mode with no thematic limitations, all other funding schemes follow a thematically oriented funding logic with broader thematic foci and frameworks. Synergy Grants are available for joint project teams of two to four collaborating lead researchers, who can be located in EU Members States or associated countries (European Commission, 2017). According to Annex A of the Horizon 2020 Work Programme 2018–2020, RIAs in the other funding schemes require a minimum of one partner from a minimum of three EU Member States or associate countries, even though most projects funded in those schemes actually consist of medium size or large country teams.¹ As an EU funding framework, funding conditions in Horizon 2020 strongly focus on strengthening European research collaborations, but also allow for international research collaboration projects.

6 | DISCUSSION OF PROJECT CONSTELLATIONS AND FORMS OF ICRPs

Section 5 illustrates that funding schemes define relevant context conditions for the project formation of ICRPs. Those conditions result in different project constellations and forms which cannot simply be summarised as one type of collaborative research projects. Rather, we suggest a further specification for their definition.

On the one hand, we suggest to further differentiate between project size (i.e., the number of collaborating countries) and the geographical distance of the collaborating countries (see Figure 2).

Shaping the team dimension of ICRPs, most funding schemes require a minimum (and sometimes maximum) number of countries eligible for funding in such projects. DFG and BMBF fund small projects, consisting of two to five collaborating countries, while Synergy Grants' funding guidelines limit the number of collaborating individual researchers from two to four. In contrast to that, projects funded in the FET-, LEIT-, and SC-funding schemes are more often medium-sized (6–10 countries) and large (more than 10 countries) multinational project collaborations.

Shaping the context dimension, most funding schemes limit the countries that are eligible for funding, and thus define the geographical spectrum of ICRPs. Figure 2 shows that the D-A-CH funding scheme results in projects with a short (European) geographical distance. The ORA funding scheme, and the Synergy Grants and RIA actions in all three priorities allow for projects with a larger geographical distance (beyond Europe). In contrast to that, BMBF funding schemes—while mostly binational in their collaboration form—allow for projects with a larger geographical expanse on a more global scale.

A second specification we suggest is related to the funding structure and funding formats that apply for ICRPs based on the funding schemes they use, which both affect the formation and the implementation of such projects in the task, time, team, and context dimension (see Figure 3).

The introduced funding schemes either have a mono-institutional or a multi-national funding structure. In mono-institutional funding schemes (Horizon 2020 funding schemes, MEC, or QDiS), funding comes from one institution for all country partners, accompanied by joint funding guidelines that all project partners need to follow. In multi-national funding schemes (D-A-CH, ORA, GIF, T-AP) project budgets for the different country partners are provided by the respective national funding institutions, which all may have differing funding guidelines. Furthermore, the analysed funding schemes differ in their thematic focus and availability. Different constellations are possible. Response-oriented funding schemes do not have thematic limitations and are permanently available with no application deadlines (D-A-CH, MEC). Thematically oriented funding calls offer funding in specific cycles limited by application deadlines and with a specific thematic focus (QDiS, T-AP, RIA). A mixed format are thematically open funding calls (Synergy Grants, ORA).

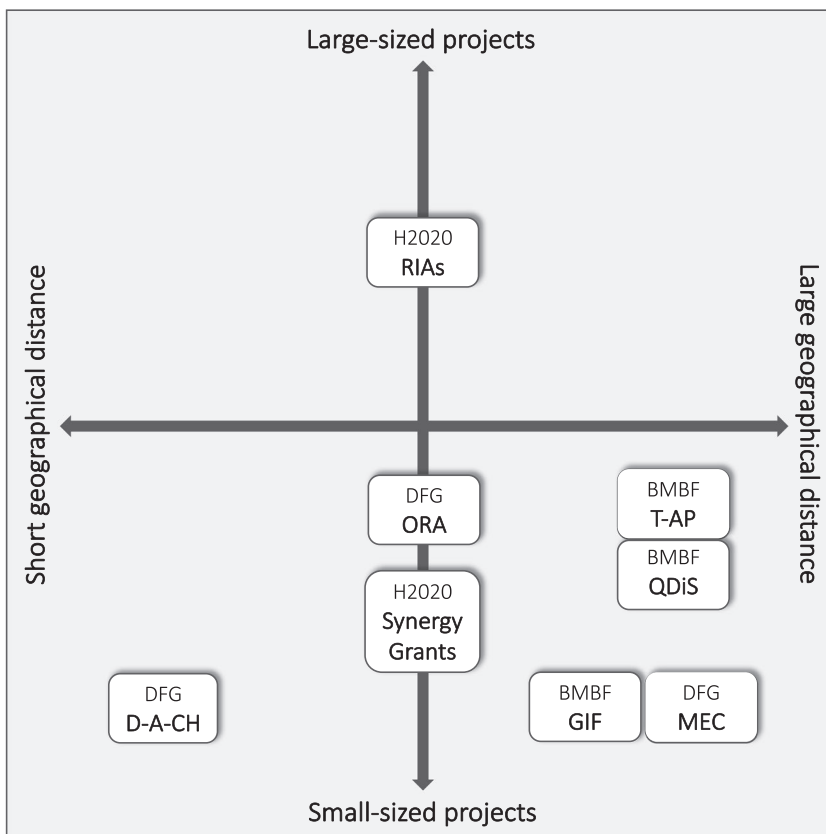


FIGURE 2 Size and geographical distance of ICRPs
Source. Authors.

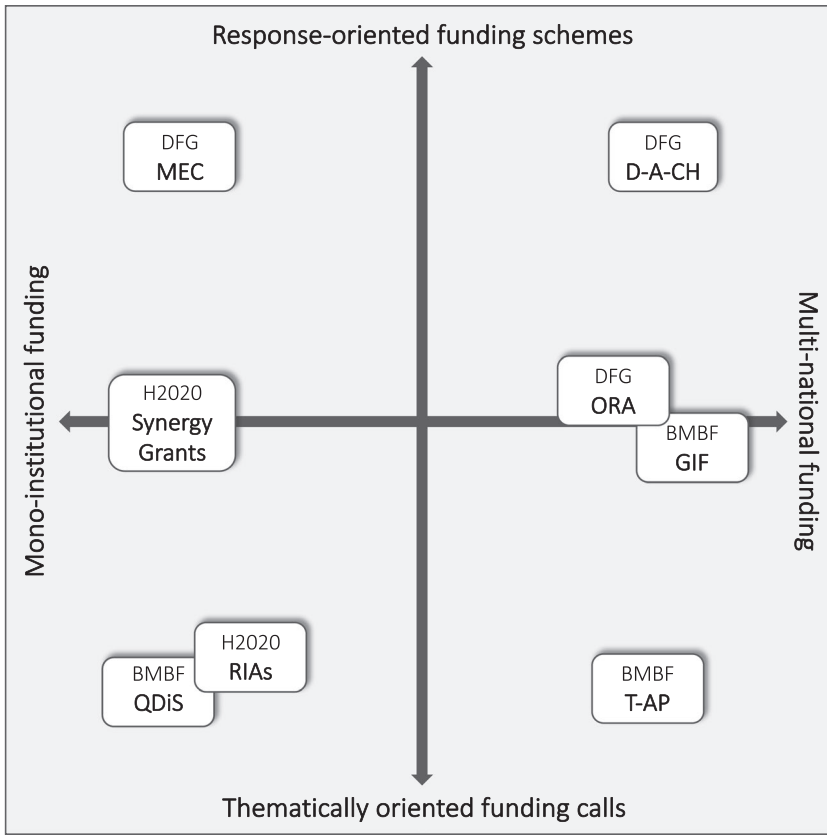


FIGURE 3 Funding structure and funding format for ICRPs
 Source. Authors.

Based on the proposed four specifications, ICRPs can have different forms, and thus should be classified accordingly, before we can analyse their characteristics (as listed in Figure 1), collaboration dynamics, outcomes, and costs. Categorising all them under the broad label *international project collaboration* neglects this variety.

7 | CONCLUSIONS

Although we conducted our analysis from the single country perspective of Germany, we propose that our case study is representative of ICRPs in the European Research Area, where researchers can obtain research project funding under similar funding conditions (Laudel & Gläser, 2014). We analysed the relationship between competitive project funding in the social sciences and the forms and characteristics of ICRPs. We propose that ICRPs do not represent one type, but that different funding conditions lead to considerable variety in the forms of international collaborative research projects. Based on our empirical focus on funding schemes, we therefore suggest a more complex conceptualisation of such projects. First, we suggest conceptualising ICRPs as temporary organisations with specific characteristics by four dimensions that are decisive for temporary organisations; namely, the task, time, team, and the context. Second, we suggest classifying international collaborative research projects by four key specifications that are formative for project constellation: size, geographical scope, funding structures, and funding formats. Depending on what form projects have based on those four specifications, their work may be affected differently.

Conditions pertaining to size and eligibility of countries by funding scheme affects the team, context, and task dimensions of research projects. Project size is, of course, relative and differs according to disciplines and research fields (Jordan, 2006). In addition to the number of collaborating countries, it encompasses the number of researchers, budget and monetary costs, and the amount and variety of equipment involved. Due to their contextuality, ICRPs in the social sciences may face more challenges in successful team building and knowledge production, if they comprise a larger number of country partners and if partners collaborate across larger geographical distances. Since contextuality in the social sciences also has an impact on the division of labour and knowledge integration (Mauthner & Doucet, 2008), geographical complexity and cultural diversity can lead to higher task complexity. Differing national research policies and research guidelines may lead to status hierarchies and asymmetrical power relationships in the team dimension (Dusdal & Powell, 2021), and may complicate the communication of knowledge.

Funding sources may also affect the time and team dimensions because they tie research to a specific timetable and budget (Brew et al., 2013). Mono-institutional funding structures may allow for more coherence especially in project management, since all partners follow the same guidelines on budget spending, project controlling, or reporting etc. In multi-national funding structures, country partners must follow different project guidelines, and ICRPs may thus face more coordination (task and time related) and coordination conflicts due to differing obligations for budget spending, project controlling, and reporting. This may also lead to collaborating researchers holding different assumptions and expectations of how projects should be planned, performed, and reported on. With regard to team dimensions, if funding is provided by one national institution for all country partners, this may lead to hierarchies in the project team, if one partner oversees the project budget and the budget distribution is arranged via subcontracts.

Limited availability of funding may affect the team and task dimensions of projects particularly for emerging collaborations that are not yet formally established (Ulnicane, 2015). The independence of research is always a matter of degree in terms of the extent to which a researcher is free from influences that alter their choices. More independence is not always better, but we can assume that funding policies and arrangements promote specific kinds of research (Laudel & Gläser, 2014). In our analysis, response-oriented funding schemes may offer the most independence for project formation, since researchers do not face any thematic limitations, can choose the right moment for a joint application, and can take their time to find suitable partners in advance. In contrast, thematically oriented funding calls define a narrow thematic focus, which may force ICRPs to adjust or change their own research focus and topics. Also, their availability is limited; thus, researchers need to closely watch funding announcements and have less time to prepare a collaboration and project to meet application deadlines. Ideally, collaboration networks should already have been established, to hand in successful applications in limited time frames.

Several caveats to our analysis should be considered. First, our analysis is a first step to developing a more nuanced classification and typology of ICRPs. Other decisive aspects cannot be derived from the funding conditions, but need to be reconstructed, e.g., from project proposals (e.g., budget, task, duration, inter-/disciplinarity etc.), or with qualitative and quantitative research approaches that gain deeper insights to the different project forms and project characteristics. A multi-method approach that combines interviews with principal investigators and other team members, bibliometric analysis, and desk research of project websites and documents would be well suited for investigating further nuances of international collaborative projects, to develop the typology of ICRPs further, and to gain a deeper understanding of the actual research processes within such projects.

Second, our research has a European focus and outlook. Research funding systems on other continents (e.g., in China or the United States) may differ, even though the importance of competitive research grant funding is increasing everywhere (Olechnicka et al., 2019). Even in Latin America, reforms in the past two decades included the introduction of competitive grants as a new way to create incentives for the emergence and consolidation of international scientific networks (Ubfal & Maffioli, 2011). Still, collaborative research in other parts of the world

(e.g., in the Global South) might be (still) mostly pursued by regional research teams who collaborate internationally without competitive grant funding (Barrett et al., 2011).

Third, in the social sciences, we still find only few large-scale multinational collaboration networks (e.g., around large scientific instruments) and roadmap programs. Nevertheless, their forms and characteristics might differ and should be explored and included in a future typology. Also, due to our focus on funded projects, we have not included research that ties together multiple funding sources without a joint agreement program, which would result in an even more complex funding structure. Future analyses would benefit from exploring these limitations.

Despite these limitations and drawing on the analysis presented, a foundation for further empirical research on ICRPs as temporary organisations is proposed by articulating the following four research questions for follow-up research:

Team dimension. How does the funding availability and geographical representation of funding schemes affect the choice of country partners and the formation of a joint project team; and how does the resulting team composition (size, number of countries, collaboration experience or inexperience, etc.) affect project implementation?

Task dimension. How does the funding logic affect the project's thematic scope, research complexity, division of tasks, the division of labour, interdependence, and analytical design?

Time dimension. How does the funding structure (mono-institutional vs. multinational) affect communication and coordination costs (for budget spending, implementation, reporting deadlines, etc.) and project development over time?

Context dimension. How do funding schemes and their conditions affect the team composition and the contextual conditions in which researchers work in different national contexts (e.g., research integrity and ethics, criteria for the evaluation and measurement of success, or legal and normative aspects)?

Funding policies and institutions do not just increasingly focus on supporting ICRPs but will also be increasingly interested in their successful implementation, management, and development (Olechnicka et al 2019). Therefore, raising and answering relevant questions, and reflecting on challenges to the implementation of ICRPs, are important steps to maximise outcomes from international research collaborations.

ENDNOTE

- ¹ The authors derive this tacit knowledge from their own collaboration experience and from informal recommendations given by the German National Contact Points for the Horizon 2020 implementation. We also carried out a random database search in the EC portal CORDIS (Community Research and Development Information Service) to gain first insights into ICRPs funded under the thematic cluster 6 of Priority 3 on Societal Challenges. The identified projects consist mainly of medium-sized (six to ten countries) and large-sized (more than ten countries) project teams. Collaborating country partners were mainly from EU member states, but we also found 37 non-European country partners.

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