What are the social and scientific benefits of participating at academic conferences? Insights from a survey among doctoral students and postdocs in Germany

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Abstract

Academic conferences are global phenomena. As the coronavirus pandemic continues, many conferences now are being postponed or canceled. Usually, they bring together a complex network of academic and nonacademic professionals to discuss and disseminate new knowledge. The practice of ‘conferencing’ also includes activities that go far beyond the exchange of information. Conferences constitute social spaces where researchers encounter other researchers, establish new contacts, maintain old contacts, hold exploratory talks, and initiate collaborations. Academic conferences therefore can yield a plenitude of scientific and societal impacts. In the past, much progress has been made in measuring the impact of financial investments in science. There is, however, no shared understanding of how to measure the impact of academic conferences. Against the background of the time and money that is spent on both visiting and organizing conferences, it is important to understand the ways in which conferences generate impact. The coronavirus pandemic also shows that it is important to implement digital technologies like tools for virtual conferencing. This article uses qualitative and quantitative data to examine the conference activities of young scholars from German universities and to study how they profit from attending conferences. It is shown that conferences play a significant role in the qualification process. However, in terms of information and networking benefits, postdocs compared with doctoral students seem to profit more.

Key words: academic conference; impact; doctoral student; postdocs; scientific meeting; event evaluation

1. Introduction

Governments, policymakers, and science funding organizations are increasingly calling for impact assessments to communicate the effects of financial investments in research. This development reflects the importance research today plays in wider society in terms of social and economic growth. Most impact assessment frameworks are based on traditional approaches to measuring research impact. The focus is primarily on easy to measure outputs like the number of publications or the use of knowledge products by other researchers and nonacademic actors (de Jong et al. 2014; Morton 2015; Reale et al. 2018).

The notion of ‘impact’ repeatedly leads to lively discussions about possible shortcomings of classical approaches to research impact measurement. One reason is that the links between research and impact are complex and involve social processes and interactions that are not easy to measure (Martin 2011). Another reason is that different approaches to impact assessment make different assumptions about the mechanisms how impact occurs (Greenhalgh et al. 2016). In recent years, alternative approaches to assessing research impact have therefore been developed (de Jong et al. 2014; Penfield et al. 2014). For instance, as universities are increasingly expected to fulfill ‘third mission’ activities, emphasis has shifted from scientific value and relevance to the effects of the use of research products on society. Despite the increased attention devoted
to developing impact assessment frameworks, there is not much empirical knowledge about the interplay of scientists’ knowledge production and impact in science.

Academic conferences can be seen as significant vehicles for generating scientific and societal impact. The aim of this article is to explore the perceived impact of academic conferences from the perspective of young researchers in Germany. Generating empirical knowledge on the impact of academic conferences has gained in importance for two reasons. First, we do not know much about what scientists do at conferences and what impact their actions have on the science system. Against the background of the resources allocated to visiting and organizing academic conferences, it is important to understand the different ways through which impact is generated. Second, up until a few months ago, the gathering of a large number of scientists at a conference was a matter of course. The coronavirus pandemic currently has massive implications for researcher mobility and the conference activities of scientific communities in most parts of the world. Even though the usefulness of conferences has been critically questioned, the practice of ‘conferencing’ is considered an integral part of a scientific culture that has existed since the 17th century. Face-to-face interaction currently is being replaced by a practice of ‘social distancing’, challenging the informal scientific communication. Young scientists therefore find little or no opportunity to meet and interact with other scientists. At the same time, it is not foreseeable when the current lockdown in science ends and how the pandemic changes the way future conferences will be organized. If we gain empirical knowledge about what young researchers experience as ‘impact’ of the conference, then we may be able to develop appropriate and more focused support structures of social exchange in science that aim at compensating for the current deficits. Examples are digital exchange platforms and strategies for virtual conferencing.

2. The German system of training junior academics

Before exploring the impact of conferences within the German research system, some key facts on the training conditions of young academics will be presented. The training of young academics has witnessed massive changes in many countries over the past three decades (Nerad and Heggelund 2008). In Germany, reform efforts have aimed both at improving the research conditions for young researchers at universities and at increasing the attractiveness of the research career for foreign researchers (Schneiderberg and Teichler 2018). This development was triggered by the growing criticism of the quality of doctoral training that began in the early 1990s and the perceived opacity with regard to the career path of young academics. As part of the reform efforts, various structured doctoral programs have been established at universities (Ambrusat and Tesch 2017).

With the Excellence Initiative and the Joint Initiative for Research and Innovation, the German government launched two flagship funding programs in 2005 and 2006 to strengthen higher education institutions and academics. Both programs have led to a substantial diversification of the funding opportunities for young scholars particularly with regard to promoting international exchange and networking (Wissenschaftskonferenz 2019). Science funding organizations as well as universities today offer a wide range of funding programs for scientific events and the participation in conferences. For instance, the German Science Foundation (DFG) provides financial support for the realization of international scientific events in Germany (Deutsche Forschungsgemeinschaft 2017, 2019). Eligible for funding are individual scientists and scientific associations. The von Humboldt-Stiftung (2019) offers grants for scholarship holders of the foundation to attend international events. Similarly, private organizations like the Fritz Thyssen Stiftung provide funding schemes to facilitate cooperation and networking of scientists between different disciplines.

3. Research on academic conferences

Academic conferences are not new topics of inquiry (Merritt and Hanson 1989; Kyvik and Larsen 1994; Soderqvist and Silverstein 1994; Gonzalez-Santos and Dimond 2014; Nicolson 2017). One stream of research focuses on the role of conferences in the process of academic socialization of young scholars (Chapman et al. 2009; Ghosh and Githens 2009; Cherrstrom 2012; Malinovska 2012; Hottenrott and Menter 2020). According to these studies, the experiences of young scientists with conferences are part of a learning process in which the young scientists expand their knowledge and research competence, develop networking strategies and establish relationships with other professionals. Kuzhabekova and Temerbayeva (2018) found that doctoral students were very strategic in seeking new knowledge at conferences, depending on their current stage of qualification. Building on the general theory of the socialization of doctoral students described by Weidman, Twale and Stein (2001), the authors describe the four stages of socialization in the process of conference participation. In the first (anticipatory) stage the doctoral students were confronted with new rules and roles. The activities of the students in this stage were characterized by listening and observing these rules and roles. In the second (formal) and third (informal) stage the students became more task-oriented, learned to master the disciplinary rules of the game and were more confident about their professional goals. In the fourth (personal) stage, the students had internalized their new role as a researcher and had formed a professional identity (Kuzhabekova and Temerbayeva 2018: 18).

In the science and technology studies and in evaluation research, most research on academic conferences is based on bibliometric studies. These studies use the published results of conferences as sources of information to describe the development of scientific fields and to measure the impact of conference publications on the knowledge production. Examples are studies that examine the scientific impact of conference proceedings compared with journals and other sources of scientific information (Glänzel, Schlemmer and Schubert 2006; Lisée, Larivière and Archambault 2008). Research of this type has shown that conference proceedings receive fewer citations than journal articles (Zhang and Glänzel 2012). At the same time, the importance of conferences for the process of knowledge production seems to vary considerably between disciplines. In computer-related fields and engineering, conferences are seen as important channels to disseminate new knowledge. One reason is that in fast-moving research environments scientists depend on short cycles of publishing (Freyne et al. 2010; Vardi 2010). Due to the longer time from submission to publication the knowledge communicated through a journal might be outdated at the time of publication. Indeed, Eckmann, Rocha and Wainer (2012) found that for many authors in computer science the shorter time for an
outcome is a strong argument for submitting a paper to a conference. Also, scientists are attracted to elite conferences to cite papers presented at these conferences (Freyne et al. 2010). According to Lee (2019), conference series with a longer history and a better name are likely to produce highly impactful papers in the computer sciences.

4. Studying the impact of academic conferences

In evaluation research, there is no common understanding of how to study the impact of academic conferences. Despite the rich insights bibliometric studies provide, the focus on isolated indicators, such as citation measures, fails to acknowledge the social context in which academic activities take place. Hansen and Pedersen (2018) provide a literature overview of the ways in which impact of academic events have been studied. By combining search strings including synonyms for academic events, for example, conference, meeting, and symposia, the authors identified four general categories of studies: ‘The Quantified Scholar’, ‘The Visible College’, ‘Externalities’, and ‘Marketplace of Ideas’. Literature within the first category explores the impact of academic events on academic practice. The core of this literature uses bibliometric analysis and is concerned with quantifying the scientific impact of conference publications. The second category deals with studies devoted to interactive processes such as network developments and the formation of collaborations. In these studies, academic conferences are regarded as key sites for knowledge sharing, interaction and the accumulation of status and recognition. In the last two categories studies on the societal and economic impact of academic events on a broad range of sectors are explored. These sectors include for example, the industry, policy, the health sector, the environment, tourism, and teaching.

From the literature overview, it follows that a more comprehensive understanding of the impact of academic conferences involves a more theory-driven approach to differentiating between different types of conferences and focussing on different groups of academics. Taking this as a starting point, the aim of the following section is to elaborate further on how the impact of conferences in academia could be conceptualized. Taking a sociological perspective, the focus will be on two aspects of ‘impact’: information exchange and individual and collective effects. Impact is understood in the broadest sense as changes in the social world of academics that occur as a result of people meeting and interacting at the conference site. It includes for example, changes in the stock of information of the individual and changes that occur in the social organization of science, for instance, through collaborations.

4.1 Information exchange and social networks

To produce new knowledge scientists use the published contributions of their peers. Often, however, this knowledge is already outdated at the time of publication, for example, due to long peer-reviewing and the publication cycles of the publishers. To access new knowledge, researchers therefore rely on ‘not yet published’ knowledge and informal knowledge sharing (Gläser 2006: 83). At academic conferences researchers are exposed to various types of information, including unpublished pieces of knowledge. Participants arrive at the conference out of interest and with the expectation to learn about the developments in the field and to gain knowledge informally. As has been repeatedly shown, much of the communication processes involved in the production of scientific knowledge occurs in informal contexts (Hagstrom 1965; Edge 1979; Garvey 1979; Latour and Woolgar 1986; Knorr Cetina 2002). Conferences provide social spaces for these informal contexts to evolve. Certainly, a large part of the information exchanged result in epistemic activities targeted at the production and co-production of scientific knowledge. For example, a scientist may learn about an alternative research method from a colleague and may use this method in future research tasks. Yet, not all the information exchanged is dedicated to the process of knowledge production. In informal settings conversation often involves the talking about social topics and gossip (Reychava and Te’eni 2009; Storme et al. 2017). Social conversation of this type may include stories, judgments, and information on workshops, scholarships, and research funding. Often, career-relevant information of the following kind is circulated first-hand among the attendees: who got a professorship, who changed to another institution, who is leading a research group, and who offers vacant jobs. At academic conferences scholars are exposed to a multitude of spontaneous information, the content of which may or may not prove useful in the future.

The information exchanged at conferences are at the same time valuable resources embedded in social networks that are formed by the participants of the conference. The structure of the networks that is, the pattern of relationships linking the conference participants, may impact the opportunities for each individual to access these resources. From social network theory (Granovetter 1973, 1974; Burt 1992, 2001), we learn that people should benefit from their relations if they provide them access to nonredundant sources of information. The likelihood of obtaining nonredundant information depends on the number of ‘bridges’ scientists can build between otherwise disparate networks. Burt (2001) identified two sources of redundancy: cohesion and equivalence. The first source concerns redundancy caused by strong ties between people of the same group. For instance, doctoral students from the same graduate school tend to have similar information and therefore provide redundant information benefits. The second source of redundancy concerns structurally equivalent contacts. Structural equivalence means that two actors occupy the same structural position vis-à-vis a third person without having to be connected to each other (Burt 1992: 19). Two postdocs, for instance, are structurally equivalent to the extent that they have the same contacts connecting them to the same sources of information. Contacts to other participants of the conference are therefore expected to be more ‘beneficial’, if they are nonredundant. This condition should be met, if the conference attendees manage to diversify their relations. However, the extent to which they succeed in diversifying their relations depends on the social composition of the participants, who represent potential contacts. An international conference is likely to attract a socially and scientifically heterogeneous community. Examples are large international events or annual meetings organized by international professional associations. In contrast, a smaller national conference tends to bring together local and thus more homogeneous scientific communities. Examples are annual meetings of national associations or workshops organized by sections of those associations. Therefore, the likelihood to access nonredundant sources of information is probably higher at international conferences than at national conferences.

4.2 Individual and collective effects

The social interactions at conferences often remain without consequences for the individual and the science system. Yet, they may
also lead to unintended effects, for example, when two researchers decide to collaborate. Academic conferences therefore may yield individual or collective effects. By individual effects, I refer to changes on the level of the individual. An example is a single authored publication that resulted from the sharing of ideas at the conference. The effect—the publication—can only be attributed to the individual as no other author is involved. By collective effects, I refer to phenomena involving two or more individuals. Collective effects include different types of formal and informal collaborations as well as social exchange relations resulting from encounters at the conference site. In sociology, collective effects have been extensively described as aggregate or collective properties of groups emerging from the unintended consequences of individual action (Lazarsfeld and Menzel 1961; Coleman 1990; Blau 2006 [1964]; Jasso 2009). Theoretically, they result from interactions at the conference site because researchers seek to improve their situation through transactions with other researchers. One argument for this assumption can be derived from Richard Whitley’s (1984) account of “mutual dependence”. In some disciplines, according to Whitley, the success of research projects depends strongly on access to resources embedded in social networks and knowledge generated in different scientific fields. Resources considered are scarce job positions, research funds, but also technological prerequisites (e.g., machineries and laboratories) and know-how. Scientists are mutually dependent to the extent that they desire the resources and means of production other scientists and nonacademic actors have. To solve research problems, they enter into relationship with the gatekeepers who control the means. These interdependencies in turn lead to an incentive to enter into social exchange (Blau 2006 [1964]). Once these relations are established and social trust has been developed, other types of collective can emerge, such as structures, institutions, and research collaborations (collective effects). In addition, information advantages for single academic can arise from these relationships (individual effects). Collective and individual effects are likely to emerge from conferences. The reason is that the social context of the conference differs from other social contexts in academia in important ways. Social interaction at conferences takes place outside known social structures like for example, the faculty or the research lab. This context potentially creates situations that are characterized by indeterminacy. The social ties between the attendees are often weak and the interaction partners usually have no or little information about the others’ intentions. Much of the interaction process taking place at conferences is therefore uncertain with respect to its outcome.

5. Methods and data

To explore these effects and to describe the young researchers’ experiences with conferences, a mixed-methods design was utilized. The study was part of a PhD project conducted at the faculty of education science, psychology and sociology at Technische Universität Dortmund. For the qualitative study, 12 explorative (semi-structured) face-to-face interviews with doctoral students and postdocs from sociology, computer sciences, and biochemistry were conducted. The aim of this approach was to gather initial insights into the practical experiences of young scholars at conferences and to identify general dimensions of the perceived ‘impact’ of conference participation. The topics of the interviews included: 1, Expectations and motivations for conference participation; 2, Importance of conferences for the scientific qualification process; 3, discipline-specific roles of conferences; 4, interaction and communication; and 5, individual pay-off of the conference visit. By selecting interview partners from the three disciplines, it was attempted to maximize the variation of views with conferences in different disciplinary settings. In addition, the variance in the answers was increased by including researchers from different qualification phases—PhD students and postdocs—in the sample. After the interviews had been transcribed, the material was analyzed using qualitative content analysis (Mayring 2014). The identified categories containing statements on the perceived impact of the participation were then used to construct the questionnaire for the second study.

The aim of the second study was to complement the qualitative study by a quantitative analysis of those aspects of the conference that the young researchers had identified as ‘impacts’. To this end, two online surveys were conducted. For the first survey, a list of contact information of scholarship holders who received conference funding from the German Academic Exchange Service (DAAD) between January 2013 and June 2015 was compiled. Scholarship holders who provided a professor title in their application were deleted from the list. Next, the online survey was administered by e-mail to all remaining scholarship holders in the list. The net population covered 4,608 doctoral students and postdocs in different stages of their qualification. After the survey had been closed, data from 900 scholarship holders were available for the analysis. The response rate was 19.5% based on the net population. The second online survey was carried out among doctoral students and postdocs at selected German universities. The aim of the second survey was to complement the group of DAAD scholarship holders by a population of young scholars for whom it can be assumed that the majority have not received funding. Initially, universities were selected and requested to support the survey. The universities were selected in such a way that scholars from a broad range of disciplines were covered. In total, seven universities and graduate schools agreed to participate in the survey. At five institutions, mailing lists for doctoral students and postdocs were used to contact the researchers. In these cases, the total population of subscribers remained unknown. At two institutions, personalized online surveys were carried out. After the surveys had been closed, a total of 334 researchers had completed the questionnaire. In a final step, data from both surveys were combined to one dataset resulting in a total of 1,234 completed questionnaires.

6. Empirical findings

6.1 Qualitative study

The following section summarizes the main results of the analysis. In total, five dimensions of perceived impact resulted from the qualitative study using content analysis.

6.1.1 Establishing and maintaining social relations

The first dimension of impact captures networking activities taking place at the conference. Numerous references in the interviews indicate that attending the conference allowed making new and maintaining existing contacts of different kinds. One interviewee reported that he met his second supervisor (Doktorvater) at a conference. Another interviewee stated that he gained relevant knowledge through a contact established at a conference, which enabled him to complete a publication. Another doctoral student described that he substantially expanded his professional network through
participation in conferences. Although all interviewees established new relationships at the conference, some are skeptical as to whether these relationships have the potential to last over a longer period.

At the conference my boss introduced me to about 10 interesting people. And I got to know maybe two independently of him in other situations. Of course, you kind of talk to many people. But the question is then always whether these contacts are long-lasting (ID07).

Another interviewee systematically used conferences to build a professional network. She still maintains contact with these people:

We are still in contact and work together. So I think I actually have my network built up by visiting conferences (ID03).

Yet, the motivation to expand one’s personal relations does not seem to be independent of the size and the composition of one’s existing network. One interviewee perceived a ‘wearing down effect’ that occurs when the personal network already includes many people and when there is no longer a need to expand the network to include more ‘important’ people. If the need for social relationships is saturated in this sense, motivation shifts from developing new contacts to maintaining existing ones:

This has to do with the wearing down effect of conference participation. You always meet many people, but maybe they are less important because you already have a network. But this is why it’s also important to maintain a network (ID06).

6.1.3 Learning effects
The third dimension of impact captures a broad range of personal experiences involving the advancement of skills and various social learning processes. Numerous interviewees reported that they have learned from the conference through observing the behavior others display in various social situations. For some, the conference had promoted the acquisition of presentation skills. ID08 has learned through the conference to ‘[...] give a good presentation within ten minutes’. Another scholar reported that he had learned to copy presentation techniques from ‘the good presentations’ through observing the techniques others used:

And you observe how people present their results and how they react to questions, and you start to copy this (ID03).

Differences between doctoral students and postdocs became apparent in the preferred learning experiences. The majority of doctoral students emphasized the importance of the conference for receiving personal feedback. For ID04, the conference is associated with ‘the search for feedback’. In contrast, this aspect was of little relevance to the postdocs. For them, learning meant getting to know their professional role as a scientist and forming a professional identity.

6.1.4 Access to knowledge
A substantial part of the responses relates to the category ‘access to knowledge’. The knowledge the interviewees refer to consists of informal stocks of knowledge such as research and career-relevant information, strategic information, and general overviews over research fields. For example, ID02 received information on scholarship opportunities during a discussion. Some respondents were specifically looking for information that would help them advance in their career. For ID06, it was worthwhile attending the conference, as he was given access to information on planned research projects and job opportunities. Often the information received consists of strategic information. ID08 received information on how the ‘business’ of a research area in which he was interested is organized and what publication strategies researchers pursue there. For ID04, the main impact of participating in conferences is that it will provide a general overview of the activities in a research field:

Simply to get an overview of the relevant research topics in [research field]. [...] And certainly, to get insights into what others in the field are doing (ID04).

Some interviewers partners identified their own knowledge gaps by attending conferences. They experienced that the knowledge shared by the members of their community is often limited. To acquire new knowledge, it is necessary to look beyond the boundaries of the discipline to neighboring fields. A postdoc exemplified this and reported that she strategically attended conferences that fell outside of her field. This strategy enabled her to better assess the relevance of certain conferences for her own research agenda.

6.1.5 Create visibility
The category ‘create visibility’ captures answers that provide insights into the processes of becoming visible in the scientific community. All interviewees considered the creation of visibility to be an important impact of the conference. The visibility they refer to is created by informing others about one’s own research activities. Visiting the conference enabled the young researchers to signal ‘activity’ in the scientific community and thereby to gain recognition. This process gained in importance when the standard means of...
creating visibility, through publications, were lacking. One interviewee reported that he had no opportunities for publishing scientific papers during the doctorate due to time constraints. Conference participation for him was a means of compensating for this lack:

For our doctorate we need to publish a monography, we can’t do a cumulative doctorate by publishing papers. This means that it is more costly and difficult to actually publish any articles. My hope is that the conference visit will be a substitute for this (ID08).

One postdoc strategically used conference visits during her parental leave to remain visible in the scientific community:

‘In this respect conferences are very important to signal that I am still there’ (ID05).

Some respondents also used the conference to create visibility with potential employers and, where appropriate, to signal interest in collaborating:

It’s just that it could lead to job offers, I’d say. Simply because they know you. If you would ask them now, you would already have a foot in the door (ID07).

### 6.2 Quantitative study

Based on the results of the qualitative study an online survey was designed next. The aim was to further explore the benefits of the conference visit and to quantify the reported impact.

#### 6.2.1 Description of the sample

The final sample of the online surveys consists of 879 respondents. In Table 1, key descriptive statistics of the respondents are presented. Respondents who indicated they had never attended a conference were excluded from the analysis. Also, postdocs whose doctorate was longer than 8 years ago were excluded from the sample. Only respondents who provided valid answers in key socio-demographic variables were included in the sample.

In total, the sample captures 239 female doctoral students (55%) and 196 male doctoral students (45%), who were on average 29.3 (SD = 3.6) years old (Table 1). On average, the doctoral students are in their fourth year of doctoral training. The postdocs are on average 33.3 (SD = 3.5) years old and are on average in their fourth year of postdoctoral training. Regarding the distribution of academic fields there is a noticeable concentration of respondents in the Humanities and Social Sciences in both groups. About one half of the postdocs graduated in this field, the corresponding proportion is 46% for the doctoral students. About a quarter of the doctoral students followed a PhD in the Natural Sciences while this proportion is 17% for the postdocs. Based on the latest official statistics 30% of the doctoral students in Germany aimed for a doctorate in the Humanities and Social Sciences, whereas 24% aimed at a doctorate in Mathematics/Natural Sciences (Destatis 2019). Hence, respondents in the Humanities and Social Sciences are overrepresented.

#### 6.2.2 Conference activity

The focus of the following analysis is on the young scholars’ scientific contributions to conferences. The sample persons were asked to provide information on the number of conference visits and active contributions. Oral presentations and poster presentations were both considered as ‘active’ contribution. Although both forms of presentation may differ in the recognition they generate in the scientific community and in their capacity to communicate content that attendees can recall at a later point in time (Gordon et al. 2013); they both constitute well established means to disseminate and share new knowledge (Halligan 2008; Beamish et al. 2015). Therefore, both forms were grouped into one category. Doctoral students were asked to provide the number of visits and oral/poster presentations since the start of their doctoral training. Postdocs were asked to provide information on the number of conference visits and oral/poster presentations since completion of their doctorate. All figures were surveyed separately for international and national conferences. A conference was defined ‘international’ if the respondents reported that the language at the conference was predominantly in English. Accordingly, a conference was coded ‘national’ if the respondents stated that the language at the conference was predominantly in German or other. This approach aimed to distinguish between heterogeneous and homogeneous social environments, as explained in Section 4.1.

In Figures 1 and 2, the distributions for the number of conference visits are shown. Only doctoral student in their fourth and fifth year of the doctorate and postdocs in their fourth and fifth year of their postdoctoral training were considered for the analysis. Two issues can be highlighted. First, the distributions are positively skewed, as many respondents reported to have attended few, while few stated to have attended many conferences. This pattern reflects a typical distribution of productivity in science and has been repeatedly found for different measures of scientific output (Allison and Stewart 1974; Rørstad and Aksnes 2015; Kwiek 2018). For instance, Price (1961) used the number of publications as a measure of productivity and found that <6% of publishing scientists

### Table 1. Socio-demographic characteristics of the respondents

|                        | Doctoral students (n = 435) | Postdocs (n = 279) |
|------------------------|----------------------------|--------------------|
|                        | Mean  | SD    | Mean  | SD    |
| **Age**                | 29.34 | 3.61  | 33.30 | 3.48  |
| **Female (dummy)**     | 0.55  | 0.50  | 0.47  | 0.50  |
| **Duration of doctoral training** | 3.22  | 1.42  |        |       |
| **Time to complete the doctorate** | 4.33  | 1.10  | 3.49  | 2.11  |
| **Years since completion of doctorate** | 0.46  | 0.50  | 0.53  | 0.50  |
| **Humanities and social sciences (dummy)** | 0.12  | 0.31  | 0.20  | 0.40  |
| **Life sciences (dummy)** | 0.27  | 0.44  | 0.17  | 0.37  |
| **Engineering sciences (dummy)** | 0.15  | 0.35  | 0.10  | 0.31  |
publish about 50% of the articles. If we define the number of oral and poster presentations at international conferences as a measure of productivity, then the top-22% of the most productive doctoral students account for about 46% of the total number of reported contributions. Similarly, the top-24% of the most productive postdocs account for about 44% of the total number of reported contributions. When compared with the productivity distributions usually found for publications, the skewness for conference activity is found to be rather moderate.

Second, it appears that the respondents reported to have visited more international than national conferences. This pattern can be found in all fields of research (not shown). It can be interpreted as an expression of the knowledge production predominantly organized in international cooperation networks. Due to the increased number of international scientific collaborations (Edler, Fier and Grimpe 2011), work-related international mobility has become an important aspect of work for scientists (Storme et al. 2017). Similar, universities and research funding organizations have expanded their internationalization efforts to promote the international mobility of scientists at all career stages. The median number of visits at international conferences was four for the doctoral students and five for postdocs. For national conferences the median number of visits was three for both groups.

6.2.3 Information benefits
To describe the content of nonredundant information circulating at conferences, the sample persons were asked to select from a list of predefined content those they received during their last conference visit. The list was generated from statements of the interview partners on information advantages that resulted from attending the conference. Table 2 summarizes the proportion of respondents who stated that they have received the information by type of conference. Overall, the table reveals three aspects.

First, the vast majority of the information received is directly targeted at the production of knowledge. This includes for example, information on research methods and the use of knowledge products. Most often the respondents indicated that they have received information on papers or (unpublished) manuscripts. For 69.5% of the doctoral students and 72.1% of the postdocs who visited an international conference this was the case. In contrast, information on funding opportunities are shared much less often. This kind of information is not directly beneficial in the production of knowledge. Rather, it becomes relevant at an earlier stage of the research process when research funds are being acquired.

Second, there are some noticeable differences between doctoral students and postdocs. Although over one-fifth of the postdocs who visited an international conference indicated that they have received information on funding opportunities (21.6%), this proportion is considerably lower for the doctoral students (12.6%). Also, a larger proportion of the postdocs compared with the doctoral students indicated that they have received job-related information at international conferences (36.8% vs. 27.1%). The results suggest that postdocs profit more than doctoral students from conference visits in terms of job-related information and information on research funding opportunities. A possible explanation is that the information needs of postdocs are generally high with regard to research funds and open positions. Postdocs often face a low level of integration into the internal procedures and decision-making processes at the university (van der Weijden et al. 2016). Furthermore, their job situation is often characterized by uncertainty and temporary contracts (Åkerlind 2005; Böhmer and von Ins 2009; Fitzvberger and Leuschner 2013; Dorenkamp and Weiß 2018; Renate and Weiss 2018).

![Figure 1](image-url) Conference activity of doctoral students.
Third, as Table 2 shows, visitors at international compared with national conferences reported more frequently that they had received nonredundant information. If we assume the social relations at national conferences to be predominantly strong ties, then—according to social network theory—the social structure of the national conference should constrain the diffusion of nonredundant information. The findings seem to support this assumption. One exception regards the exchange of job-related information. Although the proportion for postdocs who gained job-related information is 36.8% for international conferences, the corresponding proportion is 44.8% for national conference visits. Again, this finding most likely points to the importance of job-related information particularly for postdocs and their motivation to acquire them.

In sum, the results show that conferences are venues where scientists not only exchange information targeted at the production of knowledge. They are also key sites for sharing career-related information and information regarding the funding of science.

6.2.4 Individual and collective effects
The following analysis addresses individual and collective effects of networking at conference sites. To further explore individual and...
collective effects, the identified dimensions of impact were categorized into five individual and four collective effects and integrated into the questionnaire. The sample persons were asked to select those that occurred after the conference. The corresponding question was: ‘What impact did the conference have for you?’ The results are presented in Tables 3 and 4.

With one exception the postdocs compared with the doctoral students more frequently stated that the conference visit had one of the listed effects. From this finding, one can draw the conclusion that conference participation is more likely to pay-off for postdoctoral researchers than for doctoral students with respect to the listed effects. This particularly holds with regard to collaborations. As Table 3 shows, over one-fourth of the postdocs and 13.5% of the doctoral students who visited an international conference stated that the conference resulted in a research collaboration with other persons or institutions. Also, national conferences seem to play a certain role in promoting collaborations for postdocs. Although only 3.8% of the doctoral students reported that the conference resulted in a collaboration, for about a quarter of the postdocs the national meeting led to a collaboration (Table 4). National meetings and workshops often aim at bringing together people from different sectors to discuss how research findings and new technologies can be used to generate societal or economic benefits (Ho, Liu and Kuan 2016). Often, these meetings take place among a small selection of academics and partners from the industry. For postdocs, these meetings are probably attractive to the extent that they offer opportunities to promote their research.

Most often the respondents reported that the conference resulted in an exchange of methods or work results. About 80% of the doctoral students and 93% of the postdocs stated that they had exchanged methods or results. This high proportion is not surprising given that the act of exchange is one of the guiding principles behind organizing conferences. Less often the respondents reported that attending the conference resulted in a job offer. Still, 8.6% of the doctoral students who had visited an international conference reported that the conference resulted in such an offer.

Furthermore, Tables 3 and 4 show that conferences are important drivers of the knowledge production in terms of publications. For about one-fourth of the doctoral students and 38.4% of the postdocs who attended an international conference, the conference led to a publication project. This proportion is lower for participants of national conferences showing that publication activities are initiated predominantly at international conferences. However, this result must be interpreted with caution. In the course of their training, young researchers tend to advance their skills and knowledge through the development of research papers for conferences (Rhoads, Zheng and Sun 2016). Hence, another interpretation of this finding is that the conference was used to further advance an already existing research paper for possible publication. Yet, even in this case, the conference adds value to the process of knowledge production by helping scholars to produce quality publications.

### Table 3. Effects of the last international conference

| Collective effects                                                                 | Doctoral students (n = 325) | Postdocs (n = 190) |
|-----------------------------------------------------------------------------------|-----------------------------|--------------------|
| An exchange of study materials or devices between you and institutions/persons     | n 91 (28.0)                 | n 70 (36.8)        |
| An exchange of methods or work results between you and institutions/persons        | n 263 (80.9)                | n 178 (93.7)       |
| A research collaboration with institutions/persons                                | n 44 (13.5)                 | n 51 (26.8)        |
| The formation of a research group of which you are a member or have been a member | n 38 (11.7)                 | n 34 (17.9)        |

| Individual effects                                                                | Doctoral students (n = 325) | Postdocs (n = 190) |
|-----------------------------------------------------------------------------------|-----------------------------|--------------------|
| A publication project                                                             | n 78 (24.0)                 | n 73 (38.4)        |
| The chance to be reviewer for a journal                                          | n 24 (7.4)                  | n 32 (16.8)        |
| A job offer                                                                       | n 28 (8.6)                  | n 15 (7.9)         |
| The chance to work as a guest researcher at another institution                   | n 42 (12.9)                 | n 36 (18.9)        |
| The chance to give a presentation at another institution                          | n 59 (18.2)                 | n 62 (32.6)        |

### Table 4. Effects of the last national conference.

| Collective effects                                                                 | Doctoral students (n = 106) | Postdocs (n = 87) |
|-----------------------------------------------------------------------------------|-----------------------------|--------------------|
| An exchange of study materials or devices between you and institutions/persons     | n 24 (22.6)                 | n 19 (21.8)        |
| An exchange of methods or work results between you and institutions/persons        | n 84 (79.2)                 | n 72 (82.8)        |
| A research collaboration with institutions/persons                                | n 4 (3.8)                   | n 21 (24.1)        |
| The formation of a research group of which you are a member or have been a member | n 16 (15.1)                 | n 21 (24.1)        |

| Individual effects                                                                | Doctoral students (n = 106) | Postdocs (n = 87) |
|-----------------------------------------------------------------------------------|-----------------------------|--------------------|
| A publication project                                                             | n 16 (15.1)                 | n 26 (29.9)        |
| The chance to work as a guest researcher at another institution                   | n 3 (2.8)                   | n 9 (10.3)         |
| The chance to give a presentation at another institution                          | n 20 (18.9)                 | n 20 (23.0)        |
| A job offer                                                                       | n 5 (4.7)                   | n 2 (2.3)          |
| The chance to be reviewer for a journal                                          | n 3 (2.8)                   | n 5 (5.7)          |
7. Limitations

Before discussing the implications of the findings, some limitations related to the empirical material presented will be addressed. Some of these limitations result from common challenges when data on individuals’ subjective perceptions are collected based on surveys. First, the results may be biased by memory recall errors and selective perceptions due to the use of retrospective questions in the survey. Empirical studies show, however, that memory recall errors mostly occur when data with large retrospective intervals of 5–10 years are being surveyed (Sudman, Bradburn and Schwarz 1996). Second, it is not possible to verify whether the reported phenomena, for example, a research collaboration, actually occurred and whether the conference was the causative event, since the effects were examined on the basis of self-reported statements. Yet, this uncertainty is inherent in any methodology that uses surveys. Third, due to the lack of registers at German universities, the total population of doctoral students and postdocs is unknown. Drawing random samples is therefore not possible (Fraßdorf and Fraßdorf 2016; Ambrasat and Tesch 2017). To draw samples, researchers rely on available contact data provided by universities and funding organizations. The sample used may therefore differ from the general population of young researchers in certain characteristics, like for example, research performance and their motivation to attend conferences. Due to the selectivity of the sample, the findings are not generalizable to the total population of doctoral students and postdocs in Germany.

8. Conclusion

Despite their omnipresence and a growing academic interest in their role in science, academic conferences have not yet been extensively studied. The aim of this article was to explore the impact of academic conferences from the perspective of young scholars in Germany. It contributes to the body of knowledge on academic conferences in several ways. First, it shows the many facets of ‘impact’ in different phases of the qualification process and highlights some of the social mechanisms and processes associated with the notion of impact. Understanding the processes through which impact is achieved is an important prerequisite to arrive at a common understanding of how to study the impact of academic conferences. Second, in contrast to measuring scientific impact by drawing on bibliometric methods, a mixed method approach combining qualitative content analysis and descriptive analysis was used.

Starting with the second issue, the aim was to conceptualize scientific impact based on changes occurring in the social world of academics. Bibliometric indicators are one way to measure scientific impact. However, they ignore the social activities behind the phenomena they seek to quantify and are therefore not suitable for studying the (nonepistemic) activities of scientists. Following a sociological approach, it was argued that impact is the result of scientists meeting and interacting at conferences and that we need to study the social phenomena these interactions entail. The article sheds light on some of these phenomena and thus complements the literature on impact assessment.

The second part of the study addressed the question what young researchers from Germany perceive as impact of attending conferences. To this end, empirical results of two studies—qualitative and quantitative—were presented. In a first step, dimensions of impact were identified based on interviews with doctoral students and postdocs. Since academic conferences are held with the aim of sharing knowledge and getting in touch with other people, it is perhaps not surprising that a large number of interviewees reported that the most important effects were the acquisition of new knowledge including nonredundant information and the establishment of a professional network. However, the interviews also revealed some of the social mechanisms that are employed within these processes including limitations related to the process of networking. It was shown, for example, that the benefit of conferences for building a professional network is low if the network is already saturated and the conference does not add value to expanding the network. Although for doctoral students the conference is a mechanism for building new relationships, for postdocs it is more a means of deepening relationships and developing social trust. This process is sometimes facilitated by supervisors or other peers who actively introduce the doctoral students to other actors and thereby support the process of network building.

Regarding the epistemic activities of the young scholars, it was shown that conferences are important drivers for the knowledge production in terms of publications. The interviews revealed that researchers met other researchers with similar interests and that these acquaintances resulted in publication projects. Over one third of the postdocs reported that their last international conference resulted in a publication. Another aspect of the knowledge production is the poster session that for some interviewees was the initial starting point for a collaboration.

Although certainly a large part of the information exchanged at conferences is aimed at generating new scientific knowledge, young scientists also seem to benefit from gossip and other social issues discussed. The results show how conferences can serve as an important source of information on, for example, upcoming events, funding organizations and jobs. Postdocs in particular reported that they benefited from career-relevant information such as information about job vacancies and funding opportunities. Since social processes at conferences are inseparably linked with communicative processes, it seems worthwhile to further study the significance of these communicative processes for the knowledge production and the career progress of young scientists.

The results have implications for higher education institutions and designers of doctoral and post-doctoral training programs. Although young scientists generally benefit from participation in conferences, postdocs in particular seem to benefit from information advantages on jobs and funding opportunities. Against the background that career prospects in science are uncertain, especially for postdocs, financial support for postdocs to participate in international conferences should therefore be extended. Furthermore, the results show that international conferences are key sites where young scholars can establish relationships to people from various sectors. Conferences are therefore also places where young academics can establish contacts with actors outside academia and enhance their career prospects in nonacademic sectors. The organizers of conferences are therefore called upon to promote meetings with professionals from different sectors through special events and workshops. In the German research context, joint conferences may be organized to create boundary-spanning relationships between young scholars at universities and researchers from the nonuniversity public research sector or private firms.

Due to the coronavirus pandemic, the opportunities for young scientists to interact vis-à-vis with other scientists in conferences are currently limited. The article shows the many facets of impact associated with attending conferences. Although it is not yet possible to
anticipate what effect the reduced mobility of researchers will have on these processes, it is likely that scientific events like conferences will undergo massive changes in terms of organization, structure and forms of communication. The pandemic therefore provokes a rethink in science. Scientific communities and associations are now called upon to think more about a digital transformation of the traditional format of the academic conference. Digital technologies should be used in a more targeted way in the qualification of young scientists to organize virtual conferences, interactive webinars and online chatrooms. When conferences are held ‘virtually’ certainly one challenge will be to maintain the nature of the informal, personal and social as an important component of the knowledge production.

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