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Citizen Social Science in Germany—cooperation beyond invited and uninvited participation

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This article presents an overview of characteristics of Citizen Social Science (CSS) in Germany. CSS is defined as scientific research in the humanities and social sciences, carried out in cooperation between professional and non-professional researchers. The study draws on an online survey and semi-structured interviews with project coordinators and co-researchers. It finds that participatory research activities in the humanities and social sciences are very diverse in their disciplinary traditions and organisational settings. Key features of CSS activities initiated inside as well as outside academic institutions are analysed to understand patterns of participation and cooperation. The results show that CSS activities are frequently realised in heterogeneous consortia of academic and non-academic partners. These consortia influence interactions between professional and non-professional researchers. To investigate these observations further, the article extends the analytical gaze from participation of individual volunteers to various forms of cooperation in consortia. This shift in attention brings to sight additional actors and activities that are usually not, or only marginally, considered in discussions about C(S)S. Staff of civil society organisations, municipalities, schools or cross-sectoral initiatives as well as university students are involved in making CSS work. In addition to research tasks, CSS rests on science communication, project management and intermediation activities. This extended perspective captures more diverse constellations of knowledge production in participatory research in the social sciences and humanities than the common focus on participation. In this way, the article aims to lay the groundwork for understanding the functioning of CSS beyond aspects described by the concept of invited and uninvited participation. It shows that CSS activities are not limited to capacitating lay people for participation in science. A more adequate description is that such projects are concerned with facilitating cooperation with co-researchers and other partners in consortia inside and outside of academia. On this basis, the article introduces the notion of cooperation capacity as a heuristic device to propose new prompts for research on CSS as well as for supporting CSS practice.

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Introduction

This article examines who contributes, and how, to doing participatory research in the social sciences and humanities. A diverse and evolving ecosystem of participation approaches that stem from old and new scientific and amateur roots populate this space (Albert et al., 2021; Heinisch et al., 2021). What is more, in the social sciences and humanities, the denomination of Citizen Science (CS) is only slowly and partially adopted. Alternative framings of the subjects, objects and contexts of participation continue to be in use and intermingle with new ones introduced by CS. Focussing on this understudied area the article presents an empirical study on Citizen Social Science (CSS) in Germany. It provides a more nuanced account of the actors, their activities and interrelations, including ones that are not accounted for, so far. Finally, it condenses these findings into a modified perspective for research and practice that moves the focuses from participation to cooperation.

Existing literature on CSS. The field of CSS is currently experiencing a dynamic growth. A glance at project platforms nationally and internationally reveals that the overall space of CS is dominated by the natural sciences. Activities in the humanities and social sciences are less common (Franzen and Hilbrich, 2015, p. 26; Pettibone et al., 2017). However, they are considered as part of the core of the CS field (Haklay et al., 2021; Kullenberg and Kasperowski, 2016). Recently, CSS activity appears to be on a rise that studies of platforms and bibliometrics are only beginning to capture: In the last few years, several projects have been funded to explore and consolidate CS in the social sciences and humanities.[1] Such efforts also make already existing approaches of participatory research, for instance in the social sciences and civil society (Scheller et al., 2020), more visible. At the same time, archives and museums are increasingly using digital technologies to invite volunteers to work on their collections thus extending digital humanities to citizen humanities (Kasperowski et al., 2020).

With a community of practitioners growing in such ways, the literature on CSS is also expanding. We find two main bodies of work: On the one hand, there is a growing international debate on the state of the art of CS, in which CSS is increasingly taking space. CSS is either seen as CS in the social sciences and humanities[2] and/or CS with a focus on outcomes beyond purely scientific knowledge generation (Albert et al., 2021). The latter might take the form of contributions to public policy-making (e.g. Kythreotis et al., 2019) or issues of concern held by civil society groups (e.g. Bonhoure et al., 2019). On the other hand, there are national and regional discourses that negotiate how CS, and with it CSS, (should) relate to the traditions and emerging practices in each specific context (cf. Vohland et al., 2021). In Germany, CSS has so far mostly been discussed as part of science policy agendas (Bonn et al., 2016; Socientize, 2014) and in position papers by professional and amateur research groups (Finke, 2016; Franzen and Hilbrich, 2015; Heiss and Matthes, 2017; Kollmann, 2014).

Indeed, in both the international and national debates much of the existing research is strongly programmatic in character. It discusses potential benefits of CSS for research, e.g. interdisciplinarity (Oswald and Smolarski, 2016), mobilising research data (Purdam, 2014) and new experimental methods (Sagarra et al. 2016), mediating between science and publics (Franzen and Hilbrich, 2015; Terras, 2015) and increasing impact (Kollmann, 2014; Oswald and Smolarski, 2016). Opportunities for the public are seen in knowledge and data for political decision-making in general (Mayer et al., 2018) and for sustainability transitions in particular (Fischer et al., 2021; Sauermann et al., 2020) along with new talent for amateur communities (Oswald and Smolarski, 2016). Main challenges of CSS are seen in working with diverse

interests and motivations, ethics, relations between professional and non-professional researchers, evaluation and fuzzy terminology (Albert et al., 2021). Empirical studies to complement the programmatic work on CSS are still rare. They review literature on roles of social science and humanities in CS projects (Tauginienė et al., 2020), share experiences from the author's practice-projects (Albert et al., 2021; Amirrudin et al., 2021; Lorenz, 2020) or provide descriptions of exemplary activities (Dobreva and Azzopardi, 2014; Heinisch et al., 2021). Recently, also a debate on methods (Thomas et al., 2021) and meta-research on the epistemological cultures of CSS (Kasperowski et al., 2020) are taking shape. We will add to this strand by examining what is actually being done in practice in a study on CSS actors and activities in Germany.

Analytical framework to study CSS beyond (un)invited participation. This paper addresses the question: What are key characteristics of CSS activities in Germany, who is involved and in what ways? Our approach draws on the widely used model of *invited and uninvited participation* by Brian Wynne (2007) as sensitising device for differences regarding who initiates projects in which institutional contexts. Wynne contrasts two types of public engagement with science and science-based technologies: On the one hand, participation as part of institutionalised procedures that are dominated by scientific expertise and linked to policy-making (*invited participation*); on the other hand participation in the form of civic mobilisation (*uninvited participation*).[3] Captured by the notion of invitation, the argument is that processes of engagement are not neutral procedures but always (also) embody (and thus enforce) normative orientations. The way they are set up influences, who can or cannot participate and on what terms. In this way, formalised participation processes also limit what gets to the agenda and what forms of expertise count as legitimate (cf. Collins and Evans, 2002). Wynne's description highlights power relations. Invited participation is associated with processes driven by and favourable to academia, the state and industry. In turn, uninvited participation is described as less formalised type of activity, organised by bottom-up collectives mainly in protest against the state's or industry's handling of public issues involving science and/or technology.

The distinction of (un)invited participation is also used in the study and practice of CS. The concept can be recognised in the strongly typified opposition between CS as institutional crowd-sourcing (Mirowski, 2018) vs. CS as resistance (Kullenberg, 2015). Dickel and Franzen (2015) draw on it to describe a new set of roles in scientific knowledge production extended by public participation. However, the practice of CS is more nuanced than these ideal types suggest. Indeed, the widely used CS typology by Shirk et al. (2012) recognises the types of 'collaborative' and 'co-created projects' between the two extremes of science-driven 'contributory projects' and community-driven 'collegial' research. In addition to such a broader variety of possible forms of cooperation between top-down and bottom-up arrangements, division of work and power dynamics can also change along the course of CS activities (Kasperowski and Hillman, 2018). Studies have also identified other contributors, e.g. civil society organisations, important for the success of CS initiatives beyond individual volunteers engaging in science with(out) invitation (Göbel et al., 2021).

Against this background, we apply an organisational perspective. Based on the vast literature on mutual entanglements of organisations and knowledge generation, management and learning (cf. Easterby-Smith and Lyles, 2011) we incorporate organisational features into our analysis of CSS. Our focus is

particularly on individual as well as collective actors as contributors and CSS consortia as important contexts for doing participatory research. In contrast to Franzoni et al. (2021), who provide a framework for analysing the organisation of CS activities in great detail, our study opts for a broad overview based on survey data that will be enriched with findings from interviews. We opt for a more open and descriptive approach that distinguishes CSS activities *originating inside* and *outside of academic research* (or 'academic' and 'non-academic' initiatives).[4] We note that this terminology—in aiming to go beyond the duality of (un)invited participation—launches a new differentiation that also carries power relations by departing from institutionalised research. This choice of perspective is motivated by our research interests in the fields of Science and Technology Studies and Higher Education Research. We approach CSS as a phenomenon of the opening of science to contributions from other actors than professional scientists. The study aims to investigate empirically how such an extended form of science works and who is involved. To avoid pre-defining what relations between actors we will find, we use generic characteristics, e.g. civil society organisations or research organisations. Albeit these limitations, we will offer an inquiry that enhances the understanding of CSS in research and practice.

Outline. Section "Methods to locate CSS" outlines our methods and working definition. Section "CSS approaches and co-researcher involvement" introduces the object of study. It highlights major CSS approaches in the German context and gives an overview of survey results on the participation of co-researchers. Section "Looking beyond participation" extends the analytical gaze beyond volunteer participation. It presents key characteristics of CSS consortia as well as the actors and activities involved. Relating findings back to the distinction of (un)invited participation, section "Analysing and supporting cooperation in C(S)S beyond invited and uninvited participation" sketches a research perspective that focusses on cooperation capacity as a heuristic tool for better understanding and supporting C(S)S.

Methods to locate CSS

This exploratory study on CSS in Germany started with a document analysis to identify main strands of participatory social science and humanities research. From this overview, we built our definition of CSS that informed the online survey and interviews, which we describe below.

Document analysis. This paper maps the current activities in the field of CSS in Germany. In a first step, we undertook a *document analysis* to develop an empirically viable concept of CSS. The parent term 'Citizen Science' is generally characterised by a lack of clarity and much overlap with other practices, such as Do-it-Yourself science or Open Science (cf. Haklay et al., 2021). In order to systematise CSS, publications on a set of key terms related to public engagement and participatory research in Germany were analysed regarding their conceptualisation of CSS according to four criteria.[5] Documents in scientific journals and books as well as other practice-oriented publications, news articles and websites of CS actors were considered. This analysis showed that CS in the humanities and social sciences is characterised by a diversity of participatory research approaches (see the section "Major CSS approaches in the German context and surveyed activities"). Taking this and the fluid boundaries of the larger field of CS into account, we adopted a broad definition to explore the phenomenon of CSS as openly and comprehensively as feasible.

Working definition. We define CSS as *scientific research in the humanities and social sciences, carried out in cooperation between professional and non-professional researchers*. The three central characteristic dimensions of this definition are specified as follows:

- *Scientific research:* Scientific research in this context means the method-guided generation of theoretical as well as application-oriented knowledge. We understand CS in the sense of participatory research as one of the 'many ways in which members of the public have engaged and continue to engage in the production of scientific knowledge' (Strasser et al., 2019, p. 66). This takes into account various practices of participatory knowledge generation, such as data collection and analysis or experimental production of physical prototypes.

- *Within the humanities and social sciences:* CSS refers to CS activities in the field of humanities and social sciences that focuses on phenomena of social coexistence, culture and intellectual life using a broad spectrum of quantitative and qualitative methods.[6] We take into account approaches that are both primarily disciplinary in nature, such as history, sociology, political science or linguistics, and those that bring humanities or social science perspectives to interdisciplinary work.

- *Cooperation between professional and non-professional researchers:* Non-professional researchers are people who participate in research activities voluntarily but do not work professionally in the respective scientific field (Finke, 2014). Laypersons can therefore also be professional scientists in another field. With the definition presented above, we include different types and depths of cooperation between voluntary researchers and academic scientists. In this text, we also use the term co-researcher to refer to non-professional researchers.

This definition does not claim to reflect the self-identification of actors in the field. We use CSS as an analytical term to make empirical realities accessible to social science research.[7]

Survey and interviews. We identified CSS activities in Germany through document and online research. Based on a thesaurus of terms gained through the document analysis, scholarly and grey literature, the national CS repository as well as federal and state funding schemes that include public participation were consulted. From this list, CSS activities were then selected by applying the working definition to descriptions of the activities found online. The resulting group of projects was invited to the *online survey* from April to May 2019 to gather information, such as the duration of their CSS initiative, aims, funding, constellation of actors, research topics, participants etc. In total, 96 CSS activities were contacted to participate. Twelve of them could not be reached and seven responded that they would not fit into the CSS profile. Out of this net sample size of 77 projects, 57 activities answered the questionnaire in whole or in part, which constitutes a response rate of 74%.

In addition, we conducted semi-structured interviews with representatives of ten selected CSS activities to deepen the understanding of aspects, such as reasons for participating or quality assurance. For each activity, we attempted to interview a coordinator and a non-professional researcher. This approach goes beyond previous studies that consult co-researchers usually on their motivation to participate. To broaden the perspective further, this study aimed at examining activities organised both inside and outside scientific institutions in a balanced way. The latter are rarely considered as leading actors for CS (Göbel et al., 2021).

Moreover, thematic and methodological balance were taken into account for the case selection. In this context, insights from one of the authors' participant observation in C(S)S networking initiatives at national level was used to complement survey results for the identification of civil society-led projects. Between September and November 2019, 19 persons were interviewed in the 10 case studies (5 coordinated by academic institutions, 5 by non-academic groups or organisations), including 11 project coordinators and 8 non-professional researchers. Intermediate results were discussed with interviewees as well as other C(S)S experts in a reflection workshop in January 2020.[8]

CSS approaches and co-researcher involvement
This section presents findings from the document analyses, online survey and interviews. It first outlines major CSS approaches identified in the German context and introduces the initiatives in our survey. Then, the focus is on co-researchers involved before summing up what we learn on initiatives inside as well as outside academia.

Major CSS approaches in the German context and surveyed activities. In the document analysis, we have identified three groups of activities related to CSS in the German context:

- *Pioneering Citizen Social Sciences and Citizen Humanities:* In this group we find activities explicitly referring to themselves as 'CSS', such as crowdsourced data annotation (Oswald, 2014; Proctor and Cherry, 2013), collection of observational data on everyday activities (Purdam, 2014) or co-creative activities based on participation in different phases of the research process (Mayer et al., 2018). In the field of 'Citizen Humanities' (Oswald, 2014), galleries, libraries, archives and museums are prominent organisers of participatory activities alongside universities (Dobreva, 2016). Many of these new approaches emerge on the international level and are only beginning to be picked up and adapted in the Germany.[9]
- *Longstanding traditions of research participation:* Participatory and amateur research in the humanities and social sciences form a diverse ecosystem in Germany. Some voluntary research traditions in the humanities date back over a century (Oswald and Smolarski, 2016): Amateur archaeology and monument preservation, historical re-enactment and public history (see Heinisch et al., 2021 for a European view). In social science research, 'Participatory Action Research' (PAR) can be identified as a key concept (Unger et al., 2007).The term CS itself is used ambivalently in this context: While some groups make use of C(S)S infrastructures for their activities and also shape how CSS is understood (for instance Scheller et al., 2020), others explicitly distance themselves (e.g. Finke, 2014).
- *Transdisciplinary sustainability research:* This more recent problem-centred research field dealing particularly with sustainability is characterised by the mobilisation of knowledge from various disciplines, among them the social sciences and humanities. In addition, it relies on the inclusion of stakeholders from outside academia (Jahn et al., 2012), which makes C(S)S one of its instruments (Pettibone et al., 2018).

This heterogeneity of participatory research approaches springs from differences in the understandings of science, participation, practical relevance, etc. It reflects the epistemological, methodological and theoretical plurality of the humanities and social sciences.

Looking at CSS in practice, one finds a buzzing range of activities that do not confine themselves to these analytical categories from the literature. Some projects use one of these terms to *self-identify*, others use several and others none. From the 57 activities we surveyed, an important *goal* for almost half was to mobilise participation of citizens in the implementation of projects. Almost half also stated that the pursuit of science or the acquisition of knowledge was a primary goal of the project. The generation of innovations or practical benefits was essential for 43% of those surveyed. We found the greatest differences between projects developed in the academic and non-academic sectors in the objectives of 'doing science and gaining knowledge'. It was considerably more relevant for projects that were primarily developed in the academic field than for projects that were initiated outside of academia (57 vs. 38%). The main *topics* dealt with by the CSS activities were located in the two clusters of 'politics and society' and 'history and culture'. The first thematic area comprises those projects that mainly deal with the areas of public services and infrastructure, mobility, democracy, demography, health, integration, sustainability and digitisation. The 'history and culture' area includes those CSS activities, which—according to their own statements—mainly deal with the topics of urban history, local history, genealogy and archaeology. Almost two-thirds of the projects examined in our study were assigned to the 'politics and society' group and one third to the 'history and culture' group. In addition to the above-mentioned areas, education (knowledge acquisition and science education) played an important role in all activities.

Co-researchers: who participates and how. The number of non-professional researchers involved in the CSS activities showed a large range—between 2 and 3061. On average, 35 co-researchers were involved in the CSS activities. Thus, CSS is neither predominantly oriented towards small groups of non-professional researchers, nor is mass recruitment via the internet in terms of crowdsourcing the typical case. The findings on the composition of participants in CSS activities (Fig. 1) show that the majority of the co-researchers involved (63%) belonged to the group of employed persons. Retirees accounted for 41%, while the proportion of pupils and students was one-third. Unemployed persons were hardly involved. Most of the co-researchers involved were over 50 years old; those under 19 years of age were involved in 16% of the projects. Thus, the results of the present study point into a direction of what previous of research found for CS in general—that people from the educated, employed middle class are more likely to participate. However, to gain a better view on this, the socio-demographic and -economic contexts need to be
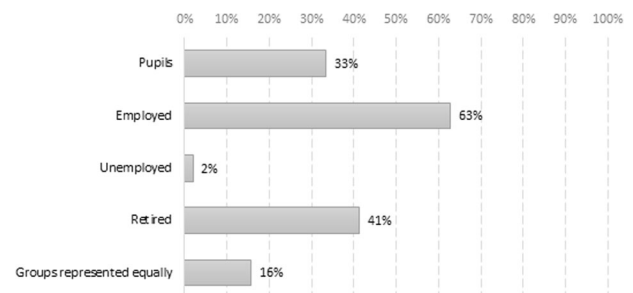

Fig. 1 Who participates in Citizen Social Science activities. Composition of participants by employment status. Multiple answers possible, $N = 51$. Source: SoCiS-Online-Survey 2019. This figure is covered by the Creative Commons Attribution 4.0 International License. Reproduced with permission of the SoCiS project.

researched more extensively than in our study (see Moczek et al., 2021 on this point).[10]

Personal interests often determine participation in CSS. The most important motivations for co-researchers were the interest in the topic, congruence of study topic and personal values (e.g. in the case of sustainability research), fun in learning as well as the possibility to influence and participate in local or societal developments. The experience of community and the handling of heterogeneity in the group also represented an important benefit for the participating co-researchers. Frequently, CSS projects resulted in new personal contacts. Only in few cases an explicit interest in scientific work was a motivation to participate in the CSS activities. The main obstacle to participation by non-professional researchers was the time resources available. However, most projects did not respond to the time constraints, e.g. by offering various participation intensities. The potential of additional financial incentives, such as expense allowances or tax benefits, or qualification incentives, e.g. certificates, remained largely unused.

How are co-researchers involved? We used the survey to gain an overview of their contributions to the research process. Given a selection of various steps of an ideal typical research process[11], respondents stated that participants were most frequently involved in the process of data acquisition or data collection with 63%. This result is in line with current research findings on CS in the natural sciences in the context of digitisation (Mahr and Dickel, 2019; Newman et al., 2012). Franzen (2019) stated that CS projects 'concentrate on supporting measures for data collection and analysis, which in turn are orchestrated by professional scientists'. However, we noted that, on average, respondents named two to three steps of the research process in which citizens were involved, which shows a more diversified engagement than through pure crowdsourcing.

The analysis of citizens' participation in the 'formulation of research questions', 'data analysis' and project 'governance' showed hardly any differences between activities initiated inside or outside of academic institutions (Fig. 2). In contrast, there were clear differences with regard to participation in the research process for the stages of 'research design', 'data acquisition' and 'publication'. In projects originating in the academic sector, co-researcher were more involved in the process steps 'create research design' (41% vs. 14% in non-academic activities),

Fig. 2 Cooperation with co-researchers. Type of scientific participation of co-researchers by main initiator and elements in the research process. Multiple answers possible, non-academic field N = 22, academic field N = 27. Source: SoCiS-Online-Survey 2019. This figure is covered by the Creative Commons Attribution 4.0 International License. Reproduced with permission of the SoCiS project.

'collecting data' (67% vs. 57% in non-academic activities) and 'generating new data' (67% vs. 48% in non-academic activities). This underlines how academic projects use participation to extend processes of scientific knowledge generation by enriching ways in which empirical studies are conceptionalised and carried out. For projects from outside academia, a broader participation of co-researchers was evident in the steps of 'formulating results' and 'publishing' them (62% and 52%, respectively, compared to 44% and 30% for projects from the academic sector). On the one hand, this relatively high number is surprising because the contribution of non-professional researchers in formulating results usually raises questions of scientific quality, so that one would expect it to be less common. On the other hand, it may point to differences in publishing cultures. Scientific publications are highly regulated and value specialist knowledge and languages, which can create barriers for co-researchers to participate or for publications to pass peer-review. Non-academic publishing, in contrast, is less regulated in terms of publication formats, contents and review procedures, while acknowledging participation might be an important quality criterion.

Terms for referring to those who participate in CS activities are highly debated (Eitzel et al., 2017). In the interview study we found two new ones typical for CSS: 'Co-researchers', which was frequently used in qualitative social science and PAR methodologies thus also common beyond Germany, and 'honorary researcher' (German: 'Ehrenamtliche'), a concept close to volunteering and community service in the German tradition. However, both terms were also criticised by other groups (Fig. 4). The majority of our interviewees did not frequently use the term 'Citizen Scientist'. Reasons they gave included already existing terms that came more naturally (like the two above), perceived unsuitability, e.g. due to lack of clarity or English language, or assumed discouraging effects due to the explicit reference to 'science'.

Participation inside and outside academia. With the distinction of invited and uninvited participation in mind, one might ask (in a pointed and oversimplified way): Is academic CSS narrowly oriented on crowdsourcing in an extractivist fashion, while activities originating outside on democratising research? Regarding involvement in research processes our results do not confirm such a conclusion. We found a wide variety of participatory activity—centring on data work but also deep participation along the whole research process—both in activities started inside and outside academic science. The model of (un)invited participation does also capture only part of what we have observed in the document analysis. What we call pioneering forms of CSS and Citizen Humanities very often originate inside scientific institutions. The latter are also better equipped to participate in the international debates on the development and methodologies of CSS through the resources available to them and their links to international scientific networks. Longstanding traditions of participation can be found both inside of academia and outside—as well as on the boundaries, like shown by transdisciplinary sustainability research. The heterogeneity of approaches to participation goes hand in hand with different epistemological and normative positions. They manifest, for instance, in debates about whether or not to adopt the term 'CS' or 'citizen scientist'. Here we find that it is rejected both from initiatives originating inside and outside academia, while it is supported mostly from academic ones. However, more research is needed to examine the ambivalences of (not) using the terms. To trace some of these findings the next section examines cooperation in CSS activities more broadly.
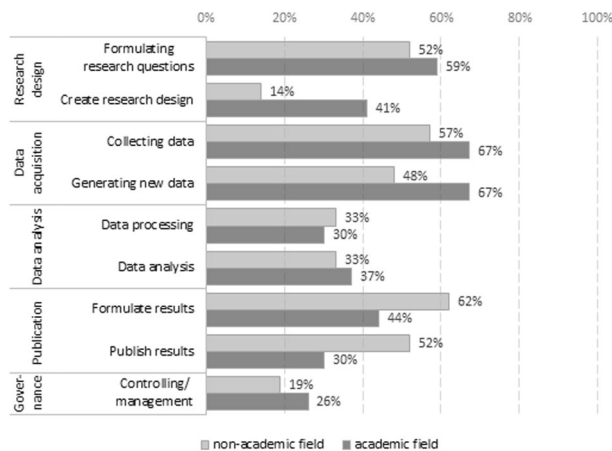
Looking beyond participation

CSS is more than the participation of non-professionals in research activities. Most projects are realised in consortia of heterogeneous partners initiated both within and outside academic institutions. This section analyses how these consortia look like and points out contributors and activities extending our view of CSS.

Key characteristics of CSS consortia. In order to understand the nature of CSS activities in Germany better, a first important characteristic is their *financial sources*. In the survey, we found that the implementation of CSS activities strongly rests on *public funding*. Three-quarters of the activities received funding by the state. Funding from the federal government and federal ministries played the central role, which two-thirds of the projects received. In contrast, only 20% of projects received funding from states or state ministries. Activities initiated by the academic sector also received money from the European Union in 10% of cases. This funding source did not appear at all with the non-academic projects. Non-academic projects, in turn, received funding from the city or local government more often than academic ones. Moreover, our results show that the surveyed CSS activities only seldom rely on private funding from businesses, donors or crowdfunding. In addition, in the interviews with 10 selected CSS activities we found that the majority resorted to *project-based financing*. Only two out of ten—one academic and non-academic activity—received long-term funding. However, funding did generally not cover all necessary work. In early phases, activities could usually not yet rely on infrastructures, such as communication channels, administrative support or meeting spaces. Similar gaps existed for periods between two projects and the work on funding applications. Such structural conditions as well as characteristics of working with volunteers in their leisure time (e.g. meetings on weekends, caring beyond tasks) were 'patched' by extra work, typically *unpaid*, by professional scientists, staff of CSOs and local government. Finally, the *voluntary work* by non-professional researchers, without doubt essential for CSS activities, was only seldom compensated financially. These observations indicate how CSS is blurring, if not shifting, boundaries between paid and unpaid as well as voluntary and non-voluntary work for research and deserve further study.

A second important aspect is the *duration* of CSS activities in Germany. The examined activities were often limited in time. Almost two thirds of the projects analysed had a duration of up to 5 years. Activities initiated primarily by non-academic partners often had terms of more than 5 years or were unlimited in time (46%), while activities from the academic sector were dominated by terms of between 2 and 5 years (48%). Respondents considered durations of less than 4 years to be counterproductive with regard to the sustainability of research, cooperation, networks, websites, etc. Firstly, lead times for the establishment of structures were not taken into account here and secondly, the question of securing the structures after the end of projects remained open.

CSS activities are typically organised in *consortia* and thus a joint effort of different groups of actors. On average, 4 different organisations were involved in the implementation. The participating institutions usually included both academic and non-academic partners (Fig. 3). The academic partners comprised universities (through scientific institutes and infrastructure facilities such as computer centre, botanical garden, coordination office for science and the public), non-university research institutions (large companies as well as small institutes) and research clusters. The non-academic institutions most frequently encountered were CSOs and local authorities. CSOs included a broad spectrum of initiatives with small associations (e.g. local
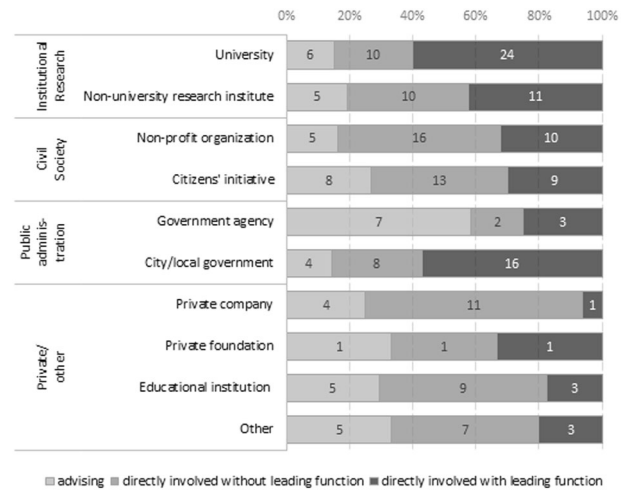

Fig. 3 Who organises Citizen Social Science activities. Number of participating institutions by function in the project. *N* = 57. Source: SoCiS-Online-Survey 2019. This figure is covered by the Creative Commons Attribution 4.0 International License. Reproduced with permission of the SoCiS project.

history associations), large organisations (e.g. welfare associations or nature conservation organisations), smaller social enterprises, intermediary organisations (for instance for urban development) and networks of CSOs. Other non-scientific institutions were educational institutions (apart from higher education, such as schools or adult education centres) as well as private companies, other state authorities, foundations and other institutions. In the following we will concentrate our observations on the 3 most strongly represented groups of actors: Higher education institutions were involved in around 70% of the projects surveyed, civil society organisation as well as city and local government in just over half, non-university research institutions in slightly less than half of CSS activities.

Regarding the roles of each partner in these instances of cooperation, we have surveyed both project initiation and various forms of involvement. First, it is notable that despite joint involvement of several actors in the CSS-activity the joint initiation of projects by partners from within and outside of academia remained seldom: 70% of projects have one sole initiator. In 40% of the projects, universities were the initiating institution; in the case of civil society and local authorities, the corresponding figure was around 20%. Second, we observed that CSS activities originated at about equal terms from within the academy (54% of initiated activities) and from outside (46% of initiated activities). When it comes to the form of involvement, universities, city, and local governments took over the majority of leading functions. CSOs led projects in one-third of the cases in which they participated. The comparatively frequent assumption of leadership functions by civil society points to CSS traditionally organised in associations (e.g. local history workshops). Indirect involvement in advisory roles was more typical for educational organisations, public administration institutions above local level and private organisations.

In sum, the findings point to universities as one central pillar in the implementation of CSS. At the same time, CSOs play a vital role. This contrasts with CS activities in many natural sciences or crowdsourcing formats, where volunteers are often directly involved through science communication activities or via digital media. In the humanities and social sciences, CSOs often mediate connections to co-researchers. Personal invitations based on previous membership in these organisations or past joint
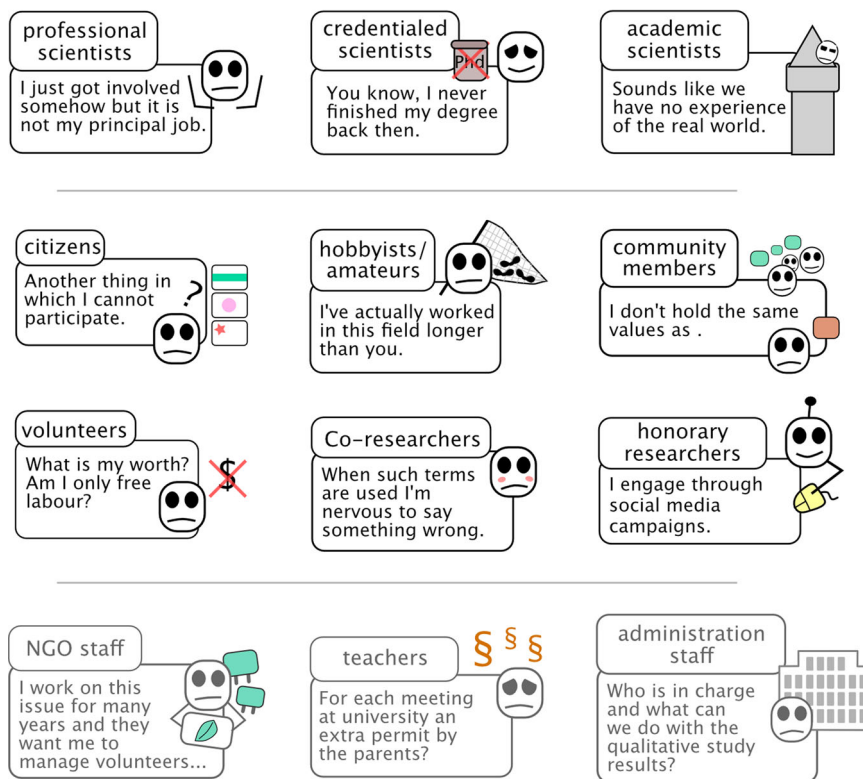
Fig. 4 Extended list of illustrated examples for calling people involved in Citizen (Social) Science projects. The figure is based on a first version by Eitzel et al. (2017) (https://t1p.de/hqss) focussing on examples of negative interpretations of commonly used names to describe people participating in CS; based on our interviews the list was extended by, first, names for participants commonly used in CSS in Germany and their critiques (as substitutes for terms, which are not typical in this context); second, participants that we have identified as invisible actors in C(S)S projects were included. This figure is covered by the Creative Commons Attribution 4.0 International License. Reproduced with permission of Tim Kiessling. For further use please use as attribution: Tim Kiessling, extension by Claudia Göbel and Susann Hippler for SoCiS project.

activities were generally important. However, one needs to read these findings with caution. The institutional systems that CSS projects are embedded in rarely allow for openness about and documentation of the real-life co-production, co-creation and co-initiation of projects. One example of this is when funding procedures are designed in ways that only permit academic institutions as project leaders. The roles of local authorities in CSS projects require further research.

Cooperation: extending the view on contributors and activities. CSS projects comprising individuals and organisations from academic and non-academic fields are important contexts for how CSS works. To capture this and take a step back from the strongly normative notion of 'participation' for a moment, we use the term 'cooperation'. In a very broad sense it refers to 'doing something together' or 'working together toward a shared aim', i.e. joint or coordinated action of all sorts by both individuals and organisations. Through this broader perspective we can reach beyond 'scientists' and 'citizens' generating scientific knowledge and identify additional (1) contributors and (2) activities essential to the functioning of CSS.

(1) *Additional contributors*: What is usually understood by the term 'citizen scientists', lay people devoting their free time to research, seems to be only one special case of non-professional researchers. In addition, the interviews helped

to identify actors that are not usually considered in the C(S)S literature ('invisible partners') and actors that are not considered official partners in the project but are important for the success of the activity ('silent partners') (Fig. 4):

- *Staff of CSOs* were often involved in the development of the research design (definition of topic, methods, etc.), sometimes leading the research. They also acted as partners in practice contexts, recruiting and supervising co-researchers and doing science education. Projects also consulted CSO staff as topic experts or for membership in advisory boards.
- *Municipalities and their staff* were involved in the CSS activities studied either in general as representatives of the localities that were to be shaped by regional development projects or in relation to a specific topic to be dealt with in the local context, e.g. migration or health.
- *University students* were involved in two roles: as researchers-in-training assisting in the coordination and research parts of CSS activities, e.g. within the framework of a practice-oriented teaching project. Or they were involved as co-researchers, e.g. in a student-led CSS project that was part of a senior citizens' university.
- *Other institutions and their staff*, such as teachers and schools, state agencies or cross-sectoral initiatives were also involved, but more rarely. Their tasks included, for example, the recruitment of non-professional researchers

(e.g. schools), the fulfilment of legal requirements for object collection or data collection, the storage of finds and participation in the development of topics.

It is important to note that these actors were not only involved in auxiliary or 'non-scientific' tasks, but they were (also) active in research activities. Considering these additional co-researchers is important for a better understanding of CSS.

(2) *Additional activities*: Beyond producing scientific knowledge, we identified 3 overarching activities evident in the majority of the CSS activities we studied that have not received much attention as part of CSS yet:

- The first key activity was *public communication of science*. Formats were very diverse, including brochures and media articles, exhibitions on project results, public lectures, science-based recipe books and plans for outdoor archaeological parks to only name a few. According to both the professional and non-professional researchers interviewed, initiatives of non-academic partners in communicating scientific results to non-scientific publics were beneficial for the CSS activities. Many non-professional researchers became active communicators and CSOs engaged as mediators or as participants in the conception of mediation formats. For non-professional researchers, participation in science communication was useful because it enabled them to generate directly visible impacts. They described this, in turn, as having positive effects on self-empowerment.
- With regard to *project management*, the initiators of CSS projects usually acted as project managers later on. The role of the coordinator was located at different hierarchical levels: For instance, in CSOs, executives, employees or volunteers took over project leadership and in academic science professors, postdocs and managers of non-university research institutions as well as administrative staff could all be in charge.
- *Intermediation activities*, e.g. through networking formats and the facilitation of online or face-to-face interactions, were an essential feature of CSS as they established connections among everybody necessary to do the work, most prominently to non-professional researchers or public institutions. Teachers, mayors or supervisors, for instance, made such links. Depending on the structure of the project, these intermediaries had a more or less central role. At times, they functioned as leading actors, who held all the threads together. At other times, intermediaries were only involved for the purpose of managing contacts with one special group, e.g. co-researchers.

These activities were often (also) key parts of the tasks of the professional scientists involved. Again, it is noteworthy that these activities do not represent 'merely' auxiliary tasks for the research (of course also those have their place), but that the success of the research depends on them.

Cooperation in CSS consortia beyond (un)invited participation. Considering the organisational contexts of CSS activities has extended the focus on involvement of non-professional researchers to a broader view on cooperation and thus brought to light additional actors and activities in CSS activities. Attention to these diverse forms of cooperation makes it possible to analyse how they relate to each other. For instance, cooperation of one sort can be used to address a challenge in another. In our interviews, we found various strategies of this type: CSOs were included as partners in consortia to recruit co-researchers among their members. Public administrations got engaged to make the research relevant for

political decisions. However, such interrelations can also create new challenges. Conflicts with CSOs arose when they were included as mere shortcut to recruit people, but their topical expertise was left aside. Professional scientists frequently reported being overwhelmed by the high share of organisational tasks involved in managing consortia and maintaining contact with co-researchers. This enlarged view thus gives deeper insights into reasons that influence successes and failures of CSS activities.

The distinction between activities initiated inside and outside academic institutions has helped to gain a better view on characteristics of CSS consortia and cooperation within them. Activities originate at about equal terms from within the academy and from outside. The large majority of them operates project-based relying mostly on public funding. With the exception of university students, we could identify most types of additional contributors outside of the academy. Activities undertaken by these consortia in addition to pure research tasks are carried out by both academic and non-academic actors. A perspective open for CSS activities inside and outside academia has, thus, proven fruitful to explore the emerging field of CSS with its heterogeneous and overlapping traditions, in which categories are fluid and relations—for instance between CSS and PAR—currently under negotiation. However, it did not directly correspond to the distinction of (un)invited participation.

The strongly typified opposition of top-down and bottom-up activities informing Wynne's concept does not fit well to explain the characteristics of the CSS activities analysed. Instead, there are many phenomena that are located somewhere between these poles, e.g. grassroots groups cooperating with institutions to supply crowdsourced data on their issue of concern, reformers within state institutions seeking to do things differently by opening up, scientists assuming transdisciplinary responsibilities or intermediaries pulling strings (not only) together. We argue that such phenomena indicate that something more than invited and uninvited participation is going on, which requires attention to understand C(S)S and its underlying dynamics. Figure 4, which we extended for the field of CSS, illustrates some of the nuances between the two poles. In order to explore such constellations as well as their power dynamics, more research is needed. The focus on cooperation beyond participation of co-researchers along with attention for CSS activities originating inside and outside academic science are two interlinked suggestions for moving forward. They represent initial steps offering merely heuristic value and need to be more theoretically informed, methodologically refined and empirically enriched for substantiation.

Analysing and supporting cooperation in C(S)S beyond invited and uninvited participation
CSS research in Germany is characterised by a high diversity of organisational settings and traditions that cover a spectrum between mostly local and national initiatives and internationally oriented ones. Current ways of describing activities in terms of varying degrees of invited or uninvited participation do not capture the whole picture of how CSS initiatives function. First, invited participation by scientific institutions is not the general reference model of CSS. Uninvited participation originating in civil society does play an equally important role. Second, participatory research activities are often embedded in heterogeneous consortia comprising partners from various societal sectors. While this study did not yield a concept that can describe CSS more accurately than (un)invited participation, we make a modest proposal for an analytical perspective to explore further in that direction. A perspective focussed on cooperation and open for CSS activities inside and outside academia has brought to sight additional actors and activities that are usually not, or only marginally, considered in discussions about C(S)S. To capture these prompts for further research and

discussion, we propose the concept of 'cooperation capacity'. It emphasizes the ability of individual and collective actors to establish connectivity and relations—inside the heterogeneous consortia as well as between them and other actors outside—to generate scientific knowledge through participatory research. The notion of cooperation capacity relaxes the focus of attention on the rather narrow question of how CSS initiatives get and capacitate people to contribute meaningfully to research ('participation capacity')—a common challenge diagnosed for CS as well as for public engagement in general (Wynne, 2007). Instead, we are prompted to ask more broadly, how CSS initiatives manage relations of heterogeneous actors in their respective organisational contexts. We argue that this shift allows for an extended view of the diverse forms of cooperation making up this emerging and heterogeneous field.

The value of such a perspective is to indicate new questions for research on CSS as well as potentials for linking back to the programmatic literature and CSS practice. In terms of further research, there is a need for ethnographic work to complement the self-reporting and discursive data on which our analysis is based. Such research can help to illuminate many of the ambivalences and ongoing negotiations that we have detected. This is essential to learn more about the power dynamics in CSS—a major topic to address. In addition to Wynne's considerations, other critical perspectives could then be brought to bear on the concept of cooperation capacity, for instance work on tokenism and manipulation in participatory activities from a PAR tradition (e.g. Hart, 2008; Arnstein, 1969). Moreover, the diversity of CSS initiatives can be explored further. Through our focus on cooperation we can contribute to understanding this diversity better in terms of the heterogeneous consortia, in which participatory research process are embedded. It is up for concretisation how such consortia are associated with existing and newly emerging approaches to do CSS, e.g. the use of online platforms for Citizen Humanities projects (cf. Heinisch et al., 2021). Another matter of further research is to examine how specific the structural feature of heterogeneous consortia is for CSS. Are CSS consortia comparable to the constellations in other fields that also involve multiple stakeholders (Tiago, 2017) or open participation (Franzoni and Sauermann, 2014)? How do experience and handling of boundaries between volunteers and project organisers (Oswald, 2020) differ in comparison to other fields of knowledge? Finally, what can be transferred to the study of CS in general?

A perspective focussed on cooperation open for initiatives inside and outside academic can also be informative for making links to the programmatic literature and may contribute insights in practice contexts. For research organisations, funders or CS platforms it can point to an extended set of relevant actors and project configurations. Those who organise C(S)S activities can use it to reflect on learnings and exchange.[12] The discourse on potentials and challenges of CSS is one area where this could be particularly interesting. A focus on cooperation capacity can help to enlarge the picture and make visible vital challenges, such as adapting funding requirements for CSOs and municipalities, as well as significant potentials, such as new perspectives for science communication by CSOs and co-researchers.[13]

Data availability
The datasets generated during the current study are not publicly available due to data protection agreements (interviews) and the ongoing embargo period (survey data) but are available from the corresponding author on reasonable request.

Notes
1. Examples of projects funded with the aim to explore and consolidate CS in the social sciences and humanities are for example the EU projects CoAct and YouCount.
2. At the European level, Citizen Humanities are sometimes treated separately from CSS (e.g. Heinisch et al., 2021).
3. Wynne's perspective is rooted in a body of work on relations between expert and lay knowledges in research and policy-making on socio-technical controversies, e.g. on environmental health related to nuclear energy (Topçu, 2013) or genetically modified crops (Bonneuil et al., 2008). Social movements and state-led technology assessment or risk governance exercises are prominent forms of 'public engagement' in these contexts. Wynne argues that with the increasing adoption of participation processes by public institutions linked to regulatory purposes, independent activities taking place outside official procedures are increasingly denied recognition.
4. Another reason for using the existing model in an open way permitting explorative research is that, like most analytical typologies for CS, has been developed based on public engagement activities in the natural sciences, while our study aims to explore a different knowledge domain.
5. The exploratory research started from central concepts identified from prominent approaches in the field of public participation in science and technology in Germany: Citizen Science, Open Science, Participatory Research, Third Mission, Transformative Research and Transdisciplinary Research. Literature on these concepts was analysed regarding four main aspects: Comparison of CS definitions, proposition of a definition of CSS in particular, explication of how C(S)S differs from related concepts and systematisation of topic areas and activities pertaining to CSS.
6. As orientation we use the scheme of scientific fields 2016–2019 (DFG, 2017) by the German Research Foundation.
7. We note that using the term CSS without considering the self-identification of actors in the field risks to reproduce the category mistake Wynne devoted his 2007 article to. We opt, however, for this approach to contribute reflections on difference to the ongoing research-practice discussions and to this end also use the terminology.
8. The reflection workshop comprised project coordinators and participants from CSS activities initiated inside and outside academia, who had previously been interviewed, along with other researchers working on C(S)S in Germany. The event served as occasion for gaining feedback on intermediate results from the analysis of survey and interview data, discussing options for recommendation to CSS practice as well as capacity building and networking. While most insights from the workshop fed into the second aim, particularly discussions on funding and terminology have added more nuance and context information to the interview and survey results thus allowing us to refine the analysis presented in this paper.
9. The increasing establishment of the explicit classification of participatory research projects in the social sciences and humanities as 'Citizen Social Sciences' or 'Citizen Humanities' in Germany can be traced by consulting the programmes and proceedings of the national CS network 'Bürger schaffen Wissen'.
10. They also discuss the lack of availability of data on participants' minority/majority backgrounds, which would be interesting to investigate participants' diversity, questions of equity and power dynamics in more detail.
11. The steps are based on the quality criteria for CS projects developed by the working group for quality criteria of the CS Network Austria.
12. In such a spirit, we have used the cooperation perspective to derive questions related to success factors and barriers to guide discussion rounds with several CSS projects at recent CS conferences. Topics of such conversations were 'How to create more diverse and inclusive spaces for starting CS initiatives?' at ECSA2020 and 'How do CSS projects contribute to SDGs?' at the Knowledge for Change conference 2020.
13. For general consideration regarding relations between science communication and CS see Lewenstein (2016), for empirical studies see Richter et al. (2019).

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Author contributions

All authors have contributed substantially to the paper by sharpening and adapting the argument, writing and shortening. In particular, CG outlined the analytical concepts and main line of argument, wrote the sections "Introduction", "Major CSS approaches in the German context and surveyed activities", "Participation inside and outside academia ", "Cooperation: extending the view on contributors and activities", "Cooperation in CSS consortia beyond (un)invited participation" and "Analysing and supporting cooperation in C(S)S beyond invited and uninvited participation", wrote the reviewed versions, edited and acted as corresponding author. SM contributed descriptions and figures of survey data, wrote chapter parts of "Major CSS approaches in the German context and surveyed activities", "Co-researchers: who participates and how", and "Key characteristics of CSS consortia". JH wrote the section "Methods to locate CSS". SM and JH provided suggestions for shortening of the reviewed version. MM and CG carried out acquisition and analysis of data and contributed to the conceptualisation of the interviews and reflection workshop. JH conceptualised and oversaw the study and contributed to acquisition and analysis of data.

Competing interests

The authors declare no competing interests.

Ethical approval

All research was performed in accordance with relevant guidelines at the Institute for Higher Education Research at University Halle-Wittenberg (HoF) including, but not limited to, informed consent and data protection. The research was carried out in accordance with the Declaration of Helsinki as far as applicable to our type of social science study. The research was performed in accordance with German research regulations, which do not forsee the approval by a committee for this type of study.

Informed consent

Informed consent was obtained from all participants.

Additional information

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