Chapter 19
Interdisciplinarity, Team Science, and the Next Generation of Researchers: The *Children's Drawings of Gods* Project Experience

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Abstract Based on an analysis of the research project *Drawings of Gods: A multicultural and interdisciplinary approach to children's representations of supernatural agents* also known as (*Children's Drawings of Gods*), this work aims to study the epistemological and methodological issues that arise when several disciplinary approaches are convened for the processing, analysis, and interpretation of a corpus of digitized children's drawings. This work shows how the interdisciplinary process is set up, with its points of convergence, its potentialities, but also its difficulties with regard to the various epistemic and cultural horizons involved. The success of such an interdisciplinary, intercultural, and international project relies on mutual consideration and respect for the diversity of objects, disciplines, and approaches in a spirit of team collaboration. This negotiated sharing of values, practices, and epistemological horizons calls for capacities for openness and creative dialogue between researchers. Further, it requires the researchers to go beyond their disciplinary centres to engage in hybrid configurations or even transgressive knowledge.

Keywords Children's drawings · Gods · Complexity · Interdisciplinarity · Digital humanities · Team science

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The materializations of the figure of God(s),[1] whether scriptural, iconographic, or through another medium of communication, vary according to religious systems, societies, cultures, and individuals. This variation, set against a background of symbolic invariants, is also reflected in the mental, social, and cultural representations that embody, orient, and valorize or divert the concept of God, with more or less originality. The material or psychosocial re-presentation practices concerning the concept of God are not exclusive to adults. Children are able to express the representations of God and its characteristics that they have constructed (and are constructing throughout their development). The representations bear the influence not only of the children's educational and cultural backgrounds, but also of their creativity, imagination and curiosity. As we see it, drawing functions as a means of graphic expression adapted to the communication capacity of the individual child. If children's drawings of gods and the cognitive strategies they implement in this act of creating the representation are taken as a subject of study (Dandarova, 2013; Brandt, 2016), what is immediately striking is the complexity of such a process. The reasons for this complexity lie both in the diversity and in the graphic density of the children's productions (shapes, colors, compositions, textures, etc.). There are, of course, also graphic invariants related to prototypical representations of the figure of God—as well as the relative specificity of individual and collective representations according to the cultural contexts included in an international and intercultural dynamic. The intercultural dimension operates here as a factor of diversification that makes it possible to identify and trace more or less specific representations of Gods. It allows us to consider them in a comparative perspective showing not only the similarities but also the stylistic differences that innervate the figures of Gods learned of, reflected upon, visualized and retranslated graphically by children of various religious, educational, and cultural backgrounds.

The complexity of graphic, religious, and intercultural representations makes it impossible for researchers to reduce their approach to a single disciplinary perspective. Neither visual semiotics, nor psychology of religion, nor cultural anthropology alone can cover all the variables to be considered. This programmed impossibility of a monodisciplinary approach thus calls for the implementation of an epistemologically, theoretically, and methodologically based interdisciplinary approach. This chapter aims to situate the issue of children's drawings of gods in a resolutely interdisciplinary perspective. To do this, I will build upon the advances and developments of the collective interdisciplinary research project *Dessins de dieux* (DDD), also called *Children's Drawings of Gods*.[2] This project serves both as a space in which the issues and practices of interdisciplinary research are brought into play

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[1] Why the term *god* begins sometimes with an uppercase letter G, sometimes with a lowercase letter g, and why it appears sometimes in the singular and sometimes in the plural, is explained in the introductive chapter of this book (Chap. 1, this volume).

[2] The international project, *Drawings of Gods: A Multicultural and Interdisciplinary Approach to Children's Representations of Supernatural Agents*, is also known in French as *Dessins de dieux* (DDD), and referred to in this volume simply as *Children's Drawings of Gods*. This interdisciplinary project was funded by the Swiss National Science Foundation (SNSF)/(2015–2018). Request

and as an example of what interdisciplinarity can actually produce in the framework of a project that is set in the context of Digital Humanities. Digital humanities are considered here as a field of research and engineering at the interface between computer science and the humanities and social sciences. The first section presents the ins and outs of the project, showing how the need for interdisciplinarity and the conditions for its emergence arise. The second section proposes a clear definition of the concepts of multi-, inter- and transdisciplinarity which makes it possible to position the *Children's Drawings of Gods* project on the gradient between monodisciplinarity and the transgression of disciplinary boundaries. Finally, I will show in the last section how interdisciplinary work is set up in a team science dynamic, outline the profiles of the researchers involved in such a process, and note which profiles are desirable for an effective realization of interdisciplinarity, both scientifically and academically.[3]

Complexity, Interculturality, and Digital Humanities in the *Children's Drawings of Gods* Project

In the context of the *Children's Drawings of Gods* project, interdisciplinarity is called to work within and between the disciplines of human and social sciences; this interdisciplinarity internal to human and social sciences is enhanced by an extended transdisciplinarity in and through interaction with computational sciences and statistics. The project embraces the challenge of intercultural complexity. To do so, it involves researchers from the humanities and social sciences (psychology, religious studies, anthropology, sociology of science, epistemology, etc.), and from the engineering sciences (computational sciences: image processing and computer vision). The fundamental challenge is to bring these multiple disciplinary perspectives together to treat, analyse, and interpret children's drawings of Gods. Certainly, rooted first in the field of humanities and social sciences, from which most of the members of the team come, the development of the project requires a close collaboration with specialists in image processing and computational sciences. This collaboration—between the digitization of qualitative images produced by children and the humanization of computer tools adapted to the corpus, all set to the background of more or less difficult communication between humanists and computer scientists—is symptomatic of what is happening in the field of digital humanities. This transdisciplinary collaborative dynamic indeed favors the ever-obvious encounter between computational technologies and the disciplines of human and social sciences, arts and humanities (Schreibman et al., 2001).

[3] These elements are more developed in two recent contributions from the project's research group. See Darbellay et al. (2018) and Cocco et al. (2018). This chapter is based primarily on developments in the first of these previous contributions.

The operation of drawings digitization, in addition to the investments in computer media that it requires, enables the storage of the drawings and their analysis by means of computer tools capable of annotation (Dessart et al., 2016) and images data processing (Cocco et al., 2017). A corpus of digital images is thus formed for the analysis and interpretation of cognitive processes and graphic strategies implemented by children to represent God. The design and development of this set of computer tools aims at a certain harmonization of treatment and analysis procedures, while remaining as sensitive as possible and adapting to the idiosyncratic singularity of each culturally and individually marked design. Considering the internal variability of the corpus of images requires an ongoing negotiation between the organizing power of quantitative computing tools and the specific needs of more qualitative analysis of sub-groups of the corpus, or particular drawings. To do this, a tool set has been created: a database (BDD) for storing drawing scans, an annotation tool for these scans specific to the needs of the project, and computer processing tools for images.

According to the Svensson (2010) classification of digital humanities projects based on modes of engagement of information technology and digital specialists in the human and social sciences, this project is clearly in a tool-type commitment, including an exploratory laboratory part. This process involves multiple negotiations between the researchers' needs and the technological tools specificities, negotiations that, in turn, modify the initial orientations of the project. This problem is typical of a digital humanities project anchored in human sciences that attempts to incorporate different but potentially complementary perspectives. Potentialities and difficulties lie in the co-construction of the object of study and the methods, and most often, they depend on very pragmatic considerations. Computer tools must thus be systematically tested, redesigned, and reformatted in the dynamics of the project, which, far from following a predefined linear trajectory, may require successive reorientations. During these decisive moments, researchers in the humanities and social sciences may discover new research questions or lines of analysis that fall outside their field of study. The choice of tools influences the way data is analysed and interpreted: there are mutual enrichments between computer tools, methods, and theoretical considerations. The digital detour also makes visible what is often invisible to the naked eye, by a technologically enhanced vision for new modes of reading. It allows a remote "distant reading" (Moretti, 2013) on the entire body of digital data understood as a global system of data and metadata upon which machine or algorithmic readings can operate (machine reading). This scale of macroscopic data contextualization is complementary to the micro-observation scale, a close reading regime (Moretti, 2013) that is more sensitive to the nuances and stylistic variations inherent to the diversity of individual and cultural designs produced.

The following diagram (Fig. 19.1) summarizes the dynamics that occur from and around the children's drawings of gods, when taken as objects of study by a group of disciplines. Without being prescriptive, the list of disciplines is open to other disciplines likely to contribute to the analysis. In the diagram, the horizontal alignment of the disciplines does not seek to mask the dominance that one discipline can take over another in practice, nor does it discount the power dynamics and
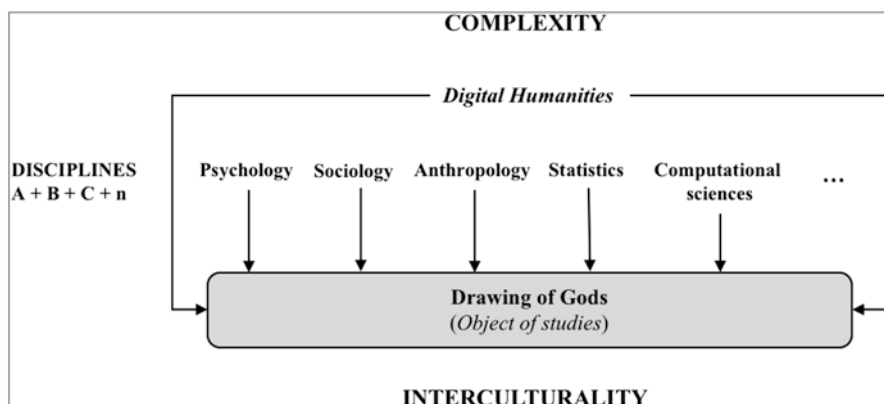
Fig. 19.1 Drawings of Gods: disciplines, complexity, interculturality

asymmetrical relations that can occur between specialists. Each discipline deals with one of the dimensions of the complexity of the object of study: the psychological, social, cultural, material, and digital dimensions. The disciplines are spread across a transdisciplinary axis (a dialogical and productive tension axis) from the human and social sciences ("soft" sciences) to computational sciences ("hard" sciences). The field of digital humanities could then represent a meeting place, or a space of convergence, between these disciplines from different epistemological, theoretical, and methodological horizons. As we pointed out above, this disciplinary approach—a multidisciplinary stage—makes sense in a broader context of interculturality and semiotic, psychological, and social complexity. Starting from this multidisciplinary anchoring at work in the *Children's Drawings of Gods* project, the central question that can arise is how, and under which conditions, this juxtaposition of disciplinary points of view can migrate towards a more interdisciplinary approach in the sense that it realizes articulations or integrations between the different disciplines.

Interdisciplinarity

From Disciplinarity to Transdisciplinarity

To understand fully the issues of interdisciplinarity, it is necessary to situate this concept in the family of concepts that frames it and inscribes it in a dynamic range from disciplinarity to transdisciplinarity. The concepts used to describe the idea of decompartmentalization between disciplines are numerous. From multi-, pluri-, poly-, alter-, anti-, inter-disciplinarity etc. to para-, supra-, post- or trans-disciplinarity, this terminological space looks, at first glance, like a battlefield or a tower of Babel, where there is an apparent cacophony against a background of
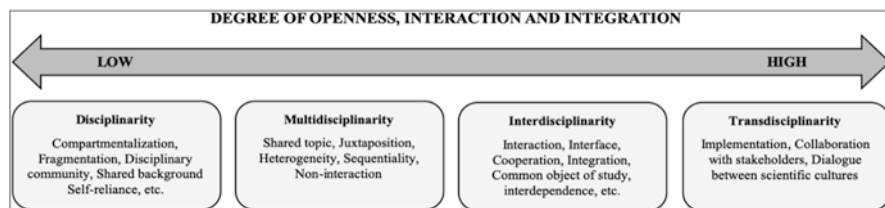
Fig. 19.2 Degrees of collaboration between disciplines

semantic dispersion and confusion. These terminological variations nonetheless present the notion of disciplinarity as an invariant element modulated on a case-to-case basis by a long series of prefixes. I will focus here on the key concepts that form a certain consensus in the scientific literature on interdisciplinarity today: *disciplinarity*, *multi-disciplinarity*, *inter-disciplinarity*, and *trans-disciplinarity* (see for example, Piaget, 1972; Thompson Klein, 1990, 2014; Darbellay, 2005; Huutoniemi et al., 2010). Figure 19.2 presents this conceptual development showing the progressivity between the different levels of complexity of the links between the disciplines.

From disciplinarity to multi-, inter-, and transdisciplinarity, there emerges a semantic and epistemological dynamic that is based on clearly identified disciplinary anchors, while integrating them into an increasingly dense and interactive network of relationships (Rosenfield, 1992; Stokols et al., 2008). With a very low degree of openness in disciplinarity, the gradual decompartmentalization of disciplines takes place from multi-, inter- and transdisciplinarity, with a progressively stronger degree of interaction and integration between branches of knowledge. The process of gradual decompartmentalization between disciplines makes it possible to go beyond the mere juxtaposition of points of view, characteristic of multidisciplinarity, in order to develop a more integrated approach to knowledge from a perspective of solving theoretical or practical problems (Clark, 2002). A dialectical tension is thus emerging between disciplinary anchors and their necessary interaction in an interdisciplinary dynamic: there is at the same time a disciplinary foundation and an opening towards an interface between and beyond disciplines.

Positioning

Where along the axis that moves from disciplinarity to transdisciplinarity (as visualized in Fig. 19.2) does the *Children's Drawings of Gods* project fall? Based on our research experience with the project, we can begin to determine its position. As already mentioned, the project calls on a number of complementary disciplines and aims for an interdisciplinary goal. The corpus of digitized drawings serves as a point of contact and discussion among researchers, it is organized in a database that is being processed and reconfigured in and by the development of new analytical

tools. The drawings translated into digital data are considered here as "intermediary objects" (Vinck, 2011) which materialize and allow the creation of a space of circulation and interdisciplinarity between concepts, tools, and heterogeneous methods. Creating such interdisciplinary links requires "articulation work" (Strauss, 1985, 1988; Oberhauser, 2016), understood as a development, transformation, and collectively negotiated process. The articulation is based on both a division of tasks between the disciplines adapted according to the project objectives and on coordination of efforts. Between the distribution of tasks and the need for collaboration, the relatively subjective perception of differences and specificities between researchers plays a key role. To work on children's drawings as objects of study and rallying points for the various disciplines is part of a desire to open up monodisciplinary approaches. It aims to overcome the simple juxtaposition of studies that have been conducted in different countries. Such a juxtaposition often lacks adequate intercultural considerations and fails to make effective comparisons between the findings from the various locales. The corpus of drawings, conceived as rallying materials, acts as a means of intercultural exploration and comparison, while catalyzing the interdisciplinary dialogue between psychology, religious studies, image analysis, cultural anthropology, sociology, etc.

The project is anchored in the area of multi-disciplinary configurations. At the same time, it sets up an interdisciplinary dialogue among the disciplines convened, as well as opening a transdisciplinary connection between the disciplines of human and social sciences and computational sciences within the framework of digital humanities. This openness to inter- and transdisciplinarity is neither self-evident nor can it be decreed arbitrarily; no recipe is supplied in advance. It is a process that gradually takes place with its points of convergence, its results, and its difficulties with regard to the various epistemic and cultural horizons. This interdisciplinary process requires negotiations between colleagues in an attempt to co-construct a common theoretical framework and develop technical analysis devices capable of responding to the hermeneutic questions of researchers in the humanities and social sciences, while being of scientific interest to researchers in computational sciences. We have experienced this positive dynamic in our project based on relationships of trust and respect (both interpersonal and academic) characterized by exchanges that occurred long before the project commenced, by having joint experiences to test the interest and feasibility of the collaboration before the elaboration the project itself, and by having regular meetings during the project. I note that regular meetings, facilitated by the presence of the principal researchers on the same campus, make it possible to discuss various issues concerning the organization, such as the research and the progress of the subprojects. Meetings also provide time and space to solve problems and share different points of view. This dynamic is reinforced by the presence of researchers who are able to establish bridges between the domains of humanities and computer sciences, reconciling and integrating both fields and working, for example, on the development of methods of automatic image analysis. This reinforcement can be seen not only within the research team in the planning and practice of co-writing interdisciplinary publications, but also between the research team and colleagues who specialize in computational sciences (for

example in dialogue about expertise, human exchanges, sharing ideas, building dynamic relationships around the same object, etc.).

Interdisciplinarity in Action

Team Science

The research team of the *Children's Drawings of Gods* project is made up of a core group of three psychologists with a background in religious studies, a sociologist of science and technology, a sociologist of communication and culture, a specialist in mathematical methods and computational sciences for social sciences and humanities, and an epistemologist of interdisciplinarity. According to the inter-institutional collaborations, the group is enriched by additional ad hoc contributions from specialists in computational sciences and automatic image analysis. The members of the research group will also draw, depending on the needs of the analysis and interpretive games, on other fields of complementary expertise such as cultural and social psychology, cognitive science, anthropology, or even history of religious art. This configuration of multiple disciplines offers a breeding ground enriched by the diversity of theoretical frameworks, concepts, and methods that are can be specific to a particular discipline (e.g., computer modeling), or more or less shared between them (for example a social constructivist view of the elaboration of god representations). Epistemic diversity increases rapidly when the distance between disciplines extends to computational sciences (hard sciences). The mobilization of the hard science disciplines in the project is likely to create the conditions for a mutual misunderstanding about the psychological and socio-cultural nature (vs. algorithmic) child drawings, as well as about the design, purpose and use of computer tools in the project.

The research project on the children's drawings of Gods mobilizes the scientific and relational skills of the members of the group. It also provides the opportunity to implement a collaborative process in a dynamic teamwork. With its successes (but also communication difficulties as noted above), teamwork can test conceptual, theoretical, and methodological strategies. In this context, the science of team science (SciTS) field is likely to shed some light on the issues and the course of interdisciplinary collaboration (Fiore, 2008; Stokols, 2006). Our project has been confronted with several key issues of teamwork.[4] We could qualify the interdisciplinary vision as an epistemological horizon of the project, an attempt at *cross-disciplinarity* in the sense that this generic concept refers to any form of collaboration between researchers or groups of researchers from different disciplines (Stokols et al., 2008). The cross-disciplinary approach thus covers the spectrum or pathway

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[4] See: *Team science glossary*. Available on: https://i2insights.org/2017/03/16/team-science-glossary/

of the project (which itself is based on multidisciplinary approaches), experimenting with interdisciplinary articulations in the framework of a transdisciplinary dialogue between the human and social sciences and the computational sciences. Without aiming for a fusion or confusion between the disciplines mobilized, the project potentially tends towards a certain "convergence" (Sharp et al., 2016) in the sharing of ideas, theories, or methods between scientific and disciplinary fields that have been heretofore historically distinct. The continuous practice of the co-constructive exchange in team science allows for the production of knowledge, approaches, or techniques of analysis that would not have come into being without this work of "collective intelligence" (Woolley et al., 2010). This collective co-production has gone through a process of co-learning between researchers from the humanities and social sciences and researchers from the computer sciences. Each group has sought, through their primary disciplinary language, to communicate theories, methods, and tools of analysis unfamiliar to the other party (see Darbellay et al., 2018). The brainstorming sessions conducted by the research group revealed the need for interdisciplinary work. The interdisciplinary work cannot move forward without arduous discussions in which one must take the time to understand the disciplinary languages of others, master the main tools when possible, and attempt to build a shared horizon. These exchanges are based on mutual trust and are essential to building the "team dynamics" (Tuckman, 1965) that occur through multiple levels of interaction: academic, professional and personal. The discussions and the need for constructive exchanges are necessary not only in the phase of co-production of ideas or methods, but also in the phase of dissemination and exploitation of research data. Through the formulation (and often the concrete reformulation) of theoretical, methodological, and descriptive elements, the work of collective publication between the team members continued the dialogue, drawing on the disciplinary backgrounds of the co-authors concerned. This co-authorship approach also allowed us to explore more or less explicitly the various co-publication models that depend on disciplinary practices with their degrees of variation. The process of co-authorship demonstrates, above all, the importance of clarifying and documenting—from the beginning of a collaborative project—each team member's objectives, involvement, and contribution (Bennet et al., 2010).

Researcher Profiles

Interdisciplinary work, individual and collective, does not come into being by decree; it is carried out by hardworking researchers who agree on the goal of working together for the common cognitive good. Collaborative and interdisciplinary scientific research in small or larger groups (or subgroups) therefore calls for researchers not only to be aware of the issues and requirements of interdisciplinarity, but ultimately to be trained to master the process and methods of interdisciplinary work. There is currently a great need in this area. Training programs dedicated to this goal are increasing at both undergraduate and doctoral levels. Instead of

going into the details of this new type of training programs, let me focus on the idea that interdisciplinarity undoubtedly calls for new profiles of researchers who are able not only to master disciplinary skills but also are able to be open to other disciplines or fields of study and link them together. We, ourselves, have experienced this in the *Children's Drawings of Gods* project; disciplinary skills in the field of human and social sciences were insufficient to deal with the complexity of the digital requirements. This challenge was forcibly revealed when we were recruiting young researchers who were potentially anchored in the field of human and social sciences or even sub-disciplines of this field (such as the psychology of religions), even though these researchers were open-minded and aware of issues related to the digitization, processing and technical analysis of children's drawings (for a detailed analysis see Darbellay et al., 2018). In the context of digital humanities, hard skills in one or more disciplines are necessary, but they must be accompanied—or even transformed—by contact with technical skills for the analysis of images, and with soft skills for communicating between and beyond disciplinary boundaries and creating transdisciplinary links. This new generation of researchers should be encouraged, trained, and valued in their interdisciplinary academic background.

Conclusion

The complexity and interculturality inherent in a research project such as *Children's Drawings of Gods*—which served here as a support for reflection and provided the opportunity to examine the scientific literature in the field of inter- and transdisciplinary studies—cannot be treated by resorting to a monodisciplinary approach. In this context, interdisciplinary stakes must imperatively be noted, especially as part of the field of digital humanities in full transformation. It is in this atmosphere of cognitive openness that teamwork takes on new meaning, allowing each specialist to assert his or her disciplinary skills while contributing to the collective effort to co-construct a collective intelligence that is capable of solving the complex theoretical and practical issues that cannot be dealt with by one field alone. The needs and demands of this collective effort call into question the legitimacy of the dominant vision of interdisciplinarity: which is simply bringing together a group of specialists from different disciplines. If we wish to prepare a new generation of scholars for the challenges of interdisciplinary research, it goes without saying that our old vision of specialization will be hindered by its limitations and will have to be overcome. What place or climate is there, or can be created, within the academic system that welcomes and nurtures interdisciplinarians, polymathic scholars, and other neo-generalists of a new era?

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