Planting and nurturing interdisciplinary collaborations: a high-stakes, high-reward endeavour

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Introduction: uncertainties about interdisciplinary collaboration

It is almost a century ago that the word 'interdisciplinary' has been coined, motivated by concerns not dissimilar to those presented to us in the case of the director of a 'competence center for plant science'. Disciplinary specialization, but also other obstacles or – implicit- assumptions about interdisciplinarity may hinder collaboration across disciplines, even if they are not always warranted. Moreover, often academics are not aware of the potential advantages that such collaborations can yield and which might outweigh their perceived risks. This may hold even more for transdisciplinary collaborations, in which extra-academic stakeholders join an interdisciplinary team of researchers (Keestra, Uilhoorn, & Zandveld, 2022).

In the present case, the director of a competence center for plant science should be commended as they are explicitly promoting interdisciplinary research, education and outreach programs in various ways. They mention a 10-year-old interdisciplinary PhD fellowship program, a call for interdisciplinary proposals connecting scientific and societal issues and more. Yet they also express some frustration about the amount of time these efforts require and the tension between fundamental plant science and connecting this with more applied and societal matters, for example. This frustration is not uncommon, though, raising the question what can be done to mitigate it? Below, I will respond to this case by addressing four topics or tensions that struck me most:

1. Should we start with topics or with people? The author describes how their plant science colleagues have already gathered some experience in collaborations with colleagues from the social sciences and humanities (SSH). Yet these collaborations are apparently discontinued and the director tells they are 'challenged in finding topics and experts' in the SSH.

2. How to get the collaboration started and deliver some returns? The director reports that their colleagues needed special tools and workshop formats to get this collaboration off the ground – even though these are time consuming. In addition, for early career researchers such collaborations are also riskier as they still need to establish themselves within a particular discipline.

3. Is experience in interdisciplinary research sufficient, or do you need special preparation? The author writes that they 'did not consider training the Principal Investigators'. Nonetheless, the director shares how most plant scientists ask them how to find SSH experts, implying that they do have difficulties in identifying potential collaborators elsewhere.

4. Can scientists who are performing fundamental research also engage in interdisciplinary collaborations? Since such collaborations would probably include value-laden contributions, benefit from the expertise of indigenous peoples and are more geared towards applications, according to the current case, they seem to distract far from this fundamental science level. Or should this opposition between fundamental and interdisciplinary research be reconsidered?

§ 1. Topics or people first? A matter of relevance.

The first question I gathered from the case is: 'Should we start with topics or with people?' The unsurprising answer must be: with both in parallel, or even in alternation. Typically, any research project starts with a question which requires for its answer specific expertise. Disciplinary questions are usually the result of preceding research and can often be answered by engaging the same expertise that was previously involved. In interdisciplinary research this is different as these questions often do not emerge from previous projects and are rather new. The current case suggests that social values or indigenous knowledge might be involved while methods of arts and anthropology could be employed. When the field of options for topics and methods is widened in such a way, how to decide where to go and how to start?

The main challenge is to decide what expertise should be included in the team. The key concept that should guide the composition of an interdisciplinary team is *relevance*. Potentially all disciplines might have something to say about any topic, given complex interdependencies across multiple levels in our reality. So we have to be pragmatic and select the most relevant ones: . For example, most plant research need not include subatomic research as the events at that level of description and explanation are not relevant for most mechanisms that determine the life and properties of plants (cf. (Machamer, Darden, & Craver, 2000)). In other words, the research question or topic guides us in composing an interdisciplinary team. Yet it may occur that after some preliminary research we have to recompose the team as a result of gained insights in what is relevance in this case, and what not - turning interdisciplinary research in an iterative decision-making process (Newell, 2007).

Not all disciplinary experts are equally interested in, or capable of interdisciplinary collaboration. Bringing multiple perspectives together requires individuals to be more patient, communicative and open minded than when working only in their disciplinary field of expertise. Involving extra-academic stakeholders in transdisciplinary learning contexts brings additional conditions along. I discussed the implications of this with an international panel of experts in transdisciplinary research and education.[1] Together we agreed on three major educational requirements distinguishing transdisciplinarity from interdisciplinarity:

1) *long-term collaborations* with businesses, as well as nongovernmental, governmental and community organisations;
2) teaching particular *dispositions and competencies;*
3) preparing students for *intercultural endeavours* (Keestra, 2018).

These additional requirements address both the persons involved as well as the organizational structure and process of transdisciplinary research.

Clearly then, extra time and resources are required for creating the necessary conditions for interdisciplinary projects like promoting team members to integrate their insights instead of working separately (Bennett, Gadlin, & Marchand, 2018). Yet it is good to know that such research is not only high-risk but also high-reward as the afterlife of published results is longer and more visible in wider circles compared to monodisciplinary ones (Leahey, Beckman, & Stanko, 2017).

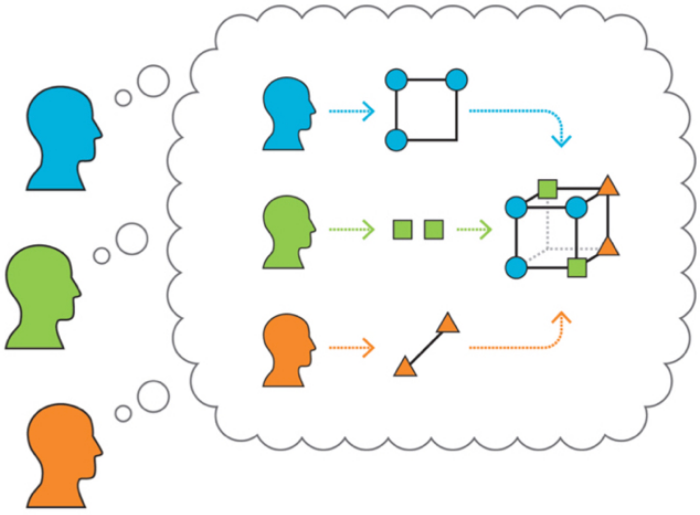
§ 2. Interdisciplinarity and the need for individual and team reflection.

The second question taken from the case presentation asks 'How to get the collaboration started and deliver some returns?' What special preparations and tools are necessary for the team and its members?

[1] The panelists at the International Transdisciplinarity Conference 2017 in Leuphana University, Germany, were: Marcel Bursztyn (University of Brasilia), Dena Fam (University of Technology Sydney), Christian Pohl (ETH Zürich), Esther Meyer (Leuphana University of Lüneburg) and Daniel Lang (Leuphana University of Lüneburg). A recording of the entire panel session can be seen at Youtube: .

The most difficult element of interdisciplinary collaboration is the integration of perspectives, without which mere multidisciplinarity is at stake. Integration can pertain to multiple elements of the scientific process, ranging from theoretical, conceptual and methodological integration to the integrated development of a practical intervention or instrument. It makes sense to separately mention integration of the research team as a form of integration (Keestra et al., 2022), which might be especially relevant for the director as their 'idea labs' are meant to identify community wants and needs and to increase trust in end users by way of these collaborations.

These efforts seem valuable and promising indeed. However, integrating the different perspectives present in such collaborations requires an individual preliminary process of reflecting upon and articulating an individual's perspective. This should provide insight in how their perspective provides affordances for connections to other perspectives – as represented in the figure below.



<FIGURE xx.1 HERE>

Fig. xx.1. An interdisciplinary team of experts develops together a more comprehensive understanding of a phenomenon – represented by the three-dimensional cube composed of different elements each of them contributes. Their joint or team metacognition and philosophical reflection upon their interdisciplinary collaboration facilitate the process of their development of an interdisciplinary integration of their distinction mental representations of the phenomenon. (Taken from Keestra, 2017, p. 156, with permission.)

There are various tools and methods available for such processes of individual and team reflection. A method that is widely used and which I've found to be helpful for teams of students as well as senior researchers is the Toolbox dialogue method. This philosophically grounded method consists of both a survey prompting individuals to reflect upon their perspective and a facilitated team dialogue about the collected survey results (Looney et al., 2014).

§ 3. Interdisciplinarity: a matter of experience or -also- of special preparation?

The director mentions that although they provided PhD students with special interdisciplinary skills training, this was not offered to their supervisors. It is not uncommon to find that academics assume that interdisciplinarity is just a matter of doing it. Complicating factor is the absence of a shared set of interdisciplinary skills and methods amongst the relevant group of interdisciplinary experts or peers. This is due to the fact that interdisciplinary research is more often focused on a specific case study or requires integration of a highly specific set of

disciplinary perspectives on a topic compared to monodisciplinary research which is usually more generalizable (Krohn, 2010).

Bringing together multiple perspectives requires a team to choose from a large number of theories, methods, models, data sets etc. stemming from different disciplines. A useful way to put a limit on this abundance is by employing the constraints that the specific features of a case study presents on certain theories and methods.[2] For example, sustainability research in an urban setting focusing on citizens and their consumer behavior requires a different set of resources than a context in which farmers and their crops are at stake.

Given that interdisciplinary research is often case-based, previous case studies may not have provided researchers the insights about their own perspective that were described above as a crucial result of the process of individual and team reflection. Consequently, the choice not to involve the senior researchers in the training courses deserves reconsideration as their previous experiences may not always be helpful towards new projects, on the contrary.

§ 4. Either fundamental or interdisciplinary science, or both?

A final topic to be addressed here concerns the alleged opposition between fundamental research and interdisciplinary collaboration. This is one of several assumptions about interdisciplinarity that are often reproduced, suggesting that interdisciplinary research necessarily remains superficial compared to monodisciplinary research. Let me raise a few objections against this accusation of interdisciplinarity's superficiality.

To begin with, this notion fails to acknowledge that research nowadays is increasingly interdisciplinary. Theoretical and methodological pluralism have become so common in most fields that we should no longer identify fundamental research with monodisciplinarity. Examples of fundamental research like quantum physics, art history, and neurobiology are in fact highly interdisciplinary and represent scientific pluralism of sorts (Keestra, 2022).

However, what may be relevant in the current case is the reported lack of long-term interdisciplinary collaborations. When research projects are carried out by interdisciplinary teams that are composed all over again, they cannot build upon previous projects as a monodisciplinary research team would more easily be able to do. There is no reason, though, why such incremental work could not be done by existing interdisciplinary collaborations. Although interdisciplinary teams often perform case-based research, there is no principal reason why they should. A benefit of interdisciplinary 'triangulation' is the increased robustness of its results: by investigating a particular result from multiple perspectives, it is less fragile than it would be if only a single theory and method had been employed (Wimsatt, 2007). Moreover, iIf a particular medical therapy has been found to be effective on both cellular and physiological levels and is in addition found to be beneficial by patients in their daily life, it will be 'socially robust' and not only hold up under narrow lab conditions but even in the messy real world (Nowotny, 2003).

In other words, I appreciate some of the obstacles that this case presents. I have explained what extra tasks and investments – particularly in extra time and effective communication – have to be made for such collaborations to be successful. "True interdisciplinary science cannot be rushed, not least because the best course of investigation is rarely clear at the outset" is a conclusion of an editorial comment in Nature about interdisciplinary research. Yet the same comment reminds us that single disciplines are often not adequate for addressing the 'pressing questions or problems' (Editorial, 2015, p. 290) that motivates much of the work that we are doing.

[2] In his analysis of interdisciplinary cognitive neuroscience, Craver describes how the space of possible mechanisms that explain a cognitive function is constrained by insights in the components known to be involved in it, as well as their spatial, temporal, manipulability and other constraints (Craver, 2007).

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