

Chapter 15

Too many cities in the city? Interdisciplinary and transdisciplinary city research methods and the challenge of integration

Machiel Keestra and Nanke Verloo

(Chapter 15 of: *Seeing the City. Interdisciplinary Perspectives on the Study of the Urban*, Eds. Nanke Verloo & Luca Bertolini, Amsterdam University Press 2020, pp. 226-242)

Introduction: Interdisciplinary, transdisciplinary and action research of a city in lockdown.

As we write this chapter, most cities across the world are subject to a similar set of measures due to the spread of COVID-19 coronavirus, which is now a global pandemic. Independent of city size, location, or history, an observer would note that almost all cities have now ground to a halt, with their citizens being confined to their private dwellings, social and public gatherings being almost entirely forbidden, and commercial areas being nearly devoid of visitors. Striking as these apparent similarities are, closer scrutiny would reveal important differences between cities and within cities – differences that can be highly relevant to consider when scholars are assessing the responses of cities to this pandemic or trying to predict the consequences of those responses.

For example, the public health systems in some cities are better prepared than in others for coping with the increasing number of patients in life threatening conditions. Multigenerational households, which are associated with a greater risk for elderly members, are not equally common in all cities. Tourist destinations have taken a more severe economic hit from the lockdown than those cities which are economically less dependent upon this particular source of income. Communal celebrations in one city will result in a higher number of contagions and perhaps even deaths in this situation, whereas that same social fabric generally does contribute to a population's health.

The pandemic has also had unprecedented effects on differences and inequalities within cities. In cities in the United States, neighborhoods primarily inhabited by African Americans have been disproportionately affected by COVID-19 due to living and health conditions, yet also due to the fact they disproportionately perform vital jobs. Parks and green spaces are crowded, while city centers like Amsterdam's Red Light District have suddenly lost the bustle of tourism, providing opportunities for citizens to reoccupy scarce public spaces and reclaim **ownership**.

Clearly, such differences between cities are in many cases only discernible to the eye of an expert, possessing the necessary background knowledge to interpret the perceptible local changes caused by the global pandemic. Typically, drawing upon his or her disciplinary training, the expert also knows how to further probe the impact of the pandemic in an appropriate way. However, compared to the usual application of expertise, this crisis situation might, in an unusual way, test even experts.¹ For the pandemic has created a unique situation, imposing unfamiliar constraints on the health, economic, social, and other conditions of cities, constraints that interact in sometimes unexpected ways with each other. Such interactions in turn force experts to collaborate across the boundaries commonly associated with disciplines, their concepts, theories, methods, and assumptions (Klein, 1996).

¹ Some research suggests that expertise is brittle as soon as it is applied to unusual, atypical cases, where common answers and approaches do not apply. Important as it is, expertise does indeed have some disadvantages, one of them being that experts tend to apply their usual approaches even in circumstances when this applicability is questionable (cf. Lewandowsky & Thomas, 2009; Keestra, 2017).

Take for example the picture below of the Amsterdam Mercator square – a picture that we used for a workshop on **interdisciplinarity** not too long before the pandemic was recognized. As we'll describe in the next section, this picture is interpreted differently by experts in city planning, history, and computational analyses, compared with the interpretation of behavioral and cultural scientists. Yet all experts would need to drastically revise their disciplinary interpretation and the research questions provoked by the picture as soon as they learned that it was taken during the pandemic while the government implemented a social lockdown policy to mitigate the virus spread, since historical, social, and architectural influences partially gave way to the impact of the pandemic. Any interdisciplinary process poses a similar challenge and requires a similarly open mindset, albeit in less unprecedented circumstances.



[insert picture 15.1 -Mercatorplein photo- here]

Picture 1: Mercatorplein in Amsterdam, Fall 2019 (picture by Eva Plevier). Note that the picture was taken before the coronavirus pandemic was publicly recognized and measures were taken.

These brief **observations** of how a virus pandemic can have differential impacts upon various cities, and what this exceptional situation might mean for the application of city methods, allow us to draw a few consequences for the current context of this chapter on interdisciplinary and **transdisciplinary** research. First, whenever we are investigating a complex and dynamic phenomenon it is by no means easy to determine which disciplinary perspectives are required to do justice to it. Indeed, the choice of useful disciplines can only be made after an initial overview of the situation and a preliminary selection of what appear to be the most important features of the situation. *Relevance* is key in guiding this selection process and scholars must remain open to the possibility that they may need to revise their earlier assessments of what is relevant and what is not. Second, if scholars from different disciplines were to study different features of a city in

isolation, their ‘**multidisciplinary**’ account would miss important dynamic and complex interactions, such as those between a city’s demographics and geographical situation, its governance and economy. In other words, it is the *integration* of the perspectives of different disciplines that is crucial, as only then are such interactions taken into account. Indeed, this integration between disciplinary perspectives is what distinguishes an interdisciplinary from a multidisciplinary account. Thirdly, in addition to checking the relevance of disciplines and aiming for their integration, the outcome of interdisciplinary and transdisciplinary research has typically *limited generalizability*. Since a city is sensitive to a multitude of internal and external dynamical factors, in ways that partly rest upon its socio-cultural history, its investigation will often have the nature of a **case study** rather than be capable of leading to law-like insights (Krohn, 2010; Menken & Keestra, 2016).

As can be seen from these three characteristics of ascertaining the relevance of different disciplinary contributions, the challenge of their integration, and the limited generalizability of their results owing to the specificity of interdisciplinary (ID) and transdisciplinary (TD) research, such research into ‘real world problems’ is clearly distinct from most monodisciplinary research.

[insert Figure 15.1 -diagram with 3 horizontal lines- here]

Figure 1. Multi-disciplinarity entails no integration of the contributions of different disciplines. Interdisciplinarity is characterized by such integration. Transdisciplinarity further includes the integration of non-academic contributions. (From Menken & Keestra, 2016)

A consequence of this distinction is the absence of a general ID/TD methodology that can guide specific case studies. By contrast, the collaboration implied in such research requires researchers – and stakeholders, if they are involved – to reflect upon their potential contribution and the implicit assumptions associated with that. We will elaborate on this in the next section. Next, we offer several typologies of integration that urban scholars could employ for their research projects, after which we will offer a few brief analyses of initial collaborations of urban research. Finally, we discuss in more detail the process of the interdisciplinary research project. This will include a brief reflection upon the decision-making process that is implied in such projects. In sum, we aim to provide some guidance in conducting an ID/TD project, albeit not in the form of a definite methodology.

Setting the stage: establishing an ID/TD research team

As mentioned above, determining which perspectives are relevant for a given project is an important task, perhaps even more so when the study results should assist government officials and politicians in taking measures. Scholars, irrespective of their discipline, might feel justified by their integrated insights in proposing a particular public policy or city planning. However, the impact of such proposals on a particular community will also be complex and dynamic, and can provoke unexpected positive or negative responses or even civil disobedience, impeding the effectiveness of the intervention.

In order to increase the *social robustness* of their knowledge-based intervention proposal, the research team should therefore invite relevant stakeholders or community representatives to participate in the project. In doing so they recognize that stakeholders – such as citizens, shop keepers, tourists – perhaps have specific experiences with the city that are not yet covered in research (for examples of transdisciplinary research, see chapters 13, 14, and 16). In addition, the normative-pragmatic choices that need to be made cannot be fully justified by knowledge claims, but require forms of community deliberation (Nowotny, 2003).

Integrating the perspectives of stakeholders in a project turns it, in fact, into a transdisciplinary one, with effects on all research stages – from problem definition, via the collection and analysis of data, to integrating and implementing the results of the project (Hirsch Hadorn et al., 2008). **Action research** goes one step further. Actionable knowledge requires integration of stakeholder perspectives while conducting the research project in such a way that it generates options for action for those stakeholders who have to cope with the problem situation (Bradbury-Huang, 2008; Kestra, 2019).

Having mentioned above the limited generalizability of interdisciplinary and transdisciplinary research, generalizability is further challenged when stakeholders are involved and actionability is adopted as a research criterion. If the results of scientific research are typically generalizable over numerous comparable situations but not directly applicable in real world situations (for example because laboratory conditions are meticulously controlled or human subjects are carefully selected), for inter- and transdisciplinary projects the reverse often holds. Avoiding the abstraction and isolation of the research object increases the applicability of the research output to the specific object under scrutiny, while constraining its applicability to objects that might appear to be comparable yet are potentially very different (Krohn, 2010).

A consequence of these preliminary observations is that interdisciplinary and transdisciplinary research projects usually cannot rely upon given theoretical frameworks or methodological apparatuses. Instead, such projects require from the very start that participants engage in team reflection upon their own and others' perspectives on the research problem, are open to reconsidering the relevance of their and others' potential contributions, and are also ready to adjust the definition of the problem they aim to investigate (Looney et al., 2014). Disciplinary and extra-academic experts alike must be prepared to engage in a metacognitive and reflective team process, as represented in the figure below.

[insert Figure 15.2 -diagram with 3+3 human heads- here]

Figure 2. An interdisciplinary team of experts develops together a more comprehensive understanding of a phenomenon – represented by the three-dimensional cube composed of the different elements each of them contributes. Their team metacognition and philosophical reflection upon their interdisciplinary collaboration facilitate the process of their development of an interdisciplinary integration of their distinct mental representations of the phenomenon. (From Kestra, 2017).

If a group of researchers has been able to agree upon their research problem and has reached a consensus about the mix of disciplinary perspectives – how to continue once that phase has been completed? With integration apparently being such a crucial step in the project, what choices have to be made, what options are available? What kind of results might the research group be expected to produce?

Integrating disciplinary perspectives

In this book, myriad methods are discussed by scholars working in various fields ranging from fields in the social sciences (geography, planning, anthropology) to the natural sciences (biology), mathematics (computational science), humanities (history and cultural studies) economics, architecture and action research. When starting from a real-world problem, the selection of relevant perspectives, the number of methods or datasets to be used, as well as the decision about their adequate integration, are constrained by the nature of this problem.

For the purpose of this book, we organized a workshop on interdisciplinarity with urban studies scholars that included a thought experiment in order to explore such decision-making. We invited them to discuss a given picture (see picture 1 and the picture on the cover of this volume) showing an urban streetscape, and imagine a research project based on their own discipline by following the question-based set-up of our volume: what do I see, how can I

understand, what do I miss, and why does it matter? Then they were asked to share their approach with a researcher from another field and imagine how their two – at times, vastly different – approaches could be integrated. We asked them to discuss the overlaps in their approaches, what they missed in the other’s approach (or perhaps their combined approaches), what would help them if they were to do research together, and how they would go about that. Based on our analysis of these conversations, we here distinguish four types of discussions about integration.

The integration of different disciplines and methodological approaches is not always easy. One of the most challenging aspects is the combination of perspectives that are grounded in different **paradigms** or different disciplinary matrices to describe, investigate, explain, and communicate about the world (Kuhn, 1970). The paradigm shapes how researchers see the nature of the world more generally and their place and role in it (Guba & Lincoln, 1994, p. 107). Importantly, though, paradigms are not simply distinct in the sense that they use qualitative or quantitative methodologies, as researchers from one paradigm might still use both qualitative and quantitative methods. Indeed, given that every discipline nowadays displays both theoretical and methodological pluralism, it is obvious that, notwithstanding paradigmatic differences between disciplines, every combination of disciplines will involve both overlaps and similarities as well as differences and even conflicts (Menken & Keestra, 2016). Since such conflicts often entail values and norms included in these disciplinary matrices, it can be very challenging for researchers to overstep the corresponding boundaries. In that situation, differences often extend to disagreement about central questions like the problem definition, assumptions about appropriate knowledge, how insights can and should be produced, what the researcher’s role is in relation to the field, and the final objective and goal of research. We therefore first consider the option of non-integration.

Conflicting perspectives – no integration

Take the example of the conversation between two urban researchers. One is a planner doing **institutional analyses** from a **critical theory paradigm** and the other is a computational scientist studying behavior in the city through sensing using a **positivist paradigm**. When they view picture 1, they both see something different, as their different paradigms shape how they perceive and understand the world. The planner sees the historical buildings of the Amsterdam School of architecture of the early twentieth century in relation to the more recent interventions in public space; the planner immediately thinks critically about this historical progress and sets out to study the political economy of postmodern renewal and its history by using cadaster data to understand the economic changes. What the computational analyst sees is an empty square that is underused, which he blames on an inadequate design. The analyst proposes to study what elements or features of the urban space would make the square more attractive to users using **street-level imagery** and computational techniques that show how people make use of, or refrain from using, the square. The two researchers are thus both interested in the interventions that produced the public space, but they have competing assumptions about which kinds of data are adequately representing the experiences of the users. The planner insists that technological approaches overlook the real experiential knowledge of the people using the square on an everyday basis, since images can’t provide understanding of the reasons why they use the square or not, and do not take account of the socio-economic and historical context. The computational scientist disagrees: he believes that images of the square can be used to ask people in a random sample online what they like or dislike about the square and in so doing collect the user knowledge required. The kinds of knowledge they intend to produce and their objectives also differ; the planner wants to make a critical analysis of the socio-economic and political decisions behind the interventions of the square, the computational analyst wants to make the square more attractive to users. If they were not interested in adjusting their perspectives, they would not be able to bridge their differences because they do not agree on the problem definition, the

appropriate data, the knowledge necessary for knowing the square, nor about the kind of knowledge they want to produce and the objective of such a study. Hence, integration seems absent, rendering this multidisciplinary and not interdisciplinary.

Narrow multidisciplinary with potential for integration

The second typology we identified in our workshop is a shared perspective between two different approaches, characterized by comparable methods used by the same or related disciplines as they work together in a project. Whenever collaborating disciplines are relatively close to each other in terms of their relevant theories, methodologies, or results, we might refer to that situation as ‘narrow’ multidisciplinary or interdisciplinarity, in contrast to ‘wide’ interdisciplinarity, which would include more diverging disciplines (Newell, 2007). In a narrow multidisciplinary approach, disciplines, their assumptions, norms, and (implicit) paradigms typically lie close to each other, making the task of establishing a common research question or integrating their methods or results fairly easy. However, such ‘narrow’ collaboration would rarely lead researchers to confront their assumptions, rethink their knowledge, or push the fields in unexpected directions – perhaps contributing to its cost-effectiveness.

Let’s look at the conversation between the same computational analyst and a GIS specialist looking at the image of the biker (see chapter 1 and the cover of this volume). They both observe a biker doing something that is not planned for: he is riding on the tramrails. Their shared problem definition is that there is a mismatch in the way space is allocated to different users. Their problem definition is also the hypothesis that they want to test by complementing each other’s findings. The computational scientist uses ‘real time data’ of videos of user movements and the GIS specialist uses ‘representative data’ via quantitative spatial data sets. They argue that their approaches complement each other easily because they share the same **post-positivist paradigm** that seeks to produce evidence-based policy evaluations, in this case of spatial designs – making this an example of ‘narrow’ interdisciplinarity. As they are researching a shared hypothesis they do engage in a process of mutual learning about the allocation of space, but they do not proceed to reinterpret their data as they merely supplement their findings with other results that increase the validity of their tests. This could be a valuable outcome for short-term policy evaluations because results and insights gain in validity and robustness when confirmed by different tests (Wimsatt, 2007). However, given the fact that this multidisciplinary approach does not yet integrate disciplinary distinct approaches, it is not likely to generate new or unexpected findings that could alter our understanding of the city or, in this case, the use of public space.

Wide multidisciplinary with potential for integration

A wide multi-disciplinary approach brings together researchers from disciplines that diverge more in terms of the theories they uphold, their methods, results, etcetera. To the extent that integration takes place between these perspectives, we can distinguish between multidisciplinary and interdisciplinary collaborations, as was represented in picture 1 above (Menken & Keestra, 2016). Nevertheless, the researchers still have to overcome differences and work together towards a process of mutual learning by discussing similarities and differences with regard to their paradigms and their approaches to collecting data in order to co-produce a shared problem definition and objective. Such a multidisciplinary research is sometimes carried out according to a phase model when the different parts of the multi-method approach are conducted subsequently or separately from each other, without the researchers needing to reinterpret their own approach or knowledge. Hence, this approach is a partial form of integration.

An example of such a multidisciplinary approach was developed in a conversation with a scholar using urban **ethnography** and a classical economist looking at the picture of the biker. The economist did not show an interest in the biker but in the historical buildings behind him. He

imagined that a lot of public money was invested in maintaining this cultural heritage and wondered whether that money was well spent? To answer that question, he would study the changes in the value of the housing prices surrounding the historic building. He would trace land registry data and data from real estate agents since the period of public investment in the building. He warned that this could not be researched in just one setting, so he would do a quasi-experiment comparing the change in property value after public investments in cultural heritage in similar cases across the country. He hypothesized that if property values were found to rise after public investments in a representative number of similar cases, you could argue that these investments were worthy and effective.

The paradigm of the economist conflicts with the paradigm of the urban ethnographer, who would also be interested in understanding the (unintended) effects of certain policies, like investments in cultural heritage, but would take a profoundly different approach. She insists that the economical focus overlooks the more subjective reasons why people choose to buy a property and what they are willing to pay for it. The economic value focus is also problematic from her perspective because it excludes the value of cultural heritage to people who do not have the resources to buy property in this area. She also considers the fact that there are many other factors that shape the property value, like the rise of Airbnb in the city center of Amsterdam or the fact that the popular Nieuwmarkt square is around the corner. The economist responds to this last argument by explaining his control variables, which should balance out the effect of other influences beyond the public investment in cultural heritage. The identification of similar cases should also deal with these external influences. This might be convincing, but it does not deal with the two prior concerns of the ethnographer.

They agree that it would be useful to work together: the economist would run his analyses regarding the changes in property value and subsequently the ethnographer would do fieldwork and **interviews** in order to understand the more subjective reasons why property owners invested in the property around the historic building. The economist warns against a 'hypothetical bias' when asking whether, for example, people value the church or not: if you ask people whether the church is important, they will always say yes. The ethnographer would, however, not do a **survey** in which people were asked whether the church was important, but in-depth **interviews**, to understand all the reasons *why* and the process of *how* people choose to buy a property there (see chapter 5). It is possible that people do not mention the church at all, in which case that is a valuable result in itself. Additionally, the ethnographer would carry out further research beyond interviewing the residents by performing **participant observations** in the space in and around the church, to include visitors who might value the church but do not live in the area. They imagine that an additional critical analysis, using statistical (chapter 2) or **GIS** data (chapter 11), of the socio-economic make-up of property owners and social renters in the area might provide alternative insights on the various ways in which the church is valued by residents in relation to unequal housing opportunities for Amsterdam residents.

Through working together and engaging with each other's viewpoints, the differences between the economist and ethnographer turn into respect and appreciation for each other's approaches. Their findings complement one another because they provide another insight on the same object. However, the two do not go as far as reinterpreting their own ways of knowing, nor do they integrate the two qualitatively different perspectives in a single yet more comprehensive view. If they were to carefully integrate their methods and insights, this would not just have an impact upon their research but also upon their potential policy advice, making it more robust – socially and scientifically – than merely adding together their perspectives.

Interdisciplinarity – seeking integration between perspectives

What makes an interdisciplinary project different from a multidisciplinary project is the extent to which the disciplines and related methodologies become integrated throughout the process of doing research. Participating researchers in an interdisciplinary project engage in an iterative

process of mutual learning and decision-making. Given the difficulty of these processes, it can be helpful when a ‘real-world problem’ serves as a boundary object. The photos of the square and the biker functioned as such boundary objects in our workshop, encouraging conversations about what each participant observed, how they would define the problem, what they would do to study that problem or phenomena. During these conversations the epistemological and ontological assumptions became tangible, and overlaps and differences became visible.

Even when scholars participate in interdisciplinary projects, they do not always have to have a complete consensus about paradigms or assumptions, let alone share the same paradigm. Differences can invite participants to consider how they might fill a gap in each other’s approaches. A way to start imagining interdisciplinary opportunities might thus begin by jointly answering the question ‘What do I miss?’ as an interdisciplinary team. Clearly, the result of such a conversation can be an even more challenging methodological and theoretical pluralism than the pluralism that is already present within a single discipline. Eventually, resulting insights should lead to a more comprehensive insight by integrating various perspectives on the same problem or phenomenon. That also means that initial outcomes might contest each other. Such contestation could invite all participants to adjust their approaches or methodologies, collect more data, reinterpret their analysis, or even reconsider their epistemologies.

While looking at the image of the Mercator square (picture 1 in this chapter), a group of scholars from the fields of cultural analysis, geography, planning, history, and computational analysis observe that the square is recently renovated but, at the time of the photograph, quite empty. Their local knowledge informs them that this square is actively used on days with better weather, especially the fountain, which is a place for children and families to gather and play. After sharing what they observe, they come to agree that it would be interesting study the seeming tension between the built environment and its use or users. They wonder why the square is not used more on other days and what effects the design of public space has on the inclusivity of a space. Each scholar approaches the definition of this problem from the perspective of their own discipline: the historian would reconstruct the architectural history, the cultural analyst would study the **aesthetics** of the public space, the geographer would study the everyday uses of the square, the planner is interested in the policy and planning process behind the current built environment, and the computational analyst would study the use of the space through remote sensing. Discussing how they would approach the square differently allows them to co-produce a problem definition that remains general enough to include different disciplinary perspectives but specific enough to share a common goal.

To integrate the disciplinary perspectives the participants need to rethink what is missing in their own approach and what the other approaches may contribute. They ask themselves, ‘What do I miss?’ By thinking through what their own approaches overlook or ignore they start to imagine the contributions of other disciplines to their findings. For example, the planner would not be able to make sense of the subtle ideological backgrounds of design aesthetics that the study of the cultural analyst would make visible. Conversely, the cultural analyst needs the study of the planner and the geographer to understand the actual planning process of the design and the intentions behind it, as well as the everyday uses and experiences of citizens. The historian would place the overall analyses in a historical perspective that shows how the progress of policies, architecture, and socio-economic changes affects the city and its users.

The participants use different approaches that influence the way they develop their insight. For the cultural analyst – taking a critical theory paradigm – the question of representation is less important. He could make a semiotic analysis (see chapter 7) of what the aesthetics of the design communicate and make an argument about the in- and exclusive meaning of the design. His analysis, however, would be strengthened by data from the historian, planner, and geographer, which show how the space was historically (see chapter 6) or institutionally (see chapter 8) produced, how planners intended the design, and how it is used on a daily basis (see chapters 3,

4, and 5 for methodologies that allow for such data). These data could validate the analysis of in- or exclusion via a close reading of the square's aesthetics, but they could also contrast with it. In that case, the cultural analyst is challenged to open his mind to another interpretation of the aesthetics based on a different set of data. Simultaneously the planner, geographer, and data scientist should stay open to a different type of learning that is not based in empirical data but in close reading of design aesthetics in its historical and cultural context.

If the scholars are able to integrate their ways of learning about the square, they would integrate different knowledges or perspectives to inform and contribute to their analyses. That way, they engage in a process of mutual learning. For example, the data about everyday use might be developed through a combination of data collection methods – interviews, participant observations and remote sensing. Together these data sets might offer the planner an insight about the unintended consequences of planning process of the design and the contingency of some previous findings concerning the use of the square. The cultural analyst might change his reading of its aesthetics upon listening to interviews with citizens about their appreciation of the space. The historic trajectory might reveal that over time the city has been investing in this space to regenerate it from a relatively marginalized neighborhood to a more affluent area. And that trajectory might be placed in a critical perspective by a geographer using quantitative analyses (see chapter 2) to show how that process of gentrification has excluded low-income families. Such process of mutual learning could provide valuable information for policy makers to rethink the practice of spatial planning and the way it affects in- or exclusion in the city.

Interdisciplinary research as an iterative process of mutual learning

The examples above highlighted how interdisciplinary research typically implies a process of mutual learning in the participants – and the same holds for transdisciplinary and action research. We noted how the perspective each participant brings along can be different from that of others with regard to important, often implicit, assumptions about what the fundamental characteristics are of a city, of knowledge, of scientific methodology, of adequate interventions, and so on. Integrating such different perspectives requires an individual and team process of metacognition and reflection, as we noted above, preparing for different degrees of collaboration and integration.

Unsurprisingly, the consequence of these challenges is that the interdisciplinary research process is typically different from a mono- or multidisciplinary research process. Although the specific nature of interdisciplinary research can be observed at all phases of the research process, its impact is especially large in the initial phase of the research process, when the research problem and questions are determined. A monodisciplinary research question is also usually formulated in its preliminary phase in agreement with the – implicit – concepts, assumptions, and methods of that discipline. Consequently, the specification of a theoretical framework in such cases creates no tension with such an initial research question, as both question and framework are constrained by those same concepts, assumptions, and methods. Yet when a theoretical framework is developed for an interdisciplinary research process, the integration of multiple perspectives will have an impact upon the preliminary research question, which will have received different formulations and interpretations from all disciplines. For the integration of these perspectives a research question must be formulated that is sustained by each perspective, adjusting perhaps all of the question's initial monodisciplinary formulations.

Obviously, once participants have jointly determined their interdisciplinary research problem, it is implausible that this can be investigated by methods stemming from only a single discipline. Something similar holds for the integration of the data that result from carrying out their interdisciplinary research. Such research will yield an unusual combination of kinds of data, the integration of which must be determined by the participants with an eye on their problem.

As a consequence, the interdisciplinary research process has the shape of an iterative decision making process (Newell, 2007) during which participants are not able to follow their

usual linear research process. Instead, at different phases of this process they must make decisions while taking into account an unusual combination of approaches, which has specific implications for each process phase. Yet the specific nature of this process is particularly visible with regard to research question, as is visible in the question's two-tiered development in the model of interdisciplinary research below (Menken & Keesstra, 2016).

[insert Figure 15.3 -diagram with ladder of multi-step process- here]

Figure 3. The Institute for Interdisciplinary Studies' model for interdisciplinary research. In this model for the interdisciplinary research process, the different steps (the blue boxes in the middle of the figure) reflect the tasks that must be completed in a specific research phase (indicated in the left margin). Although one may sometimes need to return to a previous step, the order of steps is more or less fixed and one should not skip a single one. As an obvious example, one cannot analyze data that are not yet collected. However, it is important to realize that one needs to think one step ahead (i.e. one should know how to analyze data before one starts collecting them). For this reason, several steps have been grouped together in the following phases of the interdisciplinary research process: Orientation, Preparation, Data collection and analysis, and Finalization. (From Menken & Keesstra, 2016).

This formal description of the specific nature of the interdisciplinary research process and its challenges in terms of metacognition and reflection does not, perhaps, sufficiently capture how difficult it can be for a research team to reach the consensus required for bringing their project to fruition. Let us therefore close this chapter by briefly shedding some light on how such a consensus might be reached. Particularly in those cases when integration cannot be established with the help of a shared model or theory, participants must engage in a reflective dialogue to develop common ground and integrate their perspectives (Bammer, 2014; Eigenbrode et al., 2007). A dialogue like the one we facilitated with the authors of this volume engages the participants in reflecting on their (often implicit) assumptions and paradigms and uses a boundary object like a picture to confront participants with the differences between what they see and how others view the same picture, how they define the problem, and what they would do to research it. Such a dialogue can facilitate this process of joint metacognition and reflection, as represented in figure 2 above. Students and scholars can use a variety of tools to facilitate such reflective dialogue.² During the dialogue, researchers hopefully come to recognize the value of each other's starting points and appreciate each other's guiding examples³ of valuable research while seeking maximal coherence between them and preparing themselves for joint decision making on important steps of the research process – like the definition of the research problem and question (Keesstra, 2017).

Although this is not the place to elaborate further on that process, this brief sketch does convey that interdisciplinary – and transdisciplinary or action – research brings further challenges for participants in addition to those commonly faced in disciplinary or multidisciplinary research. Because of this, this research process is perhaps not only more demanding in terms of personal and team engagement, but generally also more time consuming, at least in its initial phase. Given the current research climate, this will for many present a major obstacle to getting involved in this type of research. We hope to have made clear, though, that the extra efforts are worth investing in this mode of research. In addition to the mutual learning that benefits each participant, the

² Online tools to facilitate reflective dialogue – and other collaboration tools – can be found at the websites of e.g. Transdisciplinary-Net (https://naturalsciences.ch/topics/co-producing_knowledge), Integration and Implementation Science (<https://i2s.anu.edu.au/resources/subject/collaboration/>), Science of Team Science (<https://www.teamsciencetoolkit.cancer.gov/>) and the Association for Interdisciplinary Studies (<https://interdisciplinarystudies.org/the-scholarship-of-interdisciplinary-teaching-and-learning/>).

³ Note that 'paradigma' in Greek means also 'example'. Kuhn also refers to paradigms as 'accepted examples of scientific practice' (Kuhn, 1970, p. 10).

results of such research are generally more robust and will hold under varying conditions, making their implementation often more successful than results which are obtained under much less comprehensive conditions. Moreover, both research institutions and individual researchers are increasingly convinced that innovation and creativity are less likely to emerge within isolated disciplines than from collaborations at the intersection of disciplines (Milman et al., 2015; National Academies of Sciences, 2004). This will be no different for city research: inviting participants to move beyond disciplinary horizons and engage in unfamiliar options in urban terrains that are jointly explored will make us as researchers and practitioners better equipped to deal with complex situations like the current pandemic, which are increasingly challenging our urban environments.

REFERENCES

- Bammer, G. (2014). From toolbox to big science project. A bold proposal. In M. O'Rourke, S. Crowley, S. D. Eigenbrode, & J. D. Wulfhorst (eds.), *Enhancing communication & collaboration in interdisciplinary research* (pp. 386-406). Los Angeles (CA): Sage Publications.
- Bradbury-Huang, H. (2008). Quality and “actionability”: What action researchers offer from the tradition of pragmatism. In A. B. Shani, S. Albers Mohrman, W. A. Pasmore, B. Stymne, & N. Adler (eds.), *Handbook of collaborative management research* (pp. 583-600). London: Sage Publications.
- Eigenbrode, S. D., O'Rourke, M., Wulfhorst, J. D., Althoff, D. M., Goldberg, C. S., Merrill, K., Winowiecki, L. (2007). Employing philosophical dialogue in collaborative science. *BioScience*, 57(1), 55-64.
- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). Thousand Oaks (CA): Sage Publications.
- Hirsch Hadorn, G., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., ... Zemp, E. (eds.). (2008). *Handbook of transdisciplinary research*. Dordrecht: Springer.
- Keestra, M. (2017). Meta-cognition and reflection by interdisciplinary experts: Insights from cognitive science and philosophy. *Issues in Interdisciplinary Studies*, 35, 121-169.
- Keestra, M. (2019). Imagination and actionability: Reflections on the future of interdisciplinarity, inspired by Julie Thompson Klein. *Issues in Interdisciplinary Studies*, 37(2), 110-129.
- Klein, J. T. (1996). *Crossing boundaries: Knowledge, disciplinarity, and interdisciplinarity*. Charlottesville, VA: University Press of Virginia.
- Krohn, W. (2010). Interdisciplinary cases and disciplinary knowledge – epistemic challenges of interdisciplinary research. In R. Frodeman, J. T. Klein, & C. Mitcham (eds.), *The Oxford handbook of interdisciplinarity* (pp. 31-49). Oxford: Oxford University Press.
- Kuhn, T. S. (1970). *The structure of scientific revolutions* (2nd, enlarged ed.). Chicago: University of Chicago Press.
- Lewandowsky, S., & Thomas, J. L. (2009). Expertise: Acquisition, limitations, and control. *Reviews of Human Factors and Ergonomics*, 5(1), 140-165.
- Looney, C., Donovan, S., O'Rourke, M., Crowley, S., Eigenbrode, S. D., Rotschy, L., . . . Wulfhorst, J. D. (2014). Seeing through the eyes of collaborators. Using toolbox workshops to enhance cross-disciplinary communication. In M. O'Rourke, S. Crowley, S. D. Eigenbrode, & J. D. Wulfhorst (eds.), *Enhancing communication & collaboration in interdisciplinary research* (p. 220-243). Los Angeles (CA): Sage Publications.
- Menken, S., & Keestra, M. (eds.). (2016). *An introduction to interdisciplinary research. Theory and practice*. Amsterdam: Amsterdam University Press.

- Milman, A., Marston, J. M., Godsey, S. E., Bolson, J., Jones, H. P., & Weiler, C. S. (2015). Scholarly motivations to conduct interdisciplinary climate change research. *Journal of Environmental Studies and Sciences*, 1-12.
- National Academies of Sciences (2004). *Facilitating interdisciplinary research*. Retrieved from Washington, DC: https://www.nap.edu/download.php?record_id=11153
- Newell, W. H. (2007). Decision making in interdisciplinary studies. In G. Morçöl (ed.), *Handbook of decision making* (p. 245-264). New York: Marcel-Dekker.
- Nowotny, H. (2003). Democratising expertise and socially robust knowledge. *Science and Public Policy*, 30, 151-156.
- Wimsatt, W. C. (2007). *Re-engineering philosophy for limited beings. Piecewise approximations to reality*. Harvard University Press.