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RESEARCH ARTICLE

Mediating practices in theory and action: apprehending and creating interdisciplinary data in biosocial birth cohort research

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Abstract
Biosocial birth cohort studies are uniquely positioned to be novel sites of interdisciplinary research. Their enduring commitment to specific field sites and populations, recurring grant renewal cycles, ability to ask prospective questions while drawing on long-standing data repositories, and more ensure ongoing collaboration and allow research to remain responsive to the evolving needs and timelines of multiple disciplines. However, it is widely recognised that interdisciplinary work is often easier imagined than achieved, and additional conditions are required to facilitate it beyond assembling teams of varied experts. This piece offers *mediating practices* as a concept that refers to the practical, multi-directional, and relational processes that attempt to resolve tensions that interdisciplinary teams often confront. Mediating practices bridge gaps among different disciplines' data and methods, often relying on pragmatic strategies, like re-designing data infrastructures or planning action items after a meeting, to do so. As such, mediating practices are crucial to conducting successful interdisciplinary research. Further, the concept of mediating practices foregrounds the actions of junior team members who often perform these practices, highlighting the need to foster epistemic humility and models of horizontal knowledge production in interdisciplinary teams. Here, the authors discuss their experiences and insights as members of interdisciplinary projects and outline how mediating practices emerged in these projects and enabled interdisciplinary success.

Keywords: Epidemiology; human ecology; population health; anthropology; interdisciplinary methods

Optimistic data imaginations

After getting permission to work with families in a long-standing birth cohort study in Mexico, a senior medical anthropologist excitedly came to the cohort's data manager. She requested every piece of data they had on the 6 mother–child households enrolled in her new ethnographic project to help inform her questions and analysis. The manager was stunned; it was an impossible request, though at the time, the anthropologist didn't understand why. The manager remarked how no one had come with a data request like that before and asked instead for specific variables, defined in the codebook, she would like retrieved.

A senior biostatistician and senior epidemiologist grew excited at the idea of performing a command-find search for every mention of sleep in a team's qualitative data. They thought this would help to quickly understand the complexities of sleep when designing a new health survey.

Ethnographic students of this original project, which focused on household water infrastructure, explained that despite the expansive nature of ethnography, this analytical exercise would result in patchy and incomplete data. Deriving insights on sleep would require much more effort and time, and data on sleep might even be missing completely, given this was not a primary focus of the original project.

In the two brief instances above, qualitative and quantitative researchers solicited data from each other within the context of a biosocial birth cohort collaboration. Both kinds of researchers were eager to incorporate insights enabled by another discipline's methods into their collaborative research efforts. Each researcher had a vision of what the other discipline's methods might entail, as well as an optimistic imagination of the data's scope and their ability to work with it. These instances, though seemingly ordinary, represent both the exceptional challenge and promise of practising interdisciplinary collaborative work. As this article will show, moments of misunderstanding like these are frequent in interdisciplinary collaborations. In instances like these, disciplinary differences become visible, creating a need for *mediating practices:* actions that facilitate researchers trained in very different disciplinary backgrounds to collaboratively create new knowledge together.

Introduction

Birth cohort studies have increasingly embraced interdisciplinarity, adopting 'biosocial' or 'biocultural' frameworks that integrate many forms of data to improve the understanding of health over the life course (Elliott 2008, 2019; McEachan *et al.*, 2020; Elliott and Carpentieri, 2020; Gibbon and Mathers, 2021; Roberts, 2021; Gibson *et al.*, 2021; Carpentieri *et al.*, 2023). Birth cohort studies are uniquely poised to integrate researchers and methodologies across the social and life sciences. Their sustained commitment to specific field sites and populations often spans decades; recurring cycles of grants offer repeated opportunities to adapt research methods, redefine objectives, and integrate new research questions; and their ability to ask prospective questions while drawing on long-standing data repositories ensures ongoing collaboration and allows research to remain responsive to the evolving needs and timelines of multiple disciplines. These factors facilitate collaboration across quantitative and qualitative disciplines.

Interdisciplinary work is much easier imagined, however, than practised. Scholars of science and technology studies have long described how knowledge production is deeply rooted in place, always relies on a web of interpersonal relations, and is enacted through practices (Haraway, 1988; Mol, 2002; Cramblit, 2014). And, amidst increasing calls for interdisciplinary collaborations, scientists and science studies scholars have begun to recognise how the assumptions and methods central to one discipline become unsettled – that is, they are no longer taken for granted – when working with scientists of a very different discipline. Working across disciplines, then, often requires researchers to confront and unsettle their own assumptions about how science should be practised. While this work can be incredibly generative, leading to innovative research, it also often produces misunderstandings and tensions. When left unaddressed, or when there are inequitable relations between team members of different disciplines, small misunderstandings can grow into lasting tensions (Domino *et al.*, 2007; Mol and Hardon, 2020; Daniel *et al.*, 2022; Carrigan & Wylie, 2023). These difficulties can stall progress at best or paralyse projects at worst. Resolving the tensions that arise from interdisciplinary differences takes immense labour, effort, sensitivity, and time (Boudart and Borra, 2023).

In this paper, the authors examine their experiences as project managers and collaborators within 'Neighborhood Environments as Socio-Techno-bio Systems' (NESTSMX), a *bioethnographic* (Roberts and Sanz, 2018) project nested in a well-established longitudinal birth cohort study in Mexico City, 'Early Life Exposures in Mexico to ENvironmental Toxicants' (ELEMENT) (Perng *et al.*, 2019). NESTSMX used ethnographic and quantitative methods to understand

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household water dynamics in the families enrolled in the ELEMENT birth cohort study (Roberts, 2021). This article is written from the perspective of early career researchers who have been variously involved in these endeavours as data managers both from ELEMENT (LAM) and NESTSMX (ZB, FC) or as external collaborators (CB). Each brings their own disciplinary trainings – from public health (LAM), sociocultural anthropology (ZB), and both (FC, CB) – to these collaborations. Some have observed the qualitative fieldwork as it happened, others have processed and stored the data as it was produced and analysed, and the entire author team has been part of the interdisciplinary conversations at the centre of this work. These roles provided the opportunity to reflect on how quantitative and qualitative practices, epistemologies, analytical frames, timelines, scopes, and more, coalesced, diverged, became unsettled, and progressed within biosocial birth cohort research.

Through participating, facilitating, and observing this work – particularly in noticing, attending to, and attempting to resolve obstacles that arose – it became clear that conducting interdisciplinary research required *mediating practices*. Mediating practices are those that attempt to resolve tensions that arise when teams bump up against disciplinary differences. Mediating practices can manifest in many forms: shared reading lists, a well-timed question to untangle misunderstandings, the act of naming discomfort as it arises when integrating disparate methods, deciding when to allocate extra time for discussion in meeting agendas, and the creation of new analytical processes together, to name a few. This paper describes how mediating practices emerge, what achievements they can facilitate, and concludes with the authors' optimism that intentionally adopting mediating practices could encourage innovative, biosocial birth cohort research in the future.

Background

The ELEMENT project is an ongoing, multi-institutional, 31-year longitudinal study comprising 3 birth cohorts sequentially enrolled over 10 years starting in 1994 in Mexico City, Mexico. The study included 1,643 mother–child pairs. ELEMENT's original aim was to investigate the influence of lead exposure on fetal and infant development. Since then, its scope has expanded to study the effects of other environmental exposures on health and neurodevelopment, as well as how these effects are modified by factors such as nutrition, the social environment, and genetic susceptibility. ELEMENT has provided the basis for numerous studies and publications, trained many researchers, and informed domestic and international environmental health policy (Perng *et al.*, 2019).

In 2012, a medical anthropologist, Elizabeth Roberts, began collaborating with the Mexico PI of ELEMENT, Mara Téllez Rojo, and the University of Michigan ELEMENT PI, Karen Peterson, to add a qualitative ethnographic component to this study. The first collaboration entailed carrying out in-depth ethnographic observation of the daily lives of ELEMENT participants to understand the historical, environmental, and social circumstances shaping health and inequality in these households in Mexico City (Roberts and Sanz, 2018; Roberts, 2019). After an initial round of fieldwork, Roberts, Téllez Rojo, other ELEMENT public health researchers, and environmental engineers designed a project focused specifically on household and neighbourhood dynamics of water access: 'Neighborhood Environments as Socio-Techno-bio Systems' (NESTSMX). The project recruited 59 ELEMENT households and carried out a series of home visits where ethnographic, biomarker, water infrastructure, and water quality data were collected (Roberts, 2021; Huberts *et al.*, 2023).

In NESTSMX and ELEMENT, disciplinary differences were prevalent, primarily between epidemiology and sociocultural/medical anthropology. At times, this led to moments of misunderstanding, tension, and paralysis. Epidemiology serves as a foundational science of public health due to its quantitative nature and its role in formulating and testing hypotheses on large representative datasets and study samples (Detels, 2015). Researchers start with specific research

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questions, design studies to test these hypotheses, and rigorously analyse data to establish significant associations between exposure variables and health outcomes, guiding public health interventions when potentially causal associations are observed. In contrast, anthropology – specifically, sociocultural anthropology – focuses on understanding how and why phenomena are produced and emerge within social, economic, and political contexts. Unlike more quantitative subfields such as biological anthropology (Calcagno, 2003), medical anthropology relies on sociocultural qualitative methods, particularly ethnography. This methodology prioritises long-term, in-depth engagement with small samples of participants through techniques like participant observation and interviews. Ethnography is open ended and iterative, generating insights and hypotheses through sustained interaction over time, aiming to capture the nuanced complexity of human experiences without rigidly predefined research questions.

The scopes and scales of epidemiology and sociocultural anthropology can be oppositional at times; this presents challenges when integrating the two disciplines in projects that also benefit greatly from their combination (Béhague *et al.*, 2008). The NESTSMX project was specifically designed to develop *bioethnography* as a methodology that leverages the analytical tools and strengths of these disciplines, with the hope of developing new ways to answer questions that the siloed fields cannot answer on their own (Roberts and Sanz, 2018). Elsewhere, this methodology has been utilised to describe how unsettling boundaries between disciplines through this symmetric analytical process can be difficult but can also be key to the innovation these collaborations achieve (Boudart and Borra, 2023). These budding bioethnographic ventures have already begun to make good on their promise to 'make better numbers' about water intermittency in Mexico with powerful statistical findings that attune to lived realities (Roberts, 2021; Figueroa-Oropeza *et al.*, 2023; Osorio, 2023). It is through participation in the execution of these projects that mediating practices have been identified as central to making these interdisciplinary collaborations work.

Mediating practices in theory and action

Mediating practices are the practical, multi-directional, and relational processes that attempt to resolve tensions that interdisciplinary teams often confront. It is important not to delineate singular actors as mediators but rather to describe mediating practices, for several key reasons. First, different people can partake in mediation exercises in varying degrees throughout a long-term research collaboration and even throughout a single team meeting. Second, the relationship between biological and social methods and epistemologies in a biosocial collaboration is dynamic, iterative, and constantly renegotiated. Third, mediations are always partial, and no single 'mediator' has a master view from which to then elucidate other collaborators. And finally, mediation requires a multi-directional interaction between disciplinary habits and preferences across the whole team. Describing individuals as mediators masks the interactive, relational, and multi-directional nature of these practices in a research collaboration.

So, how do mediating practices emerge and operate in these collaborations? First, there must be a differentiation between the attitudes and actions involved. Reflecting on the brief opening vignettes, the first key aspect of mediating practices comes into view: the cultivation of shared intent, a willingness to remain open and receptive to different methods and forms of data, and the practice of epistemic humility. A prerequisite to interdisciplinary work involves all team members adopting an attitude of humility and receptivity. Collaborators must acknowledge the limits of their own scientific practices and recognise the promise and value of other disciplines' data and methods. Receptivity includes trusting that different disciplines' relevance to one another and ability to generate new knowledge together will emerge in surprising and exciting ways as the collaboration continues, even if the precise path to getting there is not always obvious from the outset (Leighton and Roberts, 2020).

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Epistemic humility

The NESTSMX collaboration was characterised by a commitment to embracing interdisciplinarity and epistemic humility, as demonstrated by the active willingness to dive into unfamiliar data terrains and learn new ways to orient to shared questions, as well as through the ongoing dedication to addressing the overwhelm that arose in the process of doing so. Interdisciplinary projects like these ask each team member to engage with different disciplinary mindsets, to suspend single-discipline methodological habits, and to adopt a receptive and humble approach to knowledge production. In the paper's opening examples, researchers admired one another's data repositories, considering them to be powerful sources of data worth integrating into their analyses moving forward. Yet even with this theoretical commitment to interdisciplinarity, challenges remained in putting bioethnographic collaboration into practice. More work was required to make each discipline's data discoverable, digestible, and fungible to one another – to create some kind of common ground from which the team could move forward together. Here is where the heart of the labour lies in mediating practices.

Enabling productive data analysis

Both instances outlined in the opening vignettes reveal how an additional step was required to move forward, since productive data analysis could not be accomplished by merely letting each expert loose in the datasets they now shared. While cultivating attitudes of humility and bi-directionality often hinges on discursive action and affective labour, mediating practices in action must translate those dynamic interpersonal processes into concrete next steps. These moments called for some practice or person to bridge the gap between each discipline's data and methods and materialise interdisciplinary action.

For example, in the instance of the team desiring a quick and easy sleep-informed analysis, a junior ethnographic team member needed to clarify to the senior quantitative team members that sleep may appear in the ethnographic data, but perhaps not in a patterned way, because while ethnography provides a deep understanding of daily life, the researchers did not study sleep systematically in all households. Here, there needed to be time and space for the quantitative team members to characterise the outputs they hoped to achieve and, from there, to discuss how the qualitative team members could help develop an analytical process to ascertain them. This collaborative process included identifying sleep-related patterns, as well as other health-related conditions the team sought to understand. Such exchanges exemplified the iterative discussions characteristic of integrating ethnographic data with quantitative methods in NESTSMX. These discussions relied on structured meetings involving project PIs, ethnographers (who would comb through the data and tag key quotes with 'codes' in Atlas.ti software while maintaining context), and graduate students (who would apply multiple forms of analysis to the collectively defined categories).

Mediating practices in these cases included guided meetings; flexible discussions; quantitative expertise to describe what the data needed to look like in order to perform the required analyses; qualitative expertise to mine the data and transform it into something transmutable; data managers to enter these new variables and models into the data system; and patience from all members when conversations stalled, when intentions were unclear, when each discipline bumped up against the limits of what was possible in the other, or when yet another meeting was required to fully parse out these objectives. This took time and concerted effort but eventually yielded novel 'ethnographically derived variables', which had definitions that were rooted in context and lived reality and could be used for statistical modelling and scaling up with larger datasets.

Creative data infrastructures

Data and project managers' responsibilities in these teams included making data accessible to diverse users and documenting how the analyses had been performed. Roles often involved

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imagining and designing ways to store data so that it could be useful to both ethnographic and quantitative team members. When tasked with data management, a mediating practice, for example, meant designing an ID structure that consistently spanned across all materials or creating data guides and variable and code dictionaries that clearly documented how quantitative variables and qualitative codes had emerged through these interdisciplinary methods. These efforts culminated in a novel data system that was able to harmonise the ethnographic and numerical data in one place.

This prompts a return to the other moment outlined at the beginning of this paper – the original data request by the anthropologist at the onset of this collaboration. Without a clear hypothesis or set of variables to guide the extraction of the dataset, the request was impractical and resource-intensive due to the logistical and computational challenges posed by the large volume of data accumulated over three decades in an ever-changing data system. However, because ethnographers don't need to know their hypotheses or define data points in advance – and often view this openness as a methodological strength – a task like proposing to work with data that stably existed in an archive had been difficult to imagine. This challenge underscored a fundamental disconnect between the methodological approaches of ethnography and biostatistics that the interdisciplinary collaboration had to confront.

In 2023, ZB and LAM redesigned the existing birth cohort's request form to make the innovated data repository accessible to a wide range of disciplines and to help formalise this process for those who came after them. To embrace the ethnographic data that had been carefully rendered to be stored alongside the existing quantitative data, the team redesigned the text fields of the data request form itself; created layers of stratified access to interviews, recordings, and photos to address privacy protections; and constructed a protocol whereby ethnographic requests would also be evaluated by a set of qualitative researchers. Instead of listing a single hypothesis, population subset, specification of discrete versus continuous variables, or some other component of a standardised data access request, this new protocol, born out of mediating practices, now enables ELEMENT's quantitative data managers to know what to do with loose themes and topics of proposed qualitative studies that lacked hypotheses, included inquiries into transcript recordings or photographs, and mentioned considerations of relationships between research staff, field workers, and participants.

In many epidemiology studies, it is standard practice to establish pathways for external collaborators to access their datasets, enabling researchers to submit data requests for specific variables or outputs. However, this is unconventional in a field like sociocultural anthropology and offers entirely new horizons for data sharing. This process of redesigning the data request form embodied the essential bi-directionality of these endeavours; here, anthropology learned and adopted a vital epidemiological practice, and epidemiological data storage became more flexible and amenable to ethnographic data and inquiries.

This data request form has now come to stand as a symbol of great interdisciplinary effort and collaboration over the long term. It also illustrates how each team member operates in this partial space – no single person has a complete view of the data repository or can evaluate a request form alone. Mediation practices are not only tools for effective interdisciplinary collaboration but structural building blocks that influence the course of research both epistemically and methodologically. These practices, and those who perform them, bring a new kind of expertise to these collaborations that engender novel ways of knowing and producing knowledge.

Power relations and the potential of junior trainees

While it is important to maintain that no single person is the sole mediator in a project, mediating practices do cluster around certain positionalities in a project. For example, the team members who regularly attended both high-level conceptual meetings with PIs and detail-oriented meetings with

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data managers and research assistants were often tasked with translating the conceptual work of interdisciplinarity into decisive action (the role of these figures in particular has been described elsewhere) (Boudart and Borra, 2023). The pragmatic execution of effective collaboration often rests heavily on the shoulders of auxiliary or junior team members. The responsibility for tasks such as note-taking, agenda-setting, mediating discussions, and adapting data request forms requires these team members to be attentive and responsive to all members of an interdisciplinary project. This includes translating between disciplines when misunderstandings emerge and figuring out how to transform a group discussion into concrete action items. Thus, these members affectively and effectively recognise tensions that arise from colliding disciplinary backgrounds and think creatively of ways forward that feel collective. Therefore, seemingly mundane project and data management tasks become crucial spaces of integrating diverse disciplines – it is through these management tasks that teams can begin to transform the crucial attitude of epistemic humility into tangible strategies and concrete actions that propel the project forward into interdisciplinary *practice*.

Additionally, the positions of junior team members may be particularly conducive to mediating practices *because* of their junior status. While PIs are well-established experts in their field and have dedicated a successful career to researching and publishing within the norms of their primary discipline, junior team members are generally beginning or are in the middle of their training in a particular discipline. In some ways, early career positions afford greater flexibility and receptivity towards different methods and epistemologies because these scholars are not yet fully trained in any single discipline. Additionally, at the time of this publication, early career scholars also began their training in a moment when interdisciplinarity was becoming more popular, affording more exposure to interdisciplinary training and literature.

It is critical to recognise here that there is a certain degree of power redistribution necessary to allow for successful mediation, since it requires valuing seemingly menial tasks of project organisation and facilitation. In NESTSMX, all team members took an active role in project design and generating new processes for data collection and analysis. Fieldwork staff, project managers, and PIs were all involved in discussions about how to write field notes, how to manage and store data, and how to conduct an analysis. The receptivity from project leadership to innovation from junior project staff was crucial to developing innovative research practices that integrated diverse data and methods. This, in part, is what differentiates mediating practices as a concept from other work on collaboration or 'co-production', which focuses on the process of bringing together experts of different disciplines, knowledge practices, and lived realities to create knowledge together equitably (Wylie & Murillo, 2023). While these crucial frames emphasise the collaborative efforts of experts negotiating different epistemologies, mediating practices centre on the pragmatic work that is done to enable these projects, attending to the actions that help to overcome moments of overwhelm or paralysis. The concept of mediating practices highlights the pragmatic work and expertise that is unbounded to a specific discipline or background – work that often falls to team members who are not yet experts in any of the disciplines that make the project 'interdisciplinary'. Mediating practices bring attention to the practical labour that allows teams to function despite/because of/between differences, navigating tensions that can stall progress.

The promise of biosocial birth cohort research and horizontal models of knowledge production

The research architecture in birth cohort studies has the incredible potential to facilitate interdisciplinary biosocial research. Birth cohort studies foster collaboration by enabling experts across the life and social sciences to address complex questions around health and disease in a dynamic and iterative fashion over the long term. Comprehensive data collection is a hallmark of these repositories, including genetic, epigenetic, socioeconomic, and psychosocial data, which lends itself well to incorporating qualitative data into these data resources. However, in order to

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achieve the interdisciplinary aims enabled by these collaborations, an additional condition is required. As this paper argues, mediating practices must be recognised and valued to realise these projects' interdisciplinary potential.

The reflections included here on mediating practices within the ELEMENT and NESTSMX studies point to a particular opportunity for biosocial collaborations in birth cohort studies and advocate for 'horizontal approaches' to leadership and collective work (Hardt and Negri, 2017). Instead of envisioning teams and expertise in a vertical hierarchical fashion, mediating practices emphasise how all members of a team can contribute conceptually and pragmatically to interdisciplinary innovation, regardless of their positions. Each member brings a partial, yet critical, component to the work. Particularly relevant to the complexity of birth cohort studies, no single team member has a complete view or grasp of the project, data repository, or analytical frames but rather relies on interdependence to achieve the project's goals. As members of collaborative teams that have been empowered to implement mediating practices and valued for doing so, the authors advocate for more teams to adopt a more horizontal stance towards knowledge production, where the expertise and labour involved in mediating practices are recognised and considered alongside the disciplinary expertise of the senior researchers who lead these teams. The experiences with NESTMX and ELEMENT demonstrate that an atmosphere of epistemic humility and horizontal knowledge production provides fertile ground for mediating practices that will continue to push projects, fields, and researchers into exciting, uncharted domains.

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