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Undisciplining the university through shared purpose, practice, and place

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Interdisciplinary scholarship and education remains elusive at modern universities, despite efforts at both the individual and institutional levels. The objective of this paper is to identify the main motivations that bring different disciplines together in joint research and identify some of the obstacles to that coming together. Here we propose that shared purpose (why do I participate?), practice (how do we interact?), and place (where do we interact?) are, in descending order, the most important drivers for what we call “undisciplinary” research in an interaction of different disciplines. Through unstructured workshops we found the choice of participants (who participates?), aspects of time (when do we interact?), and especially the research topics and focus (what are we working on?), to be less important for individual faculty engagement. Metaphor analysis obtained during a charrette-style workshop with 13 faculty from multiple disciplines suggested “inter-epistemological ways of knowing” rather than fields of study to move us from disciplinary to interdisciplinary to undisciplinary scholarship and education. Specifically, the broad intent (why do we participate?) was found to increase the impact of undisciplinary approaches that served as drivers for engagement. These lessons learned from a series of workshops were put to the test at an experimental center that clarified the importance of both synchronous and asynchronous interactions in a common space large enough to allow these and located outside the university. Despite the valuable insights gained in what undisciplinary interaction may look like in a center, it remained clear that space design must start by mapping out why and how individuals in different disciplines may want to interact at a given institution to generate buy-in and build the foundation for continuous refinement of an institutional strategy.

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Introduction

This paper tells a story about the coming together of scientists whose practice led them to an inquiry into the nature of what artists do, with artists whose practice led them into an effort to complement what scientists do, with an aim of reintroducing joy, energy, curiosity, and possibility into the research of all involved. The conflict in this story is related to the confines of institutions where science (and other forms of research) is often conducted (Firestein, 2012), and the limits institutions put on inquiry, interpretation, and action by maintaining institutions that are organized by disciplines (Osborn, 2008; Scheffer, 2014; Klein, 2021).

Within the paragraphs of this article, the different languages and jargons of academics, scientists, and artists overlap and intersect, and in this contrast between ways of writing and thinking lies a kind of *data*. These data in themselves point to certain critical flaws in the ways the university, or academia generally, is structured, as it largely prevents exchanges in terminology and even how to approach scholarship between disciplines. It also reveals problems with the ways artists are trained in their own academies, and how artistic practice is perceived outside of those academies. The approach to these challenges produced a type of collaborative practice for which we use the word “undisciplinary” that we develop in more detail in this article.

Our subject is the nature of ‘disciplines’ in learning and knowing, and the implications of this framework on sites and ways of learning, with the objective to identify motivation for disciplines to interact. Some authors here are immersed in the university (as indicated by their institutional affiliation) and looking at what might be achieved, research-wise, outside of it. Other authors here work independently of institutions and are concerned with whether and to what extent institutions can be changed to better suit the context of our time and the concerns of the future.

The reader may therefore find portions of this paper methodical, practical, or impersonal. Other portions may border on the poetical, personal, and narrative. In this collaboration we ask whether an academic or scholarly process can also serve as a story or an artwork, with which we can not only convey information but also generate empathy and engagement.

Interdisciplinarity and the limits of STEAM disciplinarity

The modern university is more siloed than ever (Keynejad et al., 2021), at the same time we observe deep fractures in society and communities. Within academia, we question whether a high degree of separation may also be counterproductive to the aims of scholarship (Yang et al., 2021). Disciplines within the university are ever more specialized (Turner, 2014) with sometimes uncertain paths to teaching interdisciplinarity (Larson et al., 2011), as requisite knowledge and technical proficiency increase, as education focuses on conveying marketable skills rather than broad vision (Stewart et al., 2019), and as time constraints with ensuing stress levels leave no room for play as a way for unstructured exploration but demand a focus on reaching the next milestone.

At the same time as university scholarship explores interdisciplinarity, the demands for solutions (or the Western ethos of *solutionism* (Morozov, 2013) and commodification (Altbach and Reisberg, 2018)) shouldered by the university are ever increasing, including developing vaccines for a pandemic, eradicating inequality and systemic racism, mitigating and adapting to climate change, addressing food security, or ensuring access to clean water (Dosi et al., 2006; Stamm et al., 2022). Tackling such complex issues is thought to require knowledge, skills and technology from multiple disciplines (Klein, 1990; Moirano et al.,

2020), usually by scholars within the university, but increasingly recognizing that society outside the university (including but not limited to stakeholders) play an indispensable role (Mauser et al., 2013; Chambers et al., 2021). The interactions with sectors outside the university is often also called transdisciplinary; for the purpose of our argument, we do not distinguish between multidisciplinary, interdisciplinary, crossdisciplinary and transdisciplinary—but we consciously choose undisciplinary to imply a challenge to the utility of boundaries between intellectual ‘territories’ or disciplines (Moirano et al., 2020; Klein, 2021). Components that define such interdisciplinary collaboration can include interdependence and mutuality, co-creation, flexibility, collective ownership of goals, and reflection on process (Bronstein, 2003; Klein, 2021). Reflecting the multiple interactions that underlie many problem-solving exercises are proposals that interdisciplinary collaborations can be explained by self-organizing principles of complex systems (Newell, 2001). These examples attest to the many efforts of how to provide a theoretical framework for interdisciplinarity with ongoing debates about what interdisciplinarity is and how it is measured (Zwanenburg et al., 2022).

Specifically, the science, technology, engineering, art, and mathematics (STEM-to-STEAM) initiatives (Bequette and Bequette, 2012; Maeda, 2013; Segarra et al., 2018) provided an initial response to the problem of interdisciplinarity, but the very acronym reveals its inherent reverence for disciplinarity. ‘STEAM teams,’ in these authors’ experience, become microcosms of the hierarchical thinking that permeates the disciplinary landscape: artists serving on ‘STEAM teams’ inevitably end up doing data visualization and website and report design—on behalf of the scientists and engineers whose disciplines are culturally considered more ‘rigorous.’ University silos remain intact, and beyond this, they are imbued with hierarchies of value that are reflective of wider social biases (i.e., the inherent gendering of disciplines considered variously ‘hard’ or ‘soft’; Hedges, 1987; Chubb and Derrick, 2020). In our opinion, too few success stories exist that break up institutional and behavioral barriers to form lasting, meaningful, and equitable engagement among disciplines. Lower funding for interdisciplinary research (Bromham et al., 2016) and lower scholarly productivity (Leahey et al., 2017) appear to pose additional barriers to engagement.

Here we demonstrate that by catalyzing universal motivation (“why we engage”) and moving from *disciplinary* to *interdisciplinary* to *undisciplinary* approaches (“how we engage” and “where we engage”), we can generate new and more effective ways of engagement. Through a combination of workshops, charrette, individual conversations, group feedback, and reflections (methods described in figure captions and using story-telling below), we develop underlying principles that help foster the elusive collaboration among disciplines within the university and with society outside the university.

Individual and collective motivation for interdisciplinary collaborations

This work began intuitively at an individual level and then was cultivated socially. Feeling variously ‘isolated’ and at a stage in their academic career where a need was felt to ‘spread wings,’ some of the participating natural scientists engaged in this work intuitively through meeting artists and experimenting with structures through which this seemingly ‘other’ discipline that could be more involved in the academic curricula for which they were responsible. How to do this? In this instance, three factors were necessary to enable the sought-after catalysis and typically start with individual interactions and conversations.

“At the core (there) is *an institution of art that brought me to artists and the artists to me* (the institutions bring artists into the open and provide the platform for the necessary first step; [...]). It is also *a story of me being open and seeking out institutions of art* (how is that happening? Long-term engagement with the topic, but also associations with the institutions). And then it is a story of *serendipitous conversations around the dinner table and on long walks through the woods in the snow*, where ideas emerge.” (email from J. Lehmann to A. Freiband, June 17, 2021; emphasis added)

These engagements, however, seemed sporadic, difficult to maintain, and had uncertain outcomes, making it difficult to perceive them as a part of continued inquiry, or to understand how they might be codified and made repeatable for other members of the academic community. The desire existed to establish some institutional mechanism at the university that allowed for the continual renewal and support for such explorations beyond one’s own discipline, for the purpose of enriching and expanding one’s discipline. This became the aim of our study.

A similar question arises among artists, both within and without the university or art academy. How does artistic research get done? How do artistic practices expand and evolve? Here there is even less tradition and precedent, because artistic education in the West is highly subjective and rooted in Romantic notions of the intuitive and the iterative (Yanai and Lercher, 2020). This situation is complicated by the pervasive influence of capitalist survivalism, where artists are trained with the seemingly conflicting messages of individualism (be yourself, be original, be creative, and if necessary be alone) and material accomplishment (incorporate yourself, brand yourself, market yourself, insinuate yourself) (Dobrovsky and Graeber, 2019). We therefore embarked on a series of two workshops to clarify motivations for interdisciplinary collaborations.

Identifying motivation of interdisciplinary collaboration—the first workshop

Coming together to explore how we can study interdisciplinarity, the scientists proposed a formal gathering (reflecting familiarity with the structure of forums, conferences, roundtables). The artists suggested throwing a kind of party. These both aim to create the circumstances for spontaneous conversation and ideation, but from two very different traditions and perspectives. It represented a divergent relationship to structure between the disciplines.

We settled on an initial one-day workshop, in which a small number of participants cleared a full afternoon and gathered in a pleasant and well-lit meeting room over sandwiches and coffee, and in front of a whiteboard, post-it notes, and view of natural landscapes. The conversation was framed as a step toward the development of an interdisciplinary research center. We got as far as the first question (what brought us all here?) before the discussion opened up into a free-flowing dialog—which we attempted to map as it progressed, using the board and post-its, and include our subjective biases as part of an initial reflexive component to the discussion.

We each identified our motivations for pursuing interdisciplinary activity. Those motivations were used to identify categories of drivers (Fig. 1) that would later be used to structure a charrette-style workshop with iterative break-out groups of a larger group (Fig. 2).

What drove people to collaborative research and gave impetus to overcoming disciplinary confinement? Our mapping suggested these motives could be grouped as such:

- who would be interesting to attract into conversation (WHO)—or, *because we like to meet new people*
- what is the group working on and for what reason (WHAT/WHY)—*because we want to work with purpose*
- how is the interaction functioning, or what kinds of methods or practice will be involved (HOW)—*because we want to try new things, and new ways of doing old ones*

All of these ideas had formed outside of a circle of priority drawn on the wall, and now we labored to move some ideas into that circle. Interestingly, during prioritization (Fig. 1), the WHO morphed from individual disciplines (e.g., engineer, artist, entrepreneur) to what the actors do (‘who gets to say’) with few aspects actually moving to the center. This is an early indication that our sense of interdisciplinary success did not depend on labels and identities as much as on processes and embodiments. The WHAT/WHY evolved away from ‘issues’ (e.g., climate change) to concepts (e.g., precarity)—which suggests a move away from issue-based solutionism toward systemic action. Finally, the HOW changed from organizational principles (e.g., hub-and-spoke) to emotions (e.g., risk).

Intriguing concepts of being “undisciplinarity” moved to the center of the debate. HOW populated a large proportion of the circle, and whether motivations originated from WHO–WHAT–HOW became somewhat indistinguishable towards the center—perhaps all three played their part. We saw emerging an emphasis on process—a way of working and a community within which to work—over topic.

We were also challenged to bring language into alignment, around terms such as ‘economy’ and ‘sustainability’ and ‘precarity’ which held very different meanings for different participants, often based on their training and their native intellectual ‘territory.’ The different understandings, however, proved to be informative, because there was resonance in the different meanings that reflected into and informed each of our understanding. For example, ‘sustainability,’ which to the environmental scientists was primarily about having a natural system fall into an equilibrium that can be continuous, for the artist and the administrators (caught in the rough currents of capitalism) this term has effectively become a synonym for profitability. This prompted all participants to consider the overarching meaning of continuity—and a recognition that both natural and human systems required it. These observations generate a language that can unite actors even from different disciplinary backgrounds, can inform different actors in new ways, and provide guidance as to how conversations may be structured in order to develop language.

Testing motivations for interdisciplinary collaboration—the second workshop

We felt we had sufficient discussion material in place with which to take a next step, to examine how people from very different disciplines across a university would react to our identified categories of motivations for becoming involved in ‘interdisciplinary’ research (WHO, WHAT, HOW, WHEN, WHERE, Fig. 2; definitions in Box 1). Borrowing a term from the design field, we planned a *charrette*, a more intensive and structured group activity that was intended to foster spontaneous discussion and surprising outcomes (methods explained in Fig. 2).

We started by discussing names of individuals (WHO) that we wanted to bring together as invitees. Central was the perceived interest of potential participants in a conversation about interdisciplinary work. The departmental affiliation (discipline) played a role as a first filter in identifying diverse disciplinary backgrounds. Weighing various factors such as these, as well as social factors (network limits, availability, group size and makeup), we

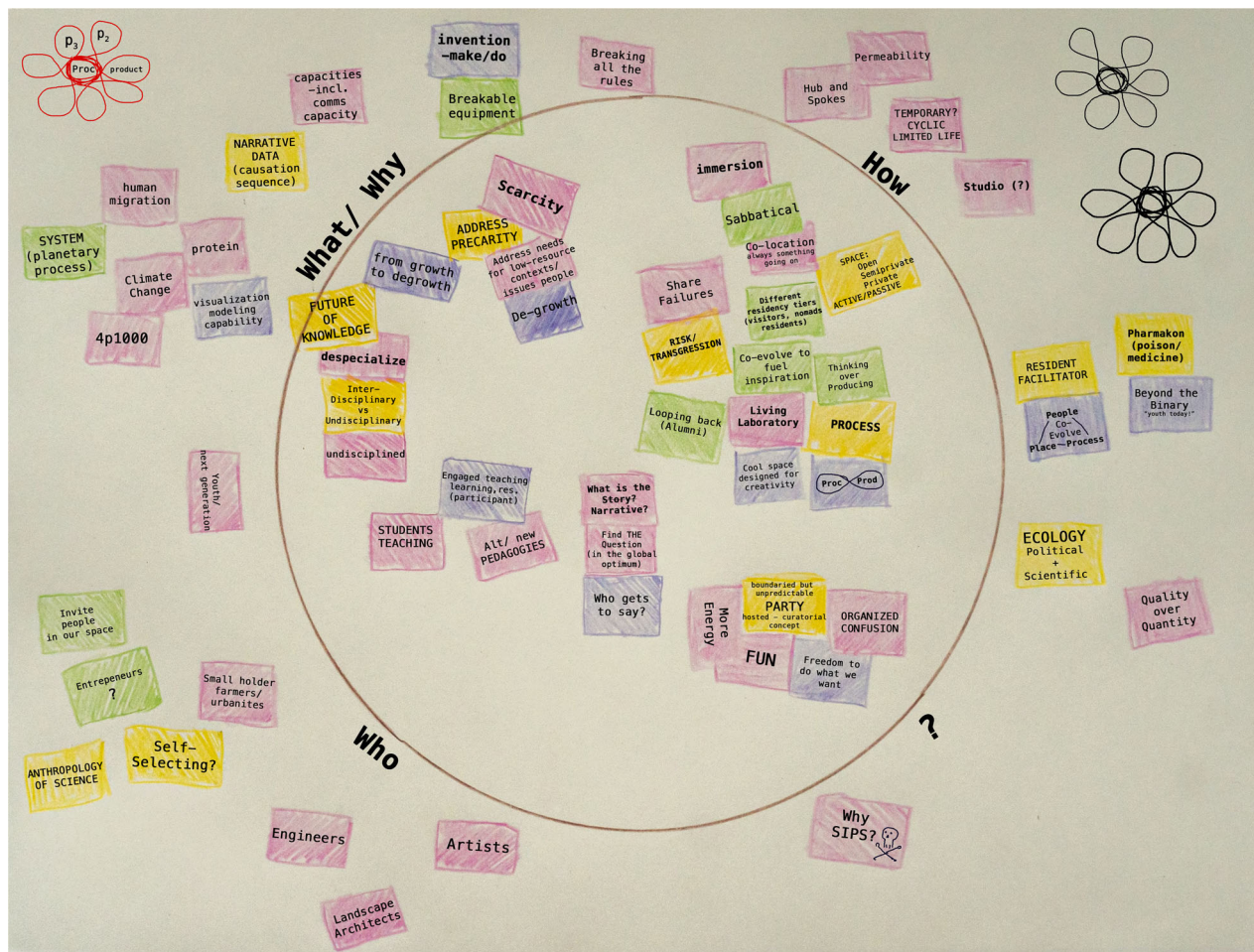


Fig. 1 Identification of motivation for engaging in an interdisciplinary activity. Motivations used to identify categories of WHAT/WHY, HOW, and WHO (Definitions in Box 1). Outcome of a workshop lasting 6 h on January 15, 2020 with three plant-science faculty, one communications specialist, one expert in organizational development, and an artist/arts-based researcher. Note the ‘flower’ forms which represent an attempted visualization of an interdisciplinary process—movement around a core principle with various ‘petals’/projects that then cycle back and feed the center again.

added eight individuals to the core group of five, introducing scholars from humanities, science, and design fields. It was not a comprehensive representation of all possible disciplines, but offered a range of diverse perspectives through which we could further explore interdisciplinarity.

We based the structure of the charrette on the outcomes of the previous workshop: WHO, HOW, WHY, WHERE, WHEN, WHAT. Participants were rotated through thematic discussions in breakout rooms (the charrette was held virtually, for reason of the pandemic), pivoting around a question of what their understanding of their *discipline* was, and what kept them ‘in’ it, and to what extent they wanted to also work ‘out’ of it. Our stated goal, again, was direction in the development of an *interdisciplinary center* (i.e., WHO might be a part of such a center, WHERE might such a center be situated, etc.), but the open nature of the discussion led to a broad qualitative experiential exchange, within which participants discussed their work, their relationship to their institutions, and their hopes for a future ‘idealized’ research environment.

Considering that our central question was what an interdisciplinary research center might work on (WHAT), this portion of the discussion contained the fewest statements connected to the originating question (Fig. 3), even though it was a ‘full cohort’ discussion, as opposed to small breakout groups - suggesting that it may be impossible to begin with the question of what we should

work on. Does this undermine the conventional procedure of beginning with a research question? We can see here that even when trying to reply to the question of WHAT they would like to work on, more often than not people answered with HOW they would like to work. Within this same discussion, though, we also examined the nature of disciplinarity itself, and this analysis was much more revealing, as we will come back to later.

Participants were broken out, 3 or 4 at a time, into the WHO discussion space to talk about with whom they would like to populate a prospective research center. Rather than focusing on individuals, we discussed qualities deemed desirable for participating in ‘interdisciplinary’ research. It is telling that even within this list of criteria, we see again a desire for fluidity, openness, pursuit of pleasure, and a distinct lack of adherence to disciplinary convention.

We included the question of WHEN as a category of discussion perhaps out of a sense of semantic symmetry. Anyone engaged in a discussion of time in the midst of the pandemic and its lockdown periods, however, is going to be perceiving time through significant distortions. Perhaps this is why people offered very limited input on the question of time (Fig. 3). That said, when time was mentioned, it again had more to do with HOW to work (i.e., slowly, beginning right away, cyclically).

This conversation took place in the early days of a global transition to reliance on virtual meetings, and so within the

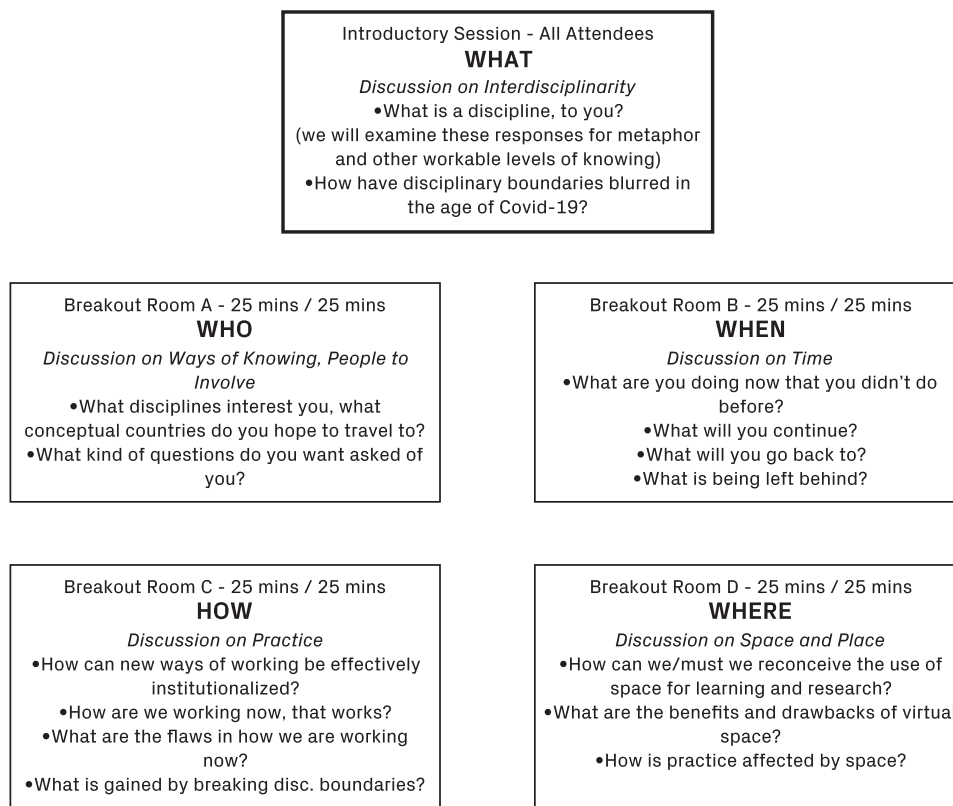


Fig. 2 Outline of the charrette structure through which we examined research and interdisciplinarity. The charrette consisted of an introduction session of 50 min, two breakout sessions of 25 min each, and a report session of 30 min, conducted June 15, 2020. The conversations were recorded, transcribed and analyzed as shown in Figs. 3 and 4.

Box 1 | Clarifying and aligning language

Obvious challenges to connecting disciplines are the different terminologies and ways of communication. During a charrette with participants from academic institutions focusing on the humanities, engineering, art, and science, as well as during brainstorming sessions with students, the terminology used here was perceived in different ways. For the purpose of this discussion, we therefore propose the following terminology:

WHAT(/WHY): The topic or the question that is the object of inquiry. Examples for the WHAT may include economic development, climate change, energy or food security, water quality.

WHEN: The time for interactions. This may include a time in the professional life (student, young academic, professor pre or post tenure; equivalent outside the university), during the year, or during the week or day when interactions may be sought out, most rewarding, or even only possible.

HOW: The mode and ways of interacting. This motivation is wide-ranging, from the physical arrangement of space, the modes of engagement, the procedural goals, or personality traits and behavior, and relates most closely to emotion (fun, freedom, confusion, etc.) and triggered the term 'undisciplinary'.

WHERE: The location where interactions take place. Typically, these are forms of real estate invariably called a center that houses core staff. However, this can also include any place on or off a university campus and does not have to be permanent or unique, but can be temporary and in multiple places, or even virtual.

WHO: The participants in the inquiry. These may not only include professors and students but also administrators and technicians inside the university as well as stakeholders outside the university.

Later, we separated the WHY dimension from WHAT:

WHY: The motivation or higher goal. This may range from abstract universal benefits (doing something significant in the world together) to universal goods and focuses on relevance for action.

conversation of WHERE, there was also consideration of the pros and cons to physical space as opposed to virtual. A 'center' within an institutional context implies a physical entity or perhaps an office or studio complex (see 'Center unpacked,' below), but the participants also identified numerous conceptual qualities to such a center (e.g. 'close,' 'in the cracks,' 'at a site of resistance'; Fig. 3). We also observed, in this segment, the frisson between various participants' terminology around place—from 'lab' to 'field,' 'studio' to 'office,' the names of the places we work point—again—to key differences in HOW we work.

It is worth highlighting how participants *do not* want to work—with 'anxiety,' 'egos and hierarchies,' 'canons,' 'labels,' and mere 'performativity' (Fig. 3). These complaints indicated some of the symptoms which dominate institutionally based scholarship and research (compare Baptista and Klein, 2022). As a remedy, the participants were looking for ways of working that are 'fluid,' 'expansive and inclusive,' 'permeable,' and 'social,' among other things. These descriptions of aspired-to methods contain a telling array of metaphors, which we examine in the next section, hoping to find answers to the question of 'what is a discipline,' and how

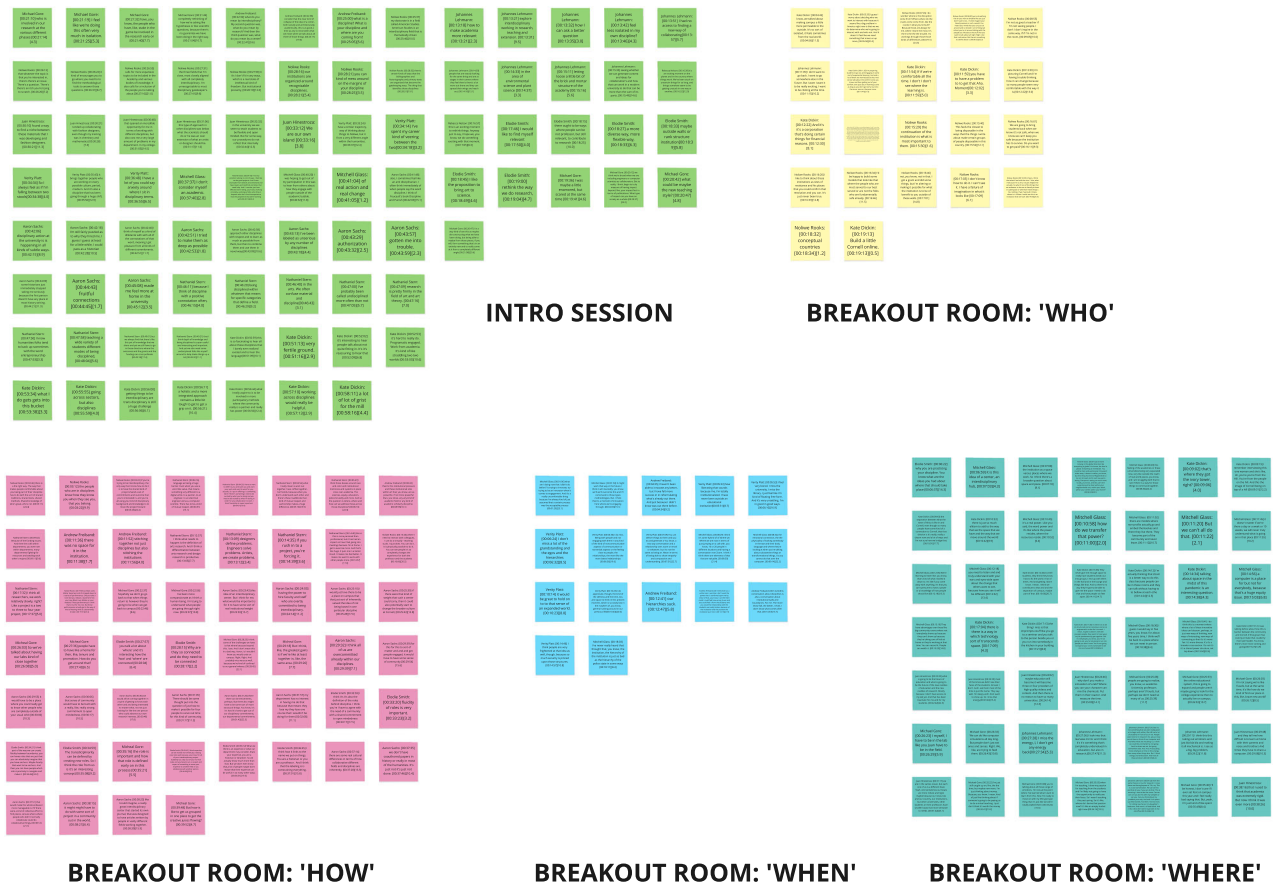


Fig. 3 Conversation analysis overview. Colored squares represented selected statements from the charrette participants. Colors indicate which ‘breakout’ conversation the statements came from, therefore visualizing how ‘on-’ or ‘off-topic’ the conversations were kept (method described in Fig. 2).

can it be transcended in order to achieve a contemporary research apparatus.

Defining the disciplinary to chart the undisciplinary

From the charrette transcript:

[00:22:23] this desire to develop an interdisciplinary research center at Cornell University. And, you know, my first question was, well, what do you mean by interdisciplinary? My second question was, what do you mean by research? And then the third question was, what do you mean by a center? [00:22:41][18.4]

First let us examine what we mean when we say ‘interdisciplinary,’ by examining what we mean when we talk about our ‘discipline,’ within our conversations. A structural understanding of ‘discipline’ itself may offer a path to a truly reimagined way of working with others.

For our analysis, we used metaphors in speech that reveal structures of thought that can also show us the constraints on our own thinking. To map these metaphors, and explore the nature of participants’ perception of their ‘discipline,’ we identified key words in conversation and clustered them around the metaphors they suggest (Fig. 4).

We found that, implicitly, participants perceived a discipline to resemble a territory—often an arable or barren one (such as a farm), with a host of defining characteristics, and behaviors that are provoked as a result of this identification. It has boundaries (with height and depth, like a wall), with gates and gatekeepers, and various degrees of ‘fertility’ and a relationship between credibility and one’s proximity to the edges. This is not the

exclusive defining metaphor, but all of them convey the possibility of isolation, separation, division, property, and even precarity. With these prevailing metaphors at play, it is no wonder this cohort expressed a desire for *inter*-disciplinarity (metaphorically, this reflects a desire for space to roam, the ability to travel and sightsee, to migrate and move). This analysis also captured the resonant alternative meaning of the word ‘discipline:’ to punish, or to enforce obedience through punitive action (Foucault, 1995).

If ‘interdisciplinarity’ is limited by our conceptions of ‘discipline’ (i.e., a field, an area, with boundaries and margins and barriers between them—or worse, a regime of punishment), can we reformulate ‘interdisciplinary’ rather to be ‘inter-epistemological’—i.e. bringing together various ways of knowing, as opposed to fields of study? Can an inter-epistemological research center be not just where art, science, engineering, and the humanities meet, but where the observed, intuited, deduced, sensed, learned, felt, and made are introduced to one another? Would such a process move us again to an undisciplinary space?

Becoming undisciplinary

How do we become ‘undisciplinary’? Unpacking and rearranging the different motivations (from Box 1 and Figs. 1–3) may allow us to chart a path forward. This path from disciplinary to undisciplinary (through unlearning, as well as learning anew, on both an organizational and individual level; Hedberg, 1981; Tsang and Zahra, 2008; Klammer and Gueldenberg, 2019) may need to be evaluated in the context of how easy it is to instill a change based on the motivations we identified and how much impact one may be able to achieve (Fig. 5). During an intermediate focus group

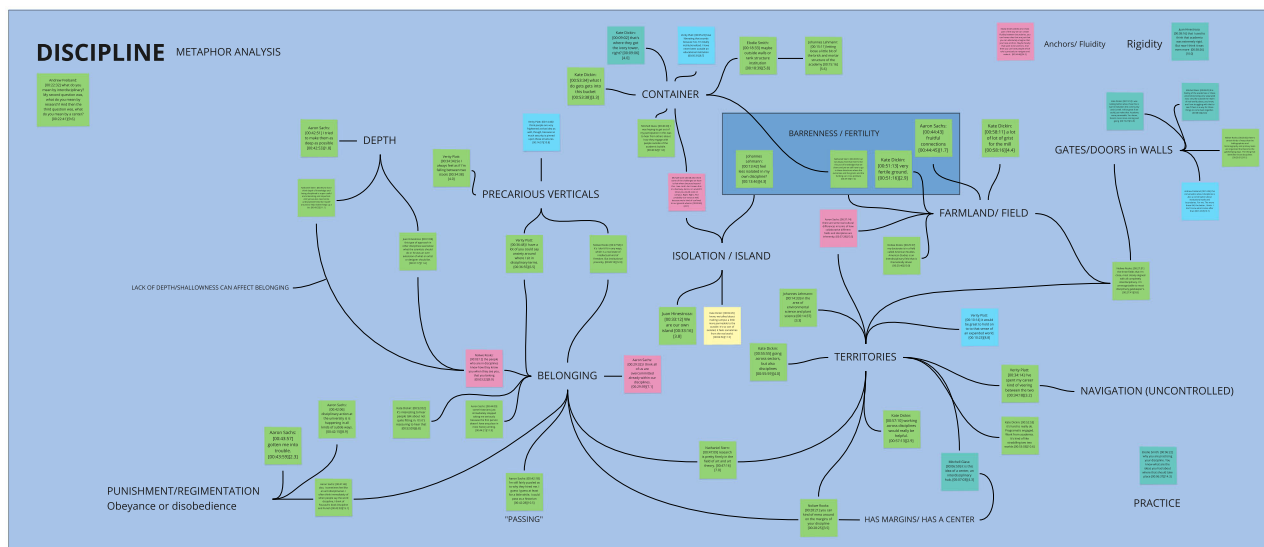


Fig. 4 Metaphor analysis of how ‘disciplines’ were perceived which allows identification of ‘undisciplining’. Quotes were extracted from the transcripts of the charrette and scanned for metaphors used (shown in Fig. 3), which were highlighted, organized, and analyzed through a manual qualitative study (charrette methodology described in Fig. 2; colors correspond to sessions shown in Fig. 3: introduction green, ‘WHO’ yellow, ‘HOW’ magenta, ‘WHEN’ blue, ‘WHERE’ olive).

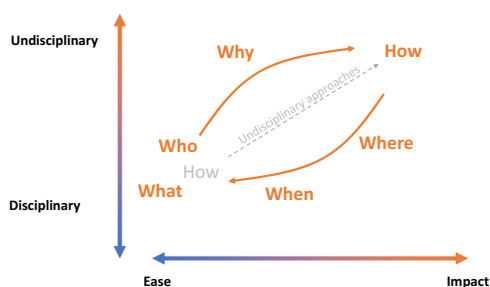


Fig. 5 Motivations for arriving at undisciplinatory interactions (an inter-epistemological ways of knowing) in relation to how easy it is to implement and how much impact it may have. WHY and HOW were perceived by participants as undisciplinatory, with HOW having the largest impact and WHY was easiest to agree on. WHAT, WHO, and WHEN were most closely identified with each discipline. WHAT, WHO, WHEN, WHERE, WHY, and HOW are defined in Box 1.

discussion, we discovered that we had to clearly identify what HOW and WHAT means (as participants had different concepts, now defined in Box 1) and that one motivation needed to be separately defined, namely WHY. While WHY was synonymous with WHAT in our initial analyses (Fig. 1), it turned out that across broader disciplinary backgrounds, we needed to introduce broader goals into our categories of motivation.

Using the initial ranking of motivations (Figs. 1 and 2), adding WHY as a new category (Box 1), WHAT, WHEN, and WHO grouped as disciplinary and having low impact but are easily deployed to leverage motivations. In comparison, WHY, HOW, and WHERE are seen by participants as being richer against an interdisciplinary context and therefore having the greatest impact. It becomes apparent that by lifting the way how activities are construed (HOW) away from a disciplinary framework to an ‘inter-epistemological’ way of knowing as described above, we may increase impact (Fig. 5). Key in our discussions was to separate the initially combined WHAT/WHY (Fig. 1) into different categories of relatively narrow projects fixed in certain disciplines (WHAT, e.g. on climate change, food security, equity) and broader and rather universal motivation (WHY, i.e. doing

something significant in the world together without specifying content).

As with our initial circle (Fig. 1), we discovered that a logical progression between these motivations exists that, again, starts with the individuals who are participating (WHO) (red arrows in Fig. 5). This circle can only be activated, if the broad motivation (WHY) is included and the HOW is positioned to be undisciplinatory to generate the impact that drives the design of the location (WHERE), the support how to weave meaningful interactions into individual career plans and the way universities are supporting engagement and assessments (WHEN).

These insights extend prevailing frameworks, such as the 3D method that includes ‘out of discipline’ thinking, ‘within discipline’ expertise, and a ‘disciplined process’ (Napier and Nilsson, 2008), by putting a spotlight on motivations for individual engagement that in our view responds to undisciplinatory interactions. Similarly, theoretical models often refer to interdisciplinary collaborations as a process (Moirano et al., 2020), where the proposed undisciplinatory interactions may provide a starting point for the collaboration and a possible guiding principle for keeping participants engaged.

“Center” unpacked

Traditionally, the physical location and design of an interdisciplinary center and how it is designed has received significant attention (Mody and Choi, 2012; Choi and Shields, 2015). Our process highlighted that the physical infrastructure of a center will need to be informed by the upstream information emanating from WHO, WHY, and especially HOW (Fig. 4) and therefore be flexible to varying needs to create a place that allows undisciplinatory interaction.

Perceiving a “Center” primarily as a building is therefore in our view a grave misunderstanding of the central function that it plays in facilitating how participants collaborate (HOW). The recent history of U.S. academic institutions leveraging real estate and new construction as a hedge against economic uncertainty and as a tool for attracting philanthropic support must also be taken into consideration (Zander, 2020). However, a *place* is in our view still indispensable for undisciplinatory interaction, even if a brick-and-mortar structure may not need to be the focus or, at



Fig. 6 Synchronous and asynchronous interactions by diverse participants to test lessons learned for an undisciplined center. Left: View through a multi-projection installation by Paulina Velazquez Solis onto a wall showing prints by the art group Franja CentroAmerica (<https://franjabcentroamerica.com/>) next to students responding to questions about motivations for engaging in a hypothetical “interdisciplinary center” (July 8, 2021); upper right: workshop on circular bio-nutrient economy using large tables on wheels with paper where conversations remain as a visible record later hanging on a wall (August 26, 2021); lower right: performances inside/outside thematizing water and environmental quality (August 14, 2021) (all images The Soil Factory, www.thesoilfactory.org).

worst, can even obscure the focus (Ramos, 2013). We also do not see any evidence for why upgrading or indeed simply repurposing existing infrastructure is not equal to or even better serves the needs of the moment—without additional resource extraction or tuition raising, while simultaneously improving the ecological footprint and furthering the academic mission of the institution. A ‘center’ can, by our definition, represent a group of people who have settled on an agreed-upon way of working, and who thus begin to use a space for their purposes. The people and the method therefore define the space, as opposed to building a space and then trying to shoehorn personnel into it.

The Soil Factory—a treatment for an undisciplined center

We borrow the term ‘treatment’ here from film arts, in order to sketch out a story that is just emerging, and to use it as a first draft of future forms of the story. It may be that this is our first model, a prototypical manifestation of the undisciplined center that we have been approaching in this work, and loosely builds on salons that initially combined science and art (Kandel, 2012).

‘The Soil Factory’ is an off-campus industrial building that we utilized for our experiment in undisciplined study, named after its previous use as initially a dairy and then as a soil manufacturing business. It is located outside a university campus for all the reasons illustrated in the above study—we have had to deliberately cross the boundaries of the institution (the keeper of discipline) in order to conduct a truly undisciplined experiment.

It mainly consists of a large, open, indoor space with 6-m high ceilings, a concrete floor, a large roll-up door, abundant wall space and the ability to fasten any artifacts to the walls or to the ceiling, as well as a large outdoor space with a covered stage, paved area and meadows that could accommodate more than one football field (Fig. 6).

The flexibility and openness of the outdoor–indoor spaces were key to making it adaptable to diverse needs: not only does this flexibility have technical benefits but also signals that not any particular discipline or group has ownership. The issue of ‘my turf—your turf’, and physically moving from one departmental

building to another one provides often not merely spatial hurdles, but also hurdles of perceived lack of welcome through the language used and the display of products even within the same institution.

The second and equally valuable aspect of the infrastructure was the abundance of space that allowed, first, multiple activities to occur at the same time, and second, the ability to retain traces of these activities over time (Mallea-Lira, 2013). The first allowed collaborations to occur synchronously by entering the space of someone else’s activity while they occur, the second allowed collaborations to be initiated asynchronously by reacting to the artifacts or projections remaining from an earlier activity. Retaining the detritus of previous conversations is foundational for unexpected encounters. Being able to connect across time and space proved invaluable for not only initiating new connections but importantly also advancing established collaborations.

Through the summer and fall of 2021, The Soil Factory was the site of classes, field trips, art installations and exhibitions, experiments in bionutrient circular economy, film screenings, salons, concerts, talks, workshops, panel discussions, residencies and more. These brought together members of the university community, as well as other members of the regional academic communities, local communities, local politicians, activists, interested members of the public, families, and friends. The abundance of indoor–outdoor spaces made it also conducive for in-person meetings during the time of a pandemic.

It should be noted that while the physical facility was essential, it was not by itself sufficient to foster undisciplined interactions. The infrastructure and design elements of The Soil Factory were only utilized to its full potential if at least two or more people were present that engaged with the material explicitly. Using the infrastructure as a mere backdrop to, for example, a dinner, was not successful in generating new interactions. It is therefore important to offer engaging activities (HOW) to activate the space, without which the location remains an empty shell.

Imbuing the space with a diversity and layering of knowledge, techniques, and viewpoints provides unexpected insights or

through-sights (Fig. 6). In this example, the video projection onto a see-through screen by an artist literally provides a new view onto the brainstorming done by scientists.

What, from one perspective, is an experiment in scholarly interdisciplinarity and the expansion of the possibilities of academia, also looks, from another, very similar to the organic formation of an artist's collective: a decentralized, informal structure for collaboration which is intrinsically *ecological*—in that it is a dynamic interplay between space, stuff, and diverse individuals in orbit around a common ethos of practice. This perspective offers another category of precedents, suggesting ways of moving into the future for undisciplinary practice that is not exclusively arts-based, scholarly, scientific, or disciplinarily specific (Tannenbaum and Allison, 2006; Scheffer and Mazzeo, 2019).

Emergent recommendations for a new generation of 'undisciplinary centers' at universities

As we point out in response to the workshops and experimentation conducted as part of this investigation, neither the terms 'interdisciplinary' nor 'center' describe what participants found most useful to foster interactions between disciplines. Metaphor analysis as well as the frequency and substance of responses by a diverse group of faculty led us to a prioritization of how we interact (HOW) and where we interact (WHERE) with particular emphasis on providing togetherness in space and aims (WHY). Evaluating these theoretical insights at The Soil Factory generated a test case for an open and undisciplinary space (through the described flexibility and openness, with multiple activities occurring at the same time, and the ability to retain traces of these activities), with the ability to attract and give agency to individuals from different disciplines that work in very different ways.

We addressed the feeling of isolation and provoked unexpected confrontation of practices, with new ways of doing and thinking, by co-locating art, humanities, science, and engineering, and giving priority to none. The ensuing intuitive adaptation may provide the type of circular or even meandering and chaotic progression that is better aligned with the human mind than a linear and step-wise process often promulgated especially in the sciences. It will be interesting to see whether challenges for justifying science itself (Vuong, 2018) can be addressed in the process, or whether potentially increased cost of undisciplinary collaborations provide a hurdle.

Motivating planners to embark on such an initiative may require more detailed analyses of the costs and benefits to the institution, and would benefit from shifts in mindset (Baptista and Klein, 2022). Challenges may also arise in aligning undisciplinary interactions with leadership, management, and facilitation that are found to be required for interdisciplinary creativity (Moirano et al., 2020). Providing structure may create wanted or unwanted friction that needs to be resolved or leveraged.

Current university structures, both physical as well as organizational, will benefit from being adapted to accommodate the insights provided here. First steps may include allocating open spaces at various locations on the university campus that allow work to be conducted and to which participants bring artifacts, posters, or projections and regularly spend time together both with and without a scheduled program. The size of those spaces may need to be established but must be sufficiently large to allow both synchronous and asynchronous activities.

However, adopting a blueprint for space design cannot succeed without identifying WHY and HOW individuals in different disciplines may want to interact at a given institution—a common purpose. Adjusting the lessons learned here is also appropriate, as our recommendations have to be seen in the context of the place

and participants they were generated in. Mapping the motivations will not only generate the buy-in needed to engage but also build the foundation for further refinement of the institutional strategy. That strategy and the emergent design and programming will need to shift over time, as actors, topics, technology, and local opportunities and constraints develop.

Further, our process here suggests that universities may benefit from tolerating a more porous structure on behalf of their faculty, staff, student body, and especially surrounding communities. In the case of The Soil Factory, 'Cornell University' as an identifying or embracing entity was nowhere to be seen—and yet the learning, sharing, and catalytic social and intellectual action was understood to have been emergent from the university, while benefiting from a clear sense of detachment. Universities' habit of funding specialized 'centers' may, based on our findings, be misguided; when what is needed is decentralization, dispersion, and undisciplining.

Data availability

Data are all included in the manuscript's display items.

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Author contributions

A.F., J.L., R.N., M.A.G. participated in the early workshop and visioning sessions. All authors participated in the charrette and follow-up meetings to shape the ideas of this manuscript. A.F. analyzed the data. A.F. and J.L. jointly wrote the first draft, all authors edited the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

Additional information

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