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Original Research

Migrating Complexity: Generalizing in Inter/Transdisciplinary Research

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Abstract: Crossing and transcending disciplines requires making generalizations from one area and applying it to another. One such area is complexity theory, which has applications across the natural and human sciences. This article shows how complexity theory is the example par excellence of generalizing by showing similar features between social, social-ecological, and narrative systems. It then asks: What happens when we move complexity or any other idea/finding from one discipline to another? Drawing on migration studies, this article outlines a set of rules that can be applied to generalizing across disciplines—moving ideas is much like migration itself. To this end, it looks at the barbarian migrations in Late Antiquity, Critical Muslim Studies, and migration through the lens of Tourism Studies. The article ends by suggesting the inter/transdisciplinary process is also like a complex system. The article, therefore, offers insight into how to generalize between disciplines and also looks at the inter/transdisciplinary research process.

Keywords: *Complexity, Migration, Generalization, Transdisciplinarity, Interdisciplinarity*

Introduction

A discipline is a categorization of a way of doing research. Inter/transdisciplinary research can be seen as the process of moving ideas, concepts, or findings from one discipline to another. This is the process of generalization. Nicolescu (2014) defines these non-disciplinarities in several ways. Multidisciplinarity involves going across boundaries but remaining in the "home" of one discipline. Interdisciplinarity transfers methods from one discipline to another. Transdisciplinarity goes beyond disciplines and looks at the unity of knowledge regarding our understanding of the world. These definitions are not exhaustive. Woods et al. (2014), for example, emphasize the integrative aspect of interdisciplinarity, which makes it more like transdisciplinarity. Postdisciplinarity (Pernecky 2019), on the other hand, is more subversive and emphasizes the practice of abstaining from disciplines and encouraging exploration. While there are, as demonstrated, various ways of moving ideas and findings, all the mentioned non-disciplinarities generalize from one area to another. This article shall focus on this process of generalization. It looks at complexity theory and says it can be applied to the natural and human sciences. Following this, the topic of migration studies is used to describe this movement from one discipline to another. It ends by comparing inter/transdisciplinarity to a complex system in itself.

Defining Complexity

Understanding how complexity is generalized across disciplines, first requires one to define complexity and the term system. A system is a network of different parts that interact with each other. Cilliers (1998) defines complexity in the following ways:

1. Complex systems consist of a large number of elements; when the number becomes sufficiently large, conventional means (e.g., a system of differential equations) not only become impractical, they also cease to assist in any understanding of the system.
2. The elements of the system have to interact with each other; this does not need to be physical. It can also be the transference of information.
3. The interaction is rich. A component is influenced by many other components.
4. The interactions are non-linear; cause and effect do not always act in a logical fashion. Small causes can have a big impact, for example.
5. The interactions usually have a fairly short range, but multiple components can connect and create longer range causes and effects.
6. There are positive and negative feedback loops in the interactions.
7. Complex systems are usually open systems—they interact with their environment. It is often hard to define the boundaries of a complex system due to this.
8. Complex systems operate under conditions far from equilibrium; there is a constant flow of energy.
9. Complex systems have a history—their past influences the present.
10. Each part of the system only has access to information locally, unless it is otherwise transferred to it.
11. Complex systems tend to have some or all of these features. It will become clear which characteristics social, social–ecological, and narrative systems have in this article. Another feature that is often present is emergence, where the whole is greater than the sum of the parts. This article will not cover all these features of complex systems, instead focusing on those most pertinent to social systems and also those mentioned in the reviewed literature.

Figure 1: Features of Complex Systems

Further clarification of other terms is also required. Firstly, generalization refers to the movement of ideas across disciplines; in the instance of this article, it is the movement of the idea of complexity. Inter/transdisciplinarity, as mentioned, refers to transgressing academic boundaries. Finally, migration can be defined as the movement of peoples (often for a long duration, but in the context of tourism—not always long).

Methodology

This article is based on an inter/transdisciplinary review of the literature. Special attention was paid to complexity across domains. The work is theoretical in nature and comparatively looks at the secondary literature. Case studies are used to provide "real-world" examples of each type of complexity. Furthermore, they are also used to show how complexity can be applied to the types of "migration" discussed. The selection of systems was based on the extent to which generalization can occur. Thus, social systems are more akin to social–ecological systems, but the inclusion of narrative complexity shows how complexity can make "huge leaps" to different domains. In the case of the migrations, they were chosen due to their

diversity to get the most possible "lessons about generalization." Migration is chosen as a topic because it usually involves movement, like generalization.

Finally, it is worth considering some limitations to this study. Firstly, this study can only look at complexity across the mentioned topics; it cannot describe or predict how generalization might occur in other contexts. Secondly, it cannot delve into the intricacies and controversies of the specific topics covered. It will not, for example, delve into the debates surrounding the Late Antique migrations. Lastly, it is also presumed that the concept of generalization could not be applied to "everything," concepts may deform under certain cases.

Complex Social Systems

For the analysis of generalization, this article starts with several features of complex social systems, before seeing how these features are also found in social–ecological and narrative systems. This allows one to see how concepts from one discipline may equally be applied to another and therefore show how generalization can work in inter/transdisciplinary research.

Firstly, social systems are emergent, which means they show behavior that cannot be explained by its parts working together (Byrne and Callaghan 2022) and forming a greater whole. For example, a nation has symbolic significance, which is greater than the sum of its inhabitants. DeLanda's (2006) analysis of Assemblage Theory, which states that the world is made up of material–semiotic (physical and linguistic) networks, shows how this works. He writes (DeLanda 2006, 104):

> An assemblage analysis of urban centers must take into account not only town and countryside, but also the geographical region they both occupy. The region is an important source of components playing a material role in the assemblage. The geographical site and situation of a given urban settlement provides with a range of objective opportunities and risks, the exploitation and avoidance of which depends on interactions between social entities (persons, networks, organizations) and physical and chemical ones (rivers, oceans, topsoil, mineral deposits).

An "urban center" emerges from "social" and "chemical" entities. It is an "assemblage" that comes together because of a vast array of "components." As DeLanda (2006, 110) notes, "the aggregate may have a pattern of its own." The behavior of the assemblage may display characteristics that are more than the sum of its parts. It is for this reason that social systems can be said to be emergent.

Social systems are also non-linear in the sense that the output does not always equal the input. A small cause can have a big impact. A big cause can have a small effect. Byrne and Callaghan (2022, 19) write "small variations in input parameters can generate very different output values in a system of equations" and that "their complexity cannot be reduced" with the "removal of relationships" causing us to "distort our understanding of such systems"

Byrne and Callaghan (2022, 64). In this way, social systems can be said to be dynamic, but also chaotic in the sense that input and output do not always follow a logical pattern.

Social systems are far from equilibrium and are open to their environment. This means they are dynamic. Actor-Network Theory (ANT) can help to illuminate this feature. Social systems are radically open to their environment. As Latour (2005, 5) puts it:

> A new vaccine is being marketed, a new job descriptions is offered, a new political movement is being created, a new planetary system is discovered, a new law is voted, a new catastrophe occurs. In each instance, we have to reshuffle our conceptions of what was associated together because the previous definition has been made somewhat irrelevant. We are no longer sure about what 'we' means; we seem to be bound by 'ties' that don't look like regular social ties.

The social is affected by a variety of factors it is open to, ranging from political movements to planetary systems. This also means it is far from equilibrium, as we have to "reshuffle our conceptions of what was associated together" (Latour, 2005, 5).

Social systems also occupy a phase space, which means it is affected by the attractors and environment it is in. Social coordination dynamics can help us here. Greenacre (2024, 362) describes it in the following way:

> Macroscopic coordination between individuals is already present across multiple facets of society. For example, political voting can mobilize a majority of a country's population, protests and petitions can bring a united effort to promote certain issues. Sporting events can cause large gatherings; meanwhile, a gathering of students can take place in a lecture theatre or seminar room.

However, Kelso, the main proponent of coordination dynamics, has found coordination in settings like ballet, brains, and fireflies (Kelso et al. 2017; Kelso and Fuchs 2018). Social ties can occupy a particular state where they can coordinate, creating a behavior that is connected across a system.

To support my argument that social systems can be seen as complex, I will draw on a case study on welfare systems. Byrne (2001, 6) writes:

> It is generally conventional to regard welfare systems as derivative products of socio-political and socio-economic forces but a complexity viewpoint regards social systems as inherently inter-linked and mutually determinant. In other words, we have to consider the constitutive role of welfare systems in establishing post-industrial social orders.

Therefore, welfare systems are part of a complex web of relations. This can be seen, as Byrne (2001) argues in the United Kingdom. Arguing in the context of his time, Byrne (2001), reveals how the existence of the Scottish Nationalist Party in Scotland means that a Labor government in Edinburgh must be welfarist, the free market is closed to them as an option. Meanwhile in New Zealand, a party to the left of Labor prevents the latter from being able to dismantle the welfare state. In other words, welfare is part of a complex system that is affected by interactions among the system's parts. This creates trivial non-linear behavior; if one was to remove a relationship, one would get a wrong picture, as shown by the intra-party dynamics. Meanwhile, constant change indicates a far from equilibrium state and finally there is behavior (in the guise of policy decisions on welfare) that cannot be understood by just examining one or the other parties in New Zealand or the UK.

Complex Social-Ecological Complex Systems

This article has advocated that social systems have several features of complex systems. To get an understanding of generalization it is necessary to see how complexity applies in other disciplines. The first step is to look at social–ecological systems, systems which are both social and natural in terms of ties. After this, a bigger jump will be made to narrative systems in literature. When generalizing it is important to note, as will become clear later, that not all concepts, ideas or findings can be transported, only some apply to broader disciplines.

Social–ecological systems, like social systems, can be emergent. Preiser et al. (2018, 4) suggest the following:

> Relations form the units of analysis in CAS (Complex Adaptive Systems). Thus, recognizing that CAS are constituted relationally acknowledges the fact that an element of a CAS is not so much a thing as a process … Moreover, the focus shifts to the nature of the relations between system elements, and the interactions that occur between a system and its wider environment. Relations shape and determine the structure and function of CAS.

There are many parts of a complex system that relate to each, social and ecological, and these "shape and determine the structure and function" of Complex Adaptive Systems. They are emergent because they focus on "the relations between systems elements." Social–ecological systems can therefore be defined as emergent.

In the section on social systems, it was highlighted that complex systems are open and far from equilibrium, this can also be said of social–ecological systems. Preiser et al. (2018, 5) go on to say:

> CAS are open systems. In other words, energy, information, and matter are exchanged between the system and its environment. However, defining the

> boundaries of CAS is not a trivial undertaking because CAS interact with their milieu in such a way that it becomes almost impossible to discern which components belong inside the system and which belong to the broader environment.

Therefore, social–ecological systems are far from equilibrium because "energy, information, and matter are exchanged between the system and its environment" (Preiser et al. 2018, 5) and are open because "it becomes almost impossible to discern" their boundaries. Social–ecological systems can therefore be compared to social systems when it comes to their complexity. This is another generalization that can be made across disciplines when it comes to complexity.

However, social–ecological systems can also be seen as non-linear, as Preiser et al. (2018, 6) go on to say, "cause and effect interactions in CAS are not unidirectional or linear, but marked by complex recursive causal pathways … System outputs can function as inputs, and small effects might have large causes and vice versa." Non-linearity is a feature of social systems and social–ecological systems. With this, the possibility of generalization across disciplines, from social to social–ecological systems is shown.

I will now use a case study of a social–ecological system to reinforce my point of view. González et al. (2008) study the Galapagos Islands, a highly biodiverse region controlled by Ecuador—with 97% of the Islands being identified for preservation. González et al. (2008) describe how cruise-boat tourism, which began in 1969, was initially promoted by conservationists, but increasing public investment caused economic development and this stimulated immigration. The immigration caused people to move to the coastal villages, and the arrival of alien species would threaten the biodiversity of the islands. This shows non-linearity in the sense that the beginnings of boat tourism unfurled a series of events that led to an unexpectedly unproportionate amount of change. Again, there was behavior in the system that was emergent, as shown by the elements interacting in the system (e.g., tourism, people, animals, and plants). Finally, it could be said to be far from equilibrium—there was a constant flow of change (as shown by the system's dynamism over time). Now I shall look at how complexity can also be found in narrative systems.

Complex Narrative Systems

A narrative, in the context of this study, refers to a story, particularly a piece of literature. The use of the term here is taken in light of complexity theory, so a narrative is not necessarily seen in a "beginning, middle and end" way, the relations between the different parts of the text are considered.

Ryan (2019, 33–34) highlights how stories can be seen as emergent, much like social and social–ecological systems:

> While authors control characters and plots from the top down, using them to pursue certain artistic goals or to demonstrate certain moral or ideological theses, within

> the fictional world there is no central controlling instance. Characters think of themselves as freely acting human beings, and they know nothing of authorial designs. Plots may be dominated by one character, namely the hero, but this does not mean that heroes are central controlling units, because there are many events that they cannot control, such as the machinations of the villain. Good plots emerge out of the conflict between different personal goals: if the goals of the characters were fully compatible, there would be no story worth telling. Narrative is therefore a top-down, centrally controlled system on the level of authorial design, but it must give the impression of an emergent, bottom-up system on the level of plot.

Narratives are seen as emerging from a diverse array of actors that emerge together to create a plot; this can be quite different from authorial intention and can display complex system-like behavior.

Ryan (2019, 42) states that "narratives are almost always linear in their presentation, since events must be represented by most media one after the other, but their plots can be highly non-linear on the level of causal relations." Texts can thus be non-linear in the sense that relations are not necessarily unidirectional; part of a text can refer forward or back. It may be possible to deconstruct it and reveal a complex system of words and meanings.

The final feature of narratives as complex systems to highlight is their openness and indeed them being far from equilibrium. This can be seen through intertextuality, like in hypertext fiction (Ryan 2019). As the cultural landscape is always changing, so are the varieties of possible interpretations also changing, as new texts become available. Narratives therefore have the trait of being open and also far from equilibrium.

Complex systems can be found in social, social–ecological, and narrative contexts. Certain features of them can be generalized across disciplines, suggesting that some ideas and findings can be applied to different settings outside of their disciplinary home. However, what happens when ideas or findings move disciplines? Understanding this requires a study of migration studies—a theme highly relevant to sociology and how ideas move.

My choice of case studies for this section is to further emphasize generalization. I want to look at how narrative systems can be about social issues. Thus, it becomes evident that a system can be a narrative and social system at the same time, despite these domains initially appearing quite distinct from each other. Uprichard and Byrne (2006, 668) describe social narratives of places:

> Narratives are descriptions not of single systems but of the interweaving of complex systems. People never tell just the story of their own life; nor do they project simply in terms of themselves. All lives are embedded in the social; there is no personal without the social. Therefore, we regard narratives and projections not just as

> accounts of the single complex system of the self, but as representations of how lives and the social intersect, that is…the essential substance of sociology as practice.

This, to me, indicates that lives (or narratives of lives) interact with the social. The case study Uprichard and Byrne (2006) use is of coal mining in the Northeast of England, particularly in South Shields. Coal mining had been done in South Shields for 700 years, but the Industrial Revolution expanded this greatly from the late eighteenth century until the 1930s. The last pit—Westoe Colliery—closed in the 1990s. Uprichard and Byrne (2006) describe the different reactions to the "Crown Tower" in South Shields, which was a shaft tower at the colliery that become symbolic of the mining industry in the area. According to Uprichard and Byrne (2006), their study identified two main narratives: the older group saw it as a piece of heritage and a connection to the past. A younger business-studies group saw it still as a link to the past, but not in a nostalgic way, and more as a reminder of a "dirty" past. This shows how social complex systems can also be linked to narrative complex systems and again there are particular features evident. The "Crown Tower" takes on emergent meaning more than just an old shaft tower; it becomes symbolic in a multiplicity of narratives. Furthermore, the debate is far from being static and from equilibrium, as shown by this multiplicity. Finally, the initial mining of over 700 years ago has large ramifications centuries later, with non-linear effects that could not have been predicted when initial mining started.

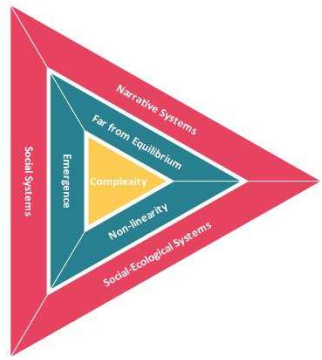

Figure 2: Types of Complex Systems and Features

Migrating Complexity–Late Antiquity

This section will see what lessons we can learn about generalizing complexity by examining migration. What lessons can we learn from migration studies about the movement of ideas and concepts from one discipline to another? How does this inform the process of generalizing complexity? To reify some lessons, one first needs an understanding of the different types of migrations that have occurred. In this section, the article shall cover the "barbarian" migrations, Critical Muslim Studies, and tourism, and how they contribute to this discussion.

Firstly, what can be learnt from the "barbarian migrations?" Taking place in Late Antiquity (approximately third to eighth centuries), the "migrations" saw the Classical world transform into the Medieval world. It was also a period characterized by the Christianization of Western Europe (Markus 1990). The first lesson that can be taken from this period is that migration leads to hybridity. This is seen in Amory's (1997) study of Ostrogothic Italy. Italy, until 493, was ruled by Odoacer, who had deposed the last Western Roman Emperor. He was replaced after an invasion by Theodoric the Great, king of the Ostrogoths. Amory (1997) argues that Theodoric, at least until the end of his reign, encouraged the policy of *Civilitas* through writings such as Cassiodorus' *Variae*. This ideology stated that Goths and Romans both had harmonious and congruent positions in the social order. Goths were warriors, whereas Romans were civilians. Migration had resulted in new hybrid scenarios being created. What is difficult to predict, is the actual scale of the migrations that resulted in the creation of Ostrogothic Italy and this leads to the next lesson. Goffart (1980) suggests that rather than acquiring land for serving in the Roman military, the Goths received a third of the tax revenue of the land "given" instead. The Goths may not have physically owned land but instead received payment. Halsall (2005) suggests one should not presume the same rules applied to different areas of the former Western Roman Empire and suggests there may have been differences across the Visigothic, Ostrogothic, and Burgundian kingdoms. It is hard to predict the exact scale of the migrations—and this can be taken later, to be evident when talking about complexity. A further lesson from Halsall (2005) is that migration can depend on the context—in Late Antiquity this was geographic as discussed.

Christianization was another hallmark of Late Antiquity in Western Europe—migration and movement can be creative and result in the generation of novelty. Markus (1990, 40) describes this process: Firstly, he writes "convinced of the crumbling away of the fabric of the material world around him, of the remnant of the Roman past, he [Gregory the Great] was driven to look beyond." He also states, "deep-rooted habits of reading encouraged him [Gregory], as they encouraged others, to distance himself from the world of his immediate experience and from the letter which conceals the spirit." Gregory adopted a more interior and spiritual view of the world after the "migrations." Markus (1997, 67) writes, "the society of Augustine's North Africa still contained a complex fabric of intellectual and religious traditions of great diversity. Gregory lived in what was intellectually a far more homogenous world." Gregory lived a couple of centuries after Augustine, but the change is clear to see—migration, regardless of its scale, had created new ways of understanding the world.

It is worth formalizing some of the ideas learned from investigating the migrations of Late Antiquity.

1. Disciplines and the ideas in them can migrate; this often alters their context though.
2. Moving disciplines often leads to hybrid studies and research.

3. It can be hard to estimate the impact of moving between disciplines.
4. Migration of disciplines generates novelty.

These lessons learned from the study of migration in Late Antiquity can help us understand the movement of ideas from discipline to discipline, particularly in the context of complexity theory. This is because, as discussed, complexity has been moved to different disciplinary settings. Furthermore, there is good reason to believe the world of Late Antiquity itself has features of a complex system. Halsall (1999, 140) describes the concept of ethnicity in Late Antiquity:

> Early medieval ethnicity was situational and multi-layered…the fact that other groups, like 'Roman' deserters (themselves a mixed bag), joined the Goths but later reappeared as, for example, 'Romans' when circumstances changed does not prove their incomplete integration, but rather shows how people have more than one ethnicity, which they can play, abandon or reorder in importance as circumstances dictate.

Let us elaborate on Halsall's (1999, 141) interpretation of archaeology to make a connection to complexity theory.

> It is time to move on from the notions that we can give unproblematic, monolithic 'Anglo-Saxon' or 'British' identities to material culture, assume straightforward links between such objects, styles or practices and people's geographical origins or genes, and explain perceived problems or discrepancies by reference to one 'people' pretending to be another.

This refers to the emergence of an Anglo-Saxon identity in England following supposed Late Antique migrations. We can see emergence in the systems of identities at play, but not in an unproblematic way. For example, the links that "create" ethnicities like objects, practices, origins, and genes do not have straightforward links—that is, just because there is a certain type of burial it does not mean it is because of ethnicity. We cannot "assume straightforward links." This implies non-linearity, causality and effect is not straightforward. The example of the Goths in Italy confirms this complexity by emphasizing people can have more than one identity which can be "played" and "changed." Ethnicity, in Late Antiquity, was a complex system if we elaborated on Halsall's (1999) view. Now this article shall examine another example of migration studies—Critical Muslim Studies—and how this influences our understanding of moving between disciplines.

Migrating Complexity–Critical Muslim Studies

Critical Muslim Studies is a post-positivist, post-orientalist, and decolonial look at Islam (Sayyid 2022). These terms need explaining. Post-positivist refers to after a post-scientism viewpoint (i.e., it comes after a viewpoint that everything can be explained by natural science). Post-orientalist and decolonial refers to after Western colonization. The first lesson that can be learnt

from the migration of Islam is that ideas, like complexity, can be integrated while still retaining their diversity. Sayyid (2022, 8) discusses this on the context of the Islamic Caliphate:

> These local inflections do not constitute distinct 'multiple' little Islams. The attempt to argue for a world of Islams would only make sense if they could exist in splendid isolation from each other, hermetically sealed…One does not need to posit an essence to Islam to argue that Islam is not reducible to its ontic manifestations. All the particular expressions of Islam exist as part of a singular Islam.

This means that if ideas, like Islam (and in the case of this study, complexity), migrate, they still retain a degree of unity. Complexity may be moved from discipline to discipline, but because of this the different context of complexity are never "hermetically sealed" and cannot exist "in splendid isolation from each other." Therefore, just as Islamisms cannot exist in isolation, complexity cannot be reduced to just its manifestations; there is an underlying unity (still with expressions).

A second lesson from Critical Muslim Studies is that migration of ideas can be incompatible, but this itself does not rule dialogue. Sayyid (2022) discusses Ayatollah Khatami, a reforming leader of Iran, to reveal how Western secularism cannot be applied universally to other countries. Instead, dialogue is possible. Khatami used ideas like puritanism, the American Revolution, and the writings of Tocqueville to make comparisons between the US and Iran in the context following 9/11. Different conceptions of complexity may contradict each other, but this does not rule out sources of dialogue.

Diaspora is also a fluid process, as Demir (2022, 20) describes it:

> Focused on processes and on subjective experiences. Its proponents were thus able to emphasize fluidity and ambiguity, and call for conviviality and creolization. They questioned ethnic absolutism and aimed to transcend and transgress essentialized understandings of race, ethnicity and culture.

This suggests diaspora is inherently dynamic and is constantly in a process of rethinking and translation. Using the Kurdish diaspora, Demir (2022) suggests Kurds translated their experiences to their new homelands in three ways: emphasizing opposition to Islamic State, mentioning the Rojava Conflict, and finally talking about their suffering. Because of this, it can be suggested that migration translates ideas and remakes them.

The lessons on migration from Critical Muslim Studies now need formalizing in the context of complexity theory. These lessons are:

1. Disciplines can be integrated and still retain their diversity.
2. If disciplines cannot be combined, they can still talk to each other.
3. Talking across disciplines might require translation.

Generalization, including the generalization of complexity, follows these principles and also the principles discussed when talking about Late Antiquity. However, before I move on to a third type of migration, I want to elaborate on how we might see Islamisms as a complex system, to reinforce the importance of generalization. Mansouri (2020) conducted an analysis of 100 journal article abstracts that looked at different reactions to "the war on terror." They (Mansouri 2020) suggested that following the 9/11 attacks in New York, media outlets identified Muslims as strangers and who were unable to assimilate into American culture. Their religion was linked to them struggling to integrate in the US. Nevertheless, as Mansouri (2020, 4) argues, this denies the complexity of Islam and Muslims: "Religion is certainly an important dimension of these issues, but not the main factor given the number of intersecting variables at play ranging from age and gender to socio-economic status and cultural heritage."

Thus, we can use Critical Muslim Studies to reveal the complexity of Islamisms. The "migrations" are emergent. The struggle to integrate is the result of interacting religious and non-religious elements. Furthermore, non-linearity can be seen in how a large cause (9/11) had an impact on the "micro-lives" of individuals and their worldviews. Finally, the dynamism and situatedness of these events and their effects suggests a far from equilibrium status. The next step is to talk about a final migration case study—tourism—a form of temporary migration.

Migrating Complexity: Tourism

The first lesson is that ideas, concepts, or findings that can be moved may have different ontologies. An ontology is a theory of existence and being. As Astudillo and Salazar (2024, 184) suggest, tourism involves imagination, but this often influenced by material elements: "The UNESCO heritage classification distinguishing the material from the intangible is not only taxonomic. Above all, it is a stance about how heritage is understood from a dominant meaning-making system over 'Other' ontology."

Imaginaries are found in "multiple conduits through which they pass and become visible in the form of images and discourses" (Salazar 2012, 866). However, they can be found in the materiality of the sites and the discourses they give. The first lesson from tourism is that different disciplines can have different ontologies and this needs to be considered when migrating ideas like complexity. An ontology is a theory of the nature of existence.

The second lesson from tourist imaginaries is that ideas are circulated in more forms than just academic research. As Astudillo and Salazar (2024, 184) write:

> These channels include the visual and textual content of documentaries and fiction movies; art, museum exhibitions, and fairs; trade cards, video games, and animation; photographs, slides, video, and postcards; travelogues, blogs, and other websites; guidebooks and tourism brochures; literature, coffee-table books, and magazines; news coverage and advertising; official documents; and quasi-scientific media such as National Geographic.

Tourism is influenced by these forms of media, just as much as academic research is influenced by multiple outside forces. Migration of complexity may potentially be moved out of the academic setting (e.g., policy) and influenced by external factors.

The lessons from tourism can be formalized as such:

1. Movable concepts or disciplines can have different ontologies.
2. There are more ways to circulate ideas than just through academic research.

The case study of complexity in tourism derives from canal boat tourism in Strasbourg, France. Mehran and Olya (2020, 10) look at how "the inclusion of socio-demographic variables and prior experience" predict "behavioral intentions of canal tour participants" in Strasbourg. According to Mehran and Olya (2020) "consumers rely heavily on non-commercial sources of information" like "recommendations from friends and family when choosing a holiday." Recommendations involve "the complex and heterogeneous nature of cognitive factors and socio-demographics factors, along with consumer satisfaction, emotion and intention to recommend" (Mehran and Olya 2020, 6). Complexity is present here in the form of the recommendation being emergent from the factors, non-linearity because it is hard to predict the outcome of a recommendation and finally far from equilibrium due to the dynamism of non-commercial sources of information (i.e., they are not just promotional material).

In this section, the article has used migration studies to talk about how complexity is generalized or migrated from discipline to discipline. There are several factors and lessons that can be gleamed from migrations studies. They are:

1. Disciplines and the ideas in them can migrate; this often alters their context though.
2. Moving disciplines often leads to hybrid studies and research.
3. It can be hard to estimate the impact of moving between disciplines.
4. Migration of disciplines generates novelty.
5. Disciplines can be integrated but still retain their diversity.
6. If disciplines cannot be combined, they can still talk to each other.
7. Talking across disciplines might require translation.
8. Movable concepts or disciplines can have different ontologies.
9. There are more ways to circulate ideas than just through academic research.

The theory developed in this article can be defined by these suggestions. In more general terms, the theory can be stated as such.

Concepts and ideas (like complexity) can be moved across disciplines; this process can be compared to migration. This leads to specific lessons, which can help us understand how knowledge is transferred.

Practically, generalization helps us to move ideas or findings from discipline to discipline. It is a methodology that consists of identifying patterns in different disciplines—

in this case, under the guise of complexity and connecting them. This was done in this article by looking at three examples: social, social–ecological, and narrative complex systems. The practical implications include:

1. An ability to identify that generalization can occur across diverse domains.
2. The process of inter/transdisciplinarity needing to take into consideration broader issues like migration in order to provide further understanding.
3. An understanding of the inter/transdisciplinary process as a complex system itself (see following paragraph).
4. Finally, a broader possibility that the diverse domains explored can be united practically and theoretically.

In the next section, I will consider other potential theories and methodologies. However, firstly, I want to highlight how that migration processes like hybridity, transformation, and assimilation are evident in the arguments made earlier. For instance, one of the lessons was that moving disciplines can lead to hybridity, which itself is evident in scenarios like Ostrogothic Italy's *Civilitas* ideology. Meanwhile, assimilation is evident in Critical Muslim Studies with there being a diverse array of Islamisms leading to diversity and unity (much like how there are different types of complex systems which still have a degree of unity). Finally, transformation can be seen in tourism (e.g., based on recommendations) and also the need to transform complexity to different contexts.

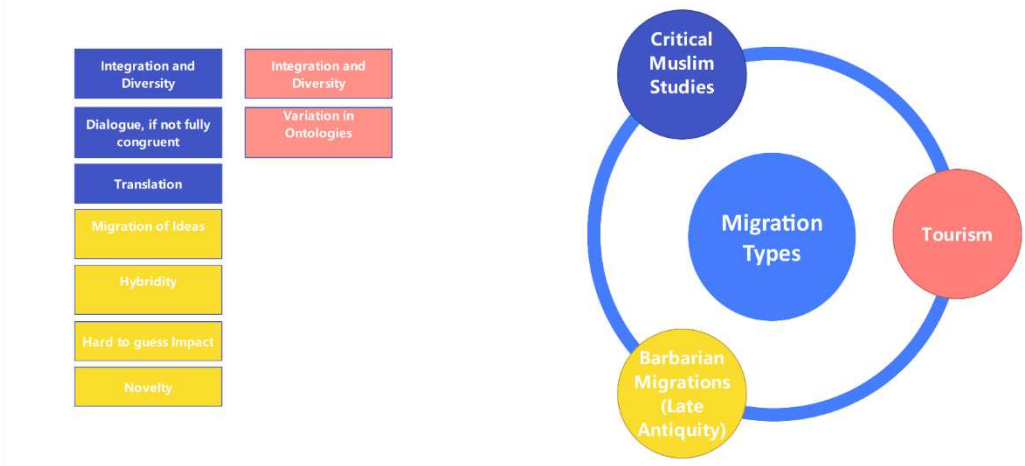

Figure 3: Types of Migration and Lessons

Generalization, Complexity, and Other Theories

In this section, I want to compare similarities and differences between the theory I have been developing and also other projects. In the first instance, this will be to other interdisciplinary

projects that use complexity. In the second instance, it will be to other ideas of knowledge transfer which are not necessarily obviously complex systems. One example of an interdisciplinary project is Melo and Campos' (2022) "complex thinking" training school. They (Melo and Campos, 2022, 91) define complex thinking as:

> CT is defined as a mode or process of coupling between an observer and a target system of interest that: (i) attends to properties of complex systems (e.g., relationality, non-linearity, recursivity, multiple time scales), (ii) while enacting them in the coupling with a target system of interest.

Their school lasted five days/thirty-five hours and it related to complexity and the Sustainable Development Goals of the United Nations and their inherent complexity. It aimed to help build sustainable futures by exploring alternative ways of thinking. The school targeted academics, activists, intervenors, and educators to look and also used creative techniques and media to promote complex thinking (Melo and Campos 2022). According to the feedback received by the organizers, many thought it had gone well. "Complex thinking" takes a complexity frame of reference and thus can be seen as complementary to the ideas introduced in this article. Generalization will be required (Melo 2020, 25):

> To embrace complexity, the thinking needs to recognize and move across different modes and levels, experiment with multiple ways of making distinction and setting boundaries, aware that setting boundary is associated with the enactment of values and creating constraints that set up a stage for different possibilities for action that bring forth different types of world.

In other words, we need to move "complexity" and other ideas across to different settings, with a realization that boundary setting can create both constraints and possibilities. I would argue that this is true in the process of generalization described in this article due to the fact that moving complexity across domains creates new possibilities of integration, but also can set boundaries (i.e. focusing on the main features of complex systems, rather than more broad usage of the term "complexity").

I now want to discuss a second interdisciplinary project that used complexity. According to Cairns et al. (2020), in 2016 the University of Sussex launched the Sussex Sustainability Research Program, which aimed to encourage interdisciplinary collaboration across the sciences, social sciences and humanities, with the aim of addressing the UN's sustainable development goals. Cairns and colleagues' investigation of this project revealed several things. Some projects (like Large Herbivores) wanted knowledge to be co-produced, which meant interacting with stakeholders outside academia to generate knowledge. There were also instances of people trying to learn an alternate disciplinary language or methodology. Cairns et al. (2020) describe how one group (Pollinators) wanted to employ social scientific

methods to study a topic that is usually considered natural scientific (i.e. Pollinators). What this project tells us is that there can be interaction across disciplines, especially when studying a complex topic like sustainability. For my argument concerning generalization, we can perhaps learn from such projects in how to test and generalize findings, as shown by the employment of diverse methodologies in both of the mentioned groups. Generalization will need to take into account different methodologies from different disciplines and how they can communicate with each other.

I now want to move on to alternate frameworks for crossing disciplinary boundaries, which are not obviously complexity-informed, but make a good constructive contrast to my theory of generalization, complexity, and migration. One alternative is theories of knowledge diffusion, which refers to how knowledge spreads, and this has been discussed in the context of scientific citations (Sorenson and Fleming 2004). For example, the aforementioned authors compared the future patent citation rates across three groups of patents. The first group consists of patents that cite academic literature, the second group includes patents that cite non-academic literature, and finally the third group includes patents that cite no literature at all. Sorenson and Fleming (2004) describe how patents that used scientific literature get ideas diffused more quickly, thereby spreading knowledge. While knowledge diffusion is an interesting approach, it is different in the sense that at least in the context of Sorenson and Fleming (2004), it looks at the "traces" of knowledge spreading, rather than being an active attempt to show how generalization can be applied in the context of complexity.

The second concept I want to discuss is "epistemic communities" (Haas 1992). This can be defined in the following way (Haas 1992, 3); "An epistemic community is a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area. Although an epistemic community may consist of professionals from a variety of disciplines."

Haas (1992) goes on to say that there are increasingly specialized knowledge communities, such as within the United Nations or academia, and that these "are channels through which new ideas circulate from societies to governments as well as from country to country" (Haas 1992, 27). Epistemic communities can be consulted for their specialized knowledge. While there is value in this channeling of deep knowledge, I suggest that overreliance on norms could be preventative of generalization. For example, would it be easy for a closed community of narrative theorists to engage with a closed community of sociologists? Therefore, I argue that the generalization approach addressed in this article is more helpful.

Trans/Interdisciplinarity as a Complex System

This article has shown how complexity theory can be generalized across disciplines using the framework of migration studies. The final question to ask is, if generalizing is itself a dynamic process, as shown in the lessons earlier, can the methodologies of inter/transdisciplinary

process be described as a complex system itself? This has been theorized to an extent by Melo and Caves (2019) and Melo (2022), but to build on this work it is necessary to return to Cilliers (1998) definition of complexity. The following factors describe the ways in which inter/transdisciplinarity itself can be seen as a complex system.

1. Transdisciplinarity is emergent—it consists of different disciplines working together and in connection. However, the end-product is more than the sum of its parts, it produces something new, whether that is novel knowledge or a new area of study.
2. Transdisciplinarity is non-linear—If you study, the input (i.e. the research) may produce outputs far beyond its original scope. This could be in the form of generalizable results (as discussed earlier) or through the production of significant and important knowledge.
3. Feedback—Every action taking in transdisciplinarity has an impact on the transdisciplinary process. If one was to study physics, then it is literally impossible for them to completely ignore that when studying a different subject (physical laws apply in the macro and micro worlds). This knowledge of physics would affect one's approach to even a distant discipline like sociology, because one cannot escape the concepts and language used in one discipline.
4. Far from equilibrium—It goes without saying that transdisciplinary knowledge is far from static, always open to other disciplines, always dynamic in terms of how knowledge can evolve. It is true this could be said of any discipline, but transdisciplinarity's openness makes it particularly susceptible to change.
5. Self-organization—Disciplines organize themselves into a transdisciplinary framework. If we understand this—that there is no central controller or discipline in transdisciplinarity—we can understand how components (disciplines) come into particular forms: it is through their mutual coordination that *emergence* occurs.
6. Openness—As discussed earlier, the transdisciplinary complex system is open and this makes it more dynamic in its knowledge production.
7. History—A transdisciplinary system has a history. We cannot understand transdisciplinarity without having knowledge of its past and general knowledge of a disciplined past. This is because the past determines the current configuration of a transdisciplinary system.

This covers a lot of the features of complex systems and how the inter/transdisciplinary process itself can be seen as a complex system. The importance of this is clear; moving concepts across domains, like complexity, is itself a complex process and therefore there needs to be attentiveness to methodology just as much as practical application. This is true for the ways the theory of generalization has been interrogated throughout.

Conclusion

To conclude, it is worth asking how does the complex system of inter/transdisciplinarity facilitate the generalization/migration of complexity? Inter/transdisciplinarity is dynamic much like migration and generalization, as shown through the description in the article. It therefore allows for a radical adaptiveness and openness that fosters complexity's movement across disciplines. Complexity opens up the pathway for more complexity, whether this through migration of ideas or due to the fact that inter/transdisciplinary research is complex in itself.

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Informed Consent

The author declares that informed consent was not required as there were no human participants involved.

Conflict of Interest

The author declares that there is no conflict of interest.

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