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Please cite as follows:

Castellani, B. (2026). Entangled: How might we reshape our entanglement with the environment? ISCIA Public Lecture Proceedings, Nelson Mandela University, Gqeberha, South Africa, 16 September 2026.

Entangled: How might we reshape our entanglement with the environment?

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BACKGROUND

This ISCIA Public Lecture at Nelson Mandela University, (Gqeberha, South Africa), which I gave on 16 September 2026, draws on a book I am currently writing, ***Entanglement***, which develops the idea as a mechanistic concept for understanding complexity.

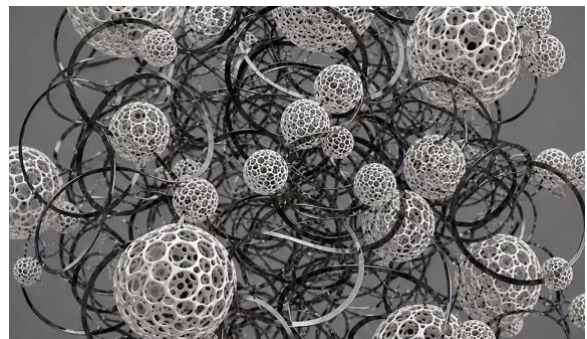


Figure 1: Entanglement

Entanglement is the process through which things become interconnected and interdependent through repeated interweaving over time. As shown in Figure 1, I also draw heavily on my [visual arts practice](#) as a key medium and method for exploring and explaining what entanglement is, how it works, and what it looks like. As I have started using the concept more widely in my scientific and artistic work and lecturing and presenting on it internationally, people have increasingly asked me for something they can read, share and cite. So, while the book is still being written and my artistic exploration of entanglement continues to develop, I thought it would be useful to write up this lecture as a first introduction to some of its central ideas, particularly how entanglements form, why they persist, and how they might be disentangled and re-entangled differently. While the focus of the lecture is environmental health, urban sustainability and just transitions, the ideas apply much more widely.

Proceedings summary

Why are some of our most serious environmental problems so difficult to change, even when we know what needs to be done? This public lecture addressed that question through the concept of ***entanglement***. Drawing together the complexity sciences, social sciences, humanities and visual arts, the lecture explored how environmental entanglements form, why they persist, and how they might be disentangled and reorganised.

The argument began from the observation that environmental problems are rarely environmental problems alone. In South Africa, the focus of my public lecture – ecological systems are entangled with how people live and work, how economies are organised, and how futures are imagined. Pollution, environmental health and just transitions are consequently inseparable from employment, inequality, infrastructure, communities and economic development. Changing one part of such a system therefore places pressure on others. This does not mean that change is impossible. It means that changing environmental systems requires understanding the wider entanglements through which they have developed and persist.

Visual complexity was integral to developing this argument rather than simply illustrating it. The lecture itself opened with images of tangled forms – some shown in this proceedings document – before moving between scientific visualisation, environmental examples, and my own visual art. These different ways of making complexity visible allowed entanglement to be approached not only as an abstract concept but as something spatial, material and dynamic: something that can be seen forming, widening, tightening, persisting and being reorganised. The visual language of the lecture returned throughout, culminating in the speculative moving-image work *When the Tangles Arrived*.

What is entanglement?

Entanglement was defined mechanistically as the process through which things become interconnected and interdependent through repeated interweaving over time. It provides a way of showing what those interdependencies look like and how they can be changed, reorganised or become difficult to disentangle.

The emphasis is not simply on connection. Elements can interact or be connected without becoming deeply entangled. Entanglement develops when repeated interactions progressively bind elements together such that they cannot simply be separated or extracted without consequences for the wider configuration.

The lecture made this mechanism visible across different scales. A microscopic biological example showed fungal hyphae extending, branching and becoming entangled with one another, together forming the larger fungal structure of the mycelium (Figure 2). Interestingly, some fungi can also break down and metabolise components of certain plastics.

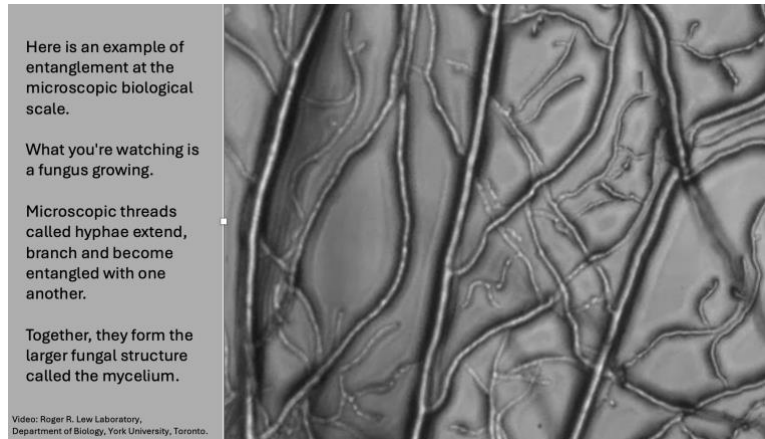


Figure 2: Mycelium Entanglement



Figure 3: Debris Entanglement on Ocean Beach

From this microscopic example, the lecture moved to a much more immediately recognisable environmental entanglement: marine debris. Fishing line, nets, rope and plastics are transported by wind, currents and waves until they encounter the structures of coastal and marine environments. Vegetation, coral, rocks, crevices, animals and other debris create repeated opportunities for flexible materials to snag, wrap, loop and tighten. In this sense, the shoreline and immediate waters can operate rather like a comb, catching material as it moves through the environment – See Figure 3.

Here are the mechanics: transport of debris by wind/currents → contact with a structure → snagging → continued wave/current movement → looping and wrapping → capture of additional material → tightening/embedding → persistent entanglement.

This distinction between interaction and entanglement is important. Not everything that encounters something else becomes entangled. Elements possess different capacities for entanglement depending upon their properties and the conditions in which interaction occurs. Repeated interaction, persistence, flexibility or deformability, embedding and constraints on simple separation can allow entanglements to deepen over time.

As an entanglement develops, it can also widen. What begins as a relationship between a relatively small number of elements can progressively incorporate technologies, infrastructures, institutions, behaviours, routines, skills, livelihoods, economic arrangements and social relationships. These elements then become increasingly interdependent not only with the original focus of the entanglement but also with one another.

This gives entanglement both breadth – referring to how widely it extends across elements, domains and scales – and depth, referring to how strongly those elements become embedded in and dependent upon one another through repetition and reinforcement over time. The expanding interdependence increases the degree to which an entanglement becomes difficult to untangle or re-entangle differently.

Entanglement, emergence and persistence

Entanglement provides one material explanation for how some forms of emergence occur. Repeated interactions can become sufficiently interwoven that a new level of organisation develops with properties, capacities and constraints that cannot be reduced to the isolated elements themselves. The process can be represented as:

interaction → interweaving → entanglement → interior (porous) formation → emergent properties

The resulting entanglement can develop an interior characterised by embedding, accumulation, density and constraint – although not always, as the formation of an interior depends on the degree of entanglement, and the interior is always porous, an open system. As these processes deepen, emergent structures can become increasingly stabilised and consequential.

Entanglement also helps distinguish emergence from self-organisation. Self-organisation concerns the development of patterns or order through interaction without central control. Entanglement concerns how repeated interactions become interwoven, persistent and difficult to disentangle. Entanglements can emerge through bottom-up self-organisation, but they can also be deliberately engineered, governed, institutionally maintained or strategically reinforced. Most real-world social systems involve combinations of these processes.

Persistence, however, should not be confused with resilience. A persistent entanglement continues through time. A resilient entanglement can withstand pressure while adapting its interweaving. Resilience therefore does not necessarily mean remaining unchanged. An entanglement can bend, redistribute pressure and reorganise itself while continuing to hold together. Conversely, an entanglement can be highly persistent while also being unhealthy or constraining.

Entanglements are multidimensional

Environmental entanglements should not be understood simply as either positive or negative. They can be healthy or unhealthy, enabling or constraining, stabilising or destabilising, resilient or brittle, and flexible or locked in.

These are dimensions rather than mutually exclusive categories. Crucially, the same entanglement can occupy different positions across these dimensions simultaneously. A coal-dependent or consumption-based system, for example, may be economically enabling, socially stabilising and highly resilient while simultaneously being environmentally unhealthy, constraining and deeply locked-in.

This multidimensionality helps explain why environmental transitions are difficult. Removing something harmful can simultaneously destabilise relationships experienced as beneficial or necessary elsewhere in the system. Resistance to change therefore cannot automatically be interpreted as a failure to recognise environmental harm. People may also be responding to other dependencies embedded within the same entanglement.

Environmental transformation consequently requires tracing what is harmful, what is valued, who and what depends upon existing relationships, and how those relationships might be reorganised without simply transferring harm elsewhere. What appears dysfunctional from one dimension of an entanglement can remain highly functional from another. That combination of harm, benefit, resilience and dependency is precisely what can make an established entanglement so difficult to change.

Affordances and the widening of entanglement

The lecture introduced [affordance](#) as an important part of this process. The concept was originally introduced by psychologist [James Gibson](#) before subsequently being taken up in fields such as design and engineering. An affordance is a possibility for action or interaction arising relationally between the properties of something and the capacities of whatever encounters it.

This relationship was explored visually through [RAAAF's The End of Sitting](#) (Figure 4), in which changing the physical organisation of a working environment creates possibilities for very different relationships between bodies, architecture and working practices.

In terms of the ocean, a rope provides a simple material example. Rope possesses properties such as flexibility, length and strength. In relation to different actors and environments, those properties afford tying, pulling, wrapping, looping or snagging. A coastline, meanwhile, contains waves, wind, coral, rocks, animals and other structures capable of interacting with those properties.

Affordances do not themselves constitute entanglement. Rather, entanglement occurs when affordances (through our engagement with them) enable repeated interactions or reliance that, over time, widen and deepen interdependence until the things involved become difficult to separate without reorganising the wider system.

**properties + capacities → affordances → repeated interaction or reliance →
widening and deepening interdependence → entanglement**

The smartphone provides another familiar everyday example. Its portability, connectivity, multifunctionality and personalisation, combined with human capacities and needs, afford numerous possibilities. As communication, work, navigation, banking, entertainment and social interaction become repeatedly organised through the device, however, reliance widens and deepens. The smartphone becomes increasingly embedded in everyday



Figure 4: RAAAF End of Sitting Project

life because a wider set of behaviours, infrastructures and relationships has become organised around its affordances.

Petrol and coal illustrate the same process at a societal scale. Their high energy density, storability, transportability and suitability for large-scale energy use interact with technologies, infrastructures, institutions and economic needs to 'afford' particular forms of use and reliance. As these affordances are repeatedly taken up and expanded, more parts of social and economic life become organised around them (Figure 5).

Reliance consequently widens and deepens, making petrol or coal progressively harder to disentangle from the wider system. Coal dependence is therefore an entanglement: removing coal affects many other parts of the system because those parts have become reliant upon it.

This is particularly important for understanding South Africa's just transition. The problem is not simply that coal is being used as a fuel. Workers, skills, businesses, communities, municipalities, infrastructures, industries and regional economies have become organised around it. Technical substitution therefore addresses only one part of a much wider configuration of interdependence.

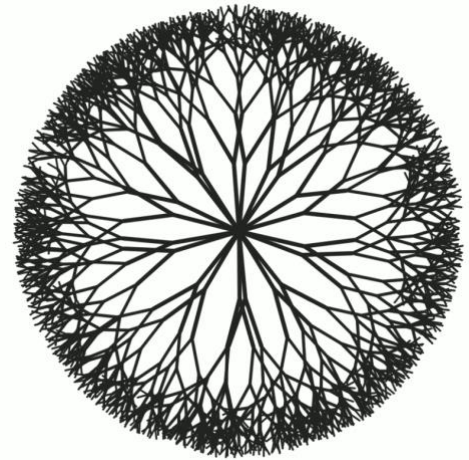


Figure 5: Example of fractal expansion of entanglement around an affordance

Perception, imagination and creativity

Affordances also introduce an explicitly psycho-social dimension. Possibilities for action are constrained by the properties of environments and the capacities of actors, but which of those possibilities people perceive also depends upon perception, knowledge, experience and imagination.

Creativity cannot make physically impossible actions possible, but it can reveal or develop different ways of acting within existing constraints. This becomes important because established entanglements can constrain not only what people can do but also what they regard as realistically possible.

Existing materials, technologies, infrastructures, skills, institutions and places may therefore afford possibilities that have become obscured by the organisation of the current system. Creativity can expand the perceived field of possible action by identifying neglected affordances, recombining existing ones or developing new possibilities through technologies, practices, institutions and infrastructures.



Figure 6: Image from When the Tangles Arrived

This psycho-social dimension also provided the transition into the visual-art component at the centre of the lecture. [*When the Tangles Arrived*](#), a 3½-minute speculative moving-image work, marked the transition between the two parts of the presentation (Figure 6). The work emerged from my artistic and research engagement with

environmental health and just transitions in Nelson Mandela Bay and uses the visual language of entanglement developed throughout the lecture. CLICK HERE TO WATCH https://www.youtube.com/watch?v=2_PUYHueXqo

Set along the Nelson Mandela Bay coastline, the film imagines unfamiliar life forms—the Tangles—arriving and beginning to repair damaged coastal environments. Their capacity to repair environmental damage ultimately proves insufficient because that damage remains embedded within wider social, economic and cultural systems, including poverty, inequality, fossil-fuel dependence and established ways of living.

The film therefore changes the scale of the question. Environmental repair cannot be reduced to repairing the immediately damaged ecological object or site. If the conditions producing that damage remain entangled with wider ways of living, working and organising economies, then those systems will continue reproducing it. The Tangles can repair the coastline, but they cannot by themselves reorganise the social entanglements through which environmental degradation is continually generated.

The film consequently served as a hinge between the two halves of the lecture. The first half asked what entanglement is, how it forms and why it persists. The second turned to the social psychology of environmental health and just-transition entanglements and asked how perception, imagination, creativity, affordances, institutional arrangements and patterns of reliance might contribute to changing them.

Dis(re)entanglement

The second part of the lecture developed dis(re)entanglement as a mechanism for changing established entanglements. If entanglement develops through repeated interweaving, embedding and accumulated dependence, changing it – e.g., dis(re)entangling) requires working on those interdependencies while alternative relationships are simultaneously developed (Figure 7).

LOOSEN → REIMAGINE → REDIRECT → REWEAVE

Loosen involves interrupting, weakening, separating, rerouting or sometimes cutting existing relationships and dependencies. Because established entanglements possess breadth and depth, changing one relationship can alter, destabilise or sometimes tighten others.

Removing invasive alien trees in South Africa provides an example. Removal can loosen an ecological entanglement, but doing so simultaneously changes relationships involving water, fire, biodiversity, livelihoods and land management. The intervention therefore cannot be understood simply as removing a problematic element. It changes a wider configuration of relationships.

Reimagine concerns recognising what else the elements of an existing system might afford. Perception, imagination and creativity make it possible to identify neglected possibilities, combine existing affordances

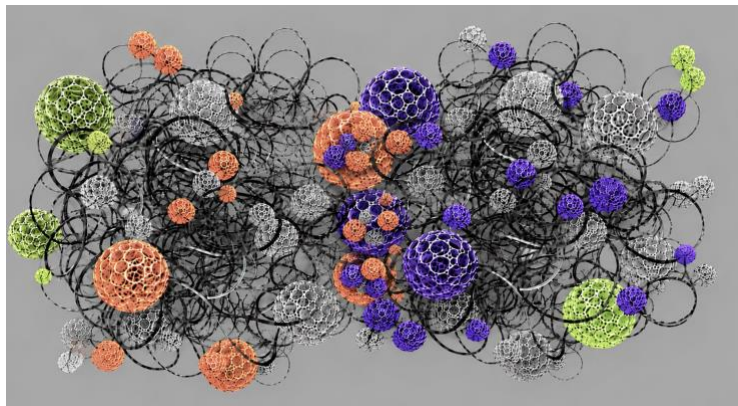


Figure 7: Image from a Video of Dis(Re)Entanglement

differently or develop new ones. Existing materials, technologies, infrastructures, skills and institutions may afford uses that have been obscured by the existing entanglement.

A disused railway corridor, for example, can be perceived not simply as obsolete infrastructure but as something capable of affording walking, cycling, ecological connectivity and public space. The physical corridor has not changed; what changes is what people perceive it as affording.

Reimagining can also occur before substantial loosening. Being able to perceive a viable alternative can itself make change more socially and practically possible.

Redirect turns possibility into practice. Possibilities alone do not change systems. Alternative affordances have to be taken up. Resources, investment, technologies, skills, institutions and everyday practices begin to organise around different possibilities, rerouting existing relationships into new pathways.

Rooftop and community solar provide an example by redirecting electricity provision away from exclusive dependence on centralised generation and toward more distributed forms of energy production.

Reweave occurs as alternative practices are repeatedly taken up. New infrastructures develop, skills accumulate, institutions adapt, economic relationships form, behaviours become routine and expectations change. New relationships begin reinforcing one another, creating a different configuration of interdependence.

Reweaving also raises explicitly social and distributive questions: who benefits, who works, who owns, and who captures the value generated by the new system? As South Africa's automotive industry moves into hybrids, electric vehicles and other new-energy technologies, for example, reweaving involves developing local manufacturing, component supply chains, skills and employment so that more of the value generated by the global transition remains within producing economies and communities.

repeated interaction → widening relationships → deepening interdependence → entanglement.

Disentanglement and re-entanglement are consequently not completely separate processes. Old relationships may be loosening while new ones are simultaneously forming.

Several implications follow

First, dis(re)entanglement is not reversal. Complex systems generally cannot be returned to some untouched earlier state. Their histories remain consequential. The elements involved have already been changed through their participation in the entanglement, infrastructures have been built, institutions and practices have developed, skills have accumulated, and expectations and ways of living have formed around them. Disentanglement therefore means working from the configuration that now exists rather than imagining a simple restoration of a pristine starting point.

This also means that repair produces something different rather than simply recreating what existed before. History becomes part of the material from which subsequent entanglements develop. Dis(re)entanglement is therefore better understood as reorganisation than reversal.

Second, dis(re)entanglement can require psychological and social processing of grief and loss as well as adaptation to what is emerging. Established entanglements can become bound up with identities, livelihoods, communities, routines and ways of life. Loosening them can therefore involve grief, loss, reconciliation or other forms of acknowledging and processing what is being left behind. At the same time, becoming entangled differently requires people and communities to develop new skills, relationships, expectations and senses of possibility. Such transitions therefore have a psychological and social pace as well as a technological, economic or political one.

Third, old and new entanglements can coexist. Disentanglement is often partial and uneven. Building on our second implication, some existing dependencies may persist while alternative relationships are developing alongside them. Rather than one system disappearing and another suddenly replacing it, transitions can involve overlapping configurations of interdependence.

This is particularly important for just transitions. A region can remain substantially dependent upon coal while renewable-energy infrastructures, industries, skills and institutions are simultaneously developing. People and organisations can therefore participate in old and emerging entanglements at the same time. Transition itself becomes an entangled condition in which different trajectories coexist, interact and sometimes conflict.

Fourth, re-entanglement is not necessarily improvement. New relationships can generate new dependencies, inequalities, vulnerabilities and lock-ins. New does not mean healthy.

This is why the multidimensional character of entanglement matters throughout the process of change. An emerging configuration must itself be examined in terms of whether it is healthier or unhealthier, enabling or constraining, stabilising or destabilising, resilient or brittle, flexible or locked in. A transition that reduces one form of environmental harm can simultaneously create another dependency or distribute benefits and costs unequally. Re-entanglement therefore remains something to be evaluated rather than assumed to represent progress simply because it is different from what came before. Fourth, re(dis)entangling something can require grief work or reconciliation or other forms of processing what was

Fifth, and perhaps most importantly, the objective is generally not independence. Complex social and ecological systems cannot simply cease being interdependent. Attempts to disentangle one relationship will themselves create, reveal or strengthen others.

The objective is therefore not to eliminate entanglement. It is to reorganise it. The central questions become: what do systems become interdependent around, through which relationships, with what consequences, and for whom?

This shifts the focus from escaping complexity toward deliberately engaging with it. Environmental change becomes a question of how existing entanglements can be loosened and redirected while alternative relationships are imagined, developed and repeatedly reinforced.

Returning to the environmental examples

The lecture concluded by returning to concrete environmental examples to show what this process can look like in practice.

The first returned to the fishing net introduced earlier in the discussion of marine entanglement. The affordances of fishing netting have not changed: the material remains strong, flexible and durable. Those same properties that allow netting to perform its intended function also allow discarded nets to persist, snag, wrap and become entangled within marine environments.

What can change is the system organised around those affordances.

Instead of the net's useful life ending at sea or in landfill, the material can be recovered and redirected into a different production cycle. At Cape Town's V&A Waterfront, a harbour-based fishing-net recycling facility provides an example. End-of-life nets are brought into port and processed on site: shredded, washed and dried before being turned into clean plastic flakes capable of returning to manufacturing.

The physical properties of the material have not fundamentally changed. What changes are the relationships organised around those properties: how the net is collected, where it goes, who handles it, what infrastructure surrounds it and what subsequent uses become possible. The example therefore returns directly to the earlier marine-debris sequence while showing how a material capable of participating in one entanglement can become incorporated into another.

The second example returned to coal and South Africa's just transition. South Africa is investing substantial effort in a just transition precisely because technical substitution is insufficient. If coal were merely a fuel being used, the problem could be framed relatively simply: replace coal-fired electricity generation with another energy source. But that is not the system that exists.

The transition involves workers, skills, businesses, municipalities, communities, infrastructure and regional economic diversification. The problem is therefore the wider entanglement that has developed around coal.

This is why the concepts of breadth, depth and widening interdependence matter. Replacing a technology does not automatically reorganise the social and economic relationships that have accumulated around it. A just transition therefore requires attention to what happens to those wider relationships as the energy system changes.

The lecture then brought this argument directly back to Nelson Mandela Bay through the Coega Biomass Centre. Existing sites, infrastructures, skills and institutions themselves create affordances for doing things differently. Disentanglement therefore does not necessarily mean removing everything and beginning again. It can mean recognising and taking up different affordances, reorganising existing relationships and building new ones.

In the Coega example, both the affordances of non-indigenous trees and those of the energy industry are creatively reconsidered. Rather than treating existing elements only in terms of the roles they currently occupy, they can become part of a different configuration of relationships. This is precisely the movement captured by **Loosen → Reimagine → Redirect → Reweave.**



Figure 8: Harbour-based fishing-net recycling facility Cape Town



Figure 9: Coega Biomass Centre, Nelson Mandela Bay

Becoming entangled differently

The lecture therefore did not end with the proposition that environmental problems can be solved by somehow escaping entanglement. Environmental entanglement is part of how complex biological, ecological and social systems exist and organise themselves. Nor does disentanglement imply that the goal is to separate people, economies and societies from their environments.

Instead, the argument shifts attention toward the organisation and consequences of interdependence.

Visual complexity and art are important to this argument because they provide ways of exploring precisely what conventional linear representations can struggle to capture: multiple relationships operating simultaneously; differences in density and scale; interiors and exteriors; widening and tightening; persistence and rupture; old and new configurations occupying the same space; and forms that remain recognisable while continually changing.

The visual language that opened the lecture therefore returned to its conceptual starting point. The tangles were not intended simply as metaphors for complicated systems. They provided a way of thinking about how relationships become spatially and temporally organised, how they constrain and enable one another, and how changing one part of a configuration can reverberate through others.

From fungal hyphae and marine debris to smartphones, coal, railway corridors, solar energy, fishing-net recycling and the Coega Biomass Centre, the examples moved across biological, material, psychological, social, economic and environmental scales. The common question was not simply whether things are connected. It was how repeated interactions and reliance widen and deepen into consequential forms of interdependence, why those entanglements persist, and how they might be reorganised.

The lecture consequently ended with the question with which this work continues:

If environmental justice and wellbeing depend on how we are entangled with the world, how might we become entangled differently?