



Exploring a Mucilage Mingle of Interspecies Incubation Assemblages¹

Nadja Reifer

nadja.reifer@kunstuni-linz.at

www.mzeindl.eu/nreifer

University of Arts Linz,

PhD candidate, Austria

1. Assemblage is a philosophical concept that counters the idea of individual action, focussing on a complex network of people, things and stories that is dependent on many different influencing factors. Within this way of thinking, society is seen as something fluid and changeable, in which things and people are interlinked (cf. McFarlane/ Anderson 2011, 162 ff.).

As part of the *Interspecies Incubation* PhD artistic research, the interdisciplinary artistic project *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages* proposes a reconceptualization of human-centred incubation theories in the creative process by considering thinking with slime as a key metaphor for a holistic view. It aims to challenge anthropocentric thinking and create a space for dialogue and encounter with the more-than-human in order to understand the relevance of reciprocal relationships for creative processes as a collaborative act of co-emergence. *Interspecies Incubation Reactors* were conceived as sympoietic open systems consisting of networks of the multi-headed organisms slime moulds, machine-learning systems and human data, inviting the viewer to a multisensory experience. In these *Interspecies Incubation Reactors*, slime mould cultures interact with machine-learning-generated light labyrinths that represent human perception of concepts and are simultaneously influenced by visitors' movements. The slime moulds react to different light colours that influence their growth, and their surface oscillations are translated into music and visuals. As the *Interspecies Incubation Reactor* is not a closed system and is dependent on constant maintenance and care, the responsibility for the species-appropriate handling of the actors involved is emphasised. The creation of opportunities for exchange and mutual understanding between the actors through artistic and mediating formats, such as sharing and caring performances or workshops, are of central importance.

1. Introduction

The fascinating world of slime, ubiquitous yet often overlooked, not only weaves the environment around us, but it is also firmly anchored in our own existence. Iridescent slime serves as a metaphorical key that gives us deeper insights into the complex, often invisible interweavings between humans and the more-than-human. Often seen as a disgusting nuisance, slime plays an important role in nature, as is the case with slime moulds, for example. The mucus that these organisms produce makes a crucial contribution to the ecological balance by being an integral part of soil life, contributing to nutrient distribution and enabling the formation of fertile humus (Romeralo & Fiz-Palacios 2013, 167 ff.; Swanson et al. 1999, 133).

The discrepancy between human aversion and the ecological significance of slime illustrates Bruno Latour's (1988) 'great divide', which describes the profound alienation in the symbiotic relationship between humans and the environment. Theorists of new materialism, object-oriented ontology and indigenous studies, including Haraway (2018), Bar-

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2. Incubation refers to a process whereby conscious cognition is temporarily suspended to allow the subconscious to engage with a problem or concept (Ghiselin 1952). A well-known example is the mathematician Poincaré, who had a sudden realisation while travelling when he was not concentrating on his mathematical problem (Poincaré in Hadamard 1945, 13). Similar stories emphasise that sleep can also promote creativity. Paul McCartney of the 'Beatles' claims that the melody for 'Yesterday' came to him in a dream, and the Nobel Prize winner Loewi had the idea for an experimental proof of his theory on chemical neurotransmission in his sleep. These examples show that creative ideas often arise in moments when the mind has peace and space to work (Ritter & Dijksterhuis 2014, 1).

3. In this paper, the term 'machine-learning' is used not only because of its technical component but also to address potential confusion and mystification associated with the term 'artificial intelligence' (AI), as highlighted by the authors Daniel Leufer, Alexa Steinbrück, Zuzana Liptakova, Kathryn Mueller, and Rachel Jang on their website aimyths.org (Leufer et al. 2024, online source). The term 'artificial intelligence' can be misleading due to its historical connotations, the collaborative nature of AI development, and the limitations of current AI systems compared to human intelligence (Morozov 2023, online source). From a technical perspective, machine-learning refers to the subset of AI that focuses on developing algorithms that empower systems to learn from data autonomously and draw predictions or make decisions devoid of direct programming (Pilotto 2022, online source).

ad (2012), Bennett (2010), Morton (2018) and TallBear (2017), have extensively explored this alienation and its implications for the human-nature relationship (Reifer 2024, 117). The critique of notions of human superiority and the perspective of slime now serve as guiding principles in this project, in order to disguise the often human-centred creative process of idea generation with a holistic perspective and recognise the complexity and importance of symbiotic relationships. This in turn opens up space for profound questions. How can the invisible connections between humans and the environment be better understood and recognised during the creative process? How can a transformation from anthropocentric ideas to an understanding of interspecific slime communities be achieved? Here, slime brings into focus not only the rational and conscious aspects of the creative process, but, more importantly, the unconscious. The connection between slime and incubation² makes clear that the phases of incubation, which are characterised by unconscious and unpredictable processes during the generation of creative ideas, are closely linked to the symbiotic interdependencies and dynamics of mucilage.

This study emphasizes the importance of unconscious processes and refers to theories such as those of Wallas (1927), Haseloff (1971) and Dörner (2008). However, these theories do not take into account the complex relationships with more-than-human beings and accept their contribution as valuable co-actors. Although various incubation theorists have presented approaches that consider not only humans, but also the relationships and negotiations between humans and the environment (Dodds et al. 2002; Christensen & Schunn 2005; Sio & Rudowicz 2007), there are calls for a new construction of subjectivity as proposed by Katie Gentile in her studies on psychoanalysis (Gentile 2021, 137). Therefore, by attempting a new construction of subjectivity in the form of reconceptualising incubation, this research seeks to contribute to a more comprehensive theory of idea creation and attempts to shake up anthropocentric edifices of thought (Reifer 2024, 117 ff.). In this research these theories are subjected to a critical examination to combine them with the necessary co-operation with other species. In doing so, I try to think along the lines of slime and consider it as the key to a holistic view in order to appreciate the complexity and importance of symbiotic relationships and to question human superiority.

With these reflections in mind, my research delves into *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages*, initially as a theoretical exploration of mutual interrelationships, and secondly, to investigate and understand creative processes as a joint endeavour of co-emergence with other species, particularly with the help of slime moulds. The multi-headed organisms of the slime mould (they/them) and machine-learning systems³ play an important role as valuable co-actors that mediate at the interfaces between the different realms and forms of conscious and unconscious creativity. The machine-learning systems serve primarily as an interface between human data and slime mould, adding further perspectives to the project and recognising specific patterns that are not visible to the human eye. Moreover, these

4. The term ‘holobiont’, coined by biologist Lynn Margulis in 1991, describes an association or metaorganism consisting of a complex network of different living organisms. This idea goes beyond the conventional view of individual life, as we are symbiotically connected to other organisms through the microbiome. It undermines the clear separation between subject and object and challenges our familiar concept of self (Margulis & Fester 1991).

5. The concept of ‘sympoiesis’ emphasises the notion that nothing exists in isolation; rather, every act of creation is dependent on a multitude of conditions and external influences. Sympoiesis highlights the interconnectedness of all phenomena, challenging the notion of individual autonomy and emphasising our inherent interdependence (Haraway 2018, 85; Gilbert et al. 2012).

systems are themselves ‘holobionts’⁴ of large networks of diverse data and materialities that are to be slimed by the slime mould.

To encapsulate, this endeavor is devoted to the pressing imperative of *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages* as a divergent viewpoint aimed at transcending the anthropocentric framework and moving beyond the notion of individual creative brilliance, instead advocating for a humanly interconnected relationship with the Other, even within the realm of artistry. For designers and artists alike, creative processes and the incubation thereof serve as enduring companions, ripe for further evolution and alteration through mutual interaction between humans and the more-than-human world.

In the next sections of this paper, I will first consider the theoretical framework of the connection between the associative milieu and the orientation of slime and then discuss the extent to which Incubation can be located within it. This is followed by descriptions and reflections on the approach and methodology, which is primarily concerned with Donna Haraway’s guiding idea of ‘making kin’ (Haraway 2018). Finally, there is a brief description of the artistic artefact resulting from the process and a final conclusion.

2. Engaging Slime in the Theoretical Reconceptualization of Interspecies Incubation

To respond to the anthropocentric bias mentioned above, theories of incubation are fundamentally re-conceptualised through the thinking with slime to incorporate a communal agency of the human-more-than-human. Gilbert Simondon’s concept of the ‘associative milieu’ (Simondon 2013) provides an initial theoretical understanding of mucilaginous *Interspecies Incubation Assemblages*. This concept emphasises that individuals should not be viewed in isolation from their environment; rather, they constantly interact with it. The associative milieu corresponds to a complex field of relationships that includes the potentiality of an individual so that the rigid boundaries between people and their environment are broken down (Simondon 2013, 143; Bardin 2015, 51; Sabolius 2021, 71 ff.). The concept of ‘sympoiesis’⁵, which Beth Dempster developed and Donna Haraway advanced, complements this perspective and represents a counter-position to the idea of ‘autopoiesis’ (Dempster 2000; Haraway 2018, 85). While autopoiesis focuses on self-regulating feedback loops, sympoietic systems characterise an interdependent environment in which different species act in a cooperative and amorphous manner (Dempster 2000, 4 ff.). In such a system, each member becomes the milieu of the other, resulting in a form of shared creativity. Stacy Alaimo has also used the term ‘transcorporeality’ to refer to the ontological perspective of the more-than-human, which occurs as a continuous structure in which bodies or entities are both distinguishable and indistinguishable (Alaimo 2008, 237 ff.). The acceptance of the diversity of transcorporeal development leads to the realisation that the human being is neither exceptional nor exclusively human; it is merely one of many entities in a world full of different forms of being (Alaimo 2008, 249 ff.; Reifer 2024, 118 ff.)

A concrete example that illustrates the orientation of slime in this discussion can be found in Wedlich’s *Das Buch vom Schleim (The Book of Slime)*. Wedlich identifies the hydrogel as a substance that connects several entities and materialities. The author examines, for example, the

6. Metastability, originally rooted in nonlinear dynamics, is also used to describe the overall functioning of the brain. Within this metastable framework, structured routines interplay with spontaneous improvisations in different brain regions while interacting with external environmental cues (Bruineberg & Rietveld 2014, 10; Minissale 2021, 33).

extensive mucus barriers on the internal interfaces of the human body, which interact with billions of resident microbes in close cohabitation through mucus and form holobionts—units consisting of multicellular organisms and numerous microorganisms (Wedlich 2019, 81). Over millennia, slime has not only influenced the interfaces of nature, but it has also captured the human imagination. Myths and legends from various cultures often tell of the creation of the world and mankind through slimy substances and living beings. The Chinese creation story, for example, tells of the snail goddess Nü-kua who, out of loneliness, moulded man out of clay (Wilkinson 2020, 212). Another example can be found in the Hebrew Bible, which speaks of a golem made of clay and mud—an unformed figure that serves man as a mute automaton (Vudka 2020, online source). The fascinating influence of slime on the imagination can be considered in conjunction with the theories of the psychologist and academic Vlad P. Glăveanu. Glăveanu has argued that creativity “is not the product of a “disconnection”, but of deeply rooted “connections” between person and environment, self and others, creator and culture” (Glăveanu 2010, 147). These examples emphasise the central role of mucus as both a physical substance and above all as a mucus metaphor that demonstrates the complexity and contradictions in the comprehensive understanding of the human and the more-than-human.

In the following, I consider how a connection between individual entities and their environments can enable the emergence of ideas and how incubation could play a key role in the creative process. The idea of the metastable⁶ state—as Simondon has proposed—can in turn bridge the concepts of incubation and the associative milieu (Simondon 2008). Simondon argues that the emergence of new imaginations only becomes possible when memory images reach a state of supersaturation. The metastable state characterises a moment of intensity in the exchange between the individual and their environment. It harbours sufficient potential energy to trigger sudden changes in the entire system and thereby enable the emergence of something new (Simondon 2008, 124). In this context, the theoretical considerations of Gilles Deleuze and Felix Guattari on chaosmosis are also interesting (Deleuze & Guattari 1994, 215). According to this theory, intensive encounters with art plunge the brain into a state of chaos in which the axioms of the existing are partially suspended. Art itself is not directly chaotic; rather, it is to be understood in the sense of an ordered chaos that produces visions and sensations. This can be described as ‘composed chaos’, which is neither predictable nor planned (Deleuze & Guattari 1994, 204). Scientists such as György Buzsáki and J. A. Scott Kelso have extensively investigated the chaotic dynamics of the brain and the dynamics of embodied emotions, providing evidence that the brain works with non-linear dynamics (metastability) and chaotic incubation. This empirically underpins the idea of a chaotic brain in which chaos is understood not as purely random, but as an interaction between order and chaos (Buzsáki 2006; Kelso 1995; Minissale 2021, 29). In the phase of the metastable state within incubation, an epistemological space of becoming can emerge. Neo-materialist approaches clarify that, in this becoming, different phenomena are always linked and also constantly changing, but it is precisely these specific, temporary connections that comprise what we call life. The various possibilities that exist at any given moment and the fusion of social and material phenomena, which should not be understood as separate from one another, give rise to concepts

7. In order to elucidate the diverse interconnections of the incubator, this study proposes an adaptation of the technofeminist concept of the apparatus as a material-discursive entity (Haraway 1995, Barad 2007), used as both a theoretical framework and a speculative tool (Barla 2019). On the one hand, this approach seeks to elucidate narratives about the intertwined nature of technological and organic entities, unravelling specific socio-political, economic, and historical complexities while promoting discussions about processes of emergence. On the other hand, the use of the apparatus as a speculative method aims to construct assemblages of the more-than-human, thereby challenging and reshaping anthropocentric notions of inequality (Reifer 2024, 129).

such as cause and effect. In a world of constant change and diversity, however, these concepts have no clear boundaries; instead, they merge into one another. (Barad 2003, 821 ff.) Matter and materiality are therefore more than things or substances, and they must be recognised as living phenomena that are constantly changing. According to Karen Barad, this occurs through a constant process of intra-action in which they are simultaneously stabilised and destabilised (Barad 2007, 210). According to Deleuze and Guattari, the ‘affective attunement’ to placing oneself in the more-than-human represents processes of becoming (Deleuze & Guattari 1987, 256; Reifer 2024, 119 ff.)

These affects depend on a structural link between the species, facilitated by vibrational rhythms, which promote a form of interaction with the other:

“Rhythm is the milieu’s answer to chaos. What chaos and rhythm have in common is the in-between—between two milieus, rhythm-chaos or the chaosmos. [...] In this in-between, chaos becomes rhythm, not inexorably, but it has a chance to. [...] There is rhythm whenever there is a transcoded passage from one milieu to another; a communication of milieus, coordination between heterogeneous space-times.” (Deleuze & Guattari 1987, 313)

This artistic investigation focuses particularly on the transitional phase of the slimy ‘in-between’ as a potential realm for interspecies creativity. By immersing oneself in the process of becoming through incubation, it’s possible to foster a deeper connection with other beings, potentially cultivating greater empathy towards them. In the ensuing exploration, this research uses an artistic methodology to engage with slime moulds and machine-learning systems, demonstrating how such *A Mucilage Mingle of Interspecies Incubation Assemblages* can be artistically explored, with a focus on the formation of slime.

3. Forging Kinship: Discovering Slimy Interspecies Incubation in the Creative Process

The methodological approach to the artistic examination of *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages* involves several steps, ranging from scientific research in the classical sense to artistic research, culminating in a speculative apparatus.⁷ The first part of this project consisted of a comprehensive literature review and the analysis of psychological incubation theories in the form of diagrams, and its aim was to conduct an initial deconstruction of the theoretical approaches. This resulted in a total of five quintessences: network activation spreading, forgetting, external stimuli, relaxation and chance (Reifer 2024, 120 ff.). These quintessences were created primarily for the purpose of orientation and are used as so-called ‘enabling constraints’ (Manning & Massumi 2014, Rousell 2018) to enable focus and divergent thinking within certain parameters. These open restrictions can thus enable the emergence of something new (Manning & Massumi 2014, 93). In this study, these enabling constraints in the form of quintessences were starting points for expert interviews with slime mould and machine-learning researchers; these interviews established common considerations regarding *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages* and suggested approaching the similarities and differences of the respective actors in the milieu of incubation.

The challenge here was also not to anthropomorphise the co-actors involved—including slime moulds and machine-learning systems—but to free them from the passive role of the exploited other.

In the second part of the project, the focus was intensive examination and experimentation with *Physarum polycephalum* (slime moulds) and machine-learning devices, and the goal was to become related to these actors. This requires a form of communication, as Starhawk (2004) has noted. She emphasises that the development of the ability to communicate with nature first requires an ontological shift so that the possibility of such communication can be recognised. She draws on the myth of bird language to illustrate that understanding natural languages begins with recognising them as such; it is then possible to listen attentively (Starhawk 2004, 7 ff.). Subsequently, alternative ways of knowing can be acquired through the practice of listening (Neimanis 2012, 13). The geneticist and biologist Barbara McClintock emphasises how crucial it is to develop a connected perception of an organism and to have the patience to be attentive to what the being or the material wants to communicate (Sheldrake 2020, 106).

This type of communication is used in this research project with the help of mucus as a metaphor for complex, symbiotic interdependencies to gain different insights into and approaches to understanding communication with more-than-human entities. One example of this is the slime of snails. The mucus trail alone conveys all the necessary information to attract a potential mate, such as species, sex or even attractiveness. In some species, this trail is even transformed into a gender-neutral mucus to avoid intrusive male suitors (Wedlich 2019, 67). If a mutual understanding is reached, slimy love arrows are exchanged with tantalising pheromones. The remaining mucus is also attractive prey for ants, but this can be to the ant's disadvantage. This mucus can harbour a parasite, such as the small liver fluke, which grows in the ant's body and ultimately takes control of its central nervous system, transforming it into a zombie ant that is doomed to die (Wedlich 2019, 200).

Another example, from the realm of slime which is particularly relevant for this research project, are slime moulds, which are multi-headed organisms. Slime moulds are also referred to as social amoebae (Bonner 1995, 165) and, due to their ability to constantly change their shape like the Greek sea god Proteus, they are also known as *Proteus animalcule* (Rösel von Rosenhof 1755, 621 ff.; McAlpine 1881, 17). They consist of a sac of amoebae surrounded by a thin mucus envelope; they have no distinct shape, but they behave intelligently, despite lacking both a brain and a nervous system (Bonner 2009, 52). Slime moulds are organisms that develop from a seemingly uncoordinated group of genetically identical individual cells into a strangely decentred structure with organismic functions that are characteristic of multicellular species with different tasks and continuous life cycles (Bonner 1995, 3 ff.). Slime moulds are living, changing, identity-varying, strange organisms. Collective behaviour plays a particularly important role in the migration and reproduction processes of slime moulds. This is because individuals that previously lived independently interact with each other and work together to achieve a common goal: the search for suitable conditions for their survival and the spread of their spores (Reid & Latty 2016, 799). In recent decades, slime moulds have attracted particular attention in entrepreneurial techno-sciences because of their astonishing behaviour, with negative consequences. Techno-scientists use them

8. In order to embark on decolonization, it is essential to adopt a dual perspective that acknowledges unique historical, geographical and political settings while facilitating cross-comparisons with alternative decolonizing methodologies (Parreñas 2018, pos. 522). Care work, which is deeply rooted in feminist scholarship, constantly grapples with power dynamics, inequalities and instances of violence, yet remains inextricably linked to labour. Particularly in the technosciences, there is a growing emphasis on the importance of care in shaping knowledge production (Parreñas, 2018, pos. 3575; Reifer 2024, 129).

for capitalist purposes, including in the form of experimental efficiency bodies. For example, slime moulds have been used to build robots and have been grown on chips to measure electrical voltages. They were also triggered with direct bright light to define the direction of robots' movement (Grube 2016, 28 ff.; Mitsch 2020, min. 46). Direct, bright white and blue light are harmful stress factors for slime moulds and trigger avoidance reactions (Häder & Schreckenbach 1984, 55 ff.; Briard et al. 2020, 3). In another application, slime moulds were used to predict Mexican migration patterns in the US (Adamatzky & Martinez 2013, 242 ff.). However, the extraordinary abilities of slime moulds have been described as examples of primitive intelligence, which in turn illustrates the anthropocentric supremacy in the species hierarchy (Bahng 2017, 320; Reifer 2024, 121 ff.) This raises the question of how it is possible to treat organisms used in artistic research processes in a species-appropriate, ethical manner.

An essential component of this artistic project therefore relates to the special care of slime moulds as independent actors in the overall artistic structure. For Juno Salazar Parreñas, cross-species caring is a kind of 'decolonial strategy'⁸ that attempts to resist the separation of the human and the more-than-human and to explore caring and relational ways of being in the world (Parreñas 2018; Kaner 2022/23, 27). Like Parreñas, Jane Bennett emphasises a responsible, strategic and sensitive approach to material things and non-human actors (Bennett 2010, 116). To overcome political challenges, she believes that people must develop an ecological sensitivity to material things. Sensitivity, mindfulness and respectful interactions with the more-than-human are central concepts in the discussion about care work (Bennett 2010, 103 ff.). This approach is based on, first, a heightened awareness of human actors with regard to other actors in a network without hierarchies and, second, the realisation that network compositions are diverse and can be changed (Bennett 2015, 84; Peters 2018, 24; Reifer 2024, 122 ff.)

As an artist who has spent the last two and a half years intimately involved in the observation and care of various species of slime mould, I've noticed the emergence of environments characterised by care, empathy and sensitivity. This notion of care not only fosters alternative perspectives that challenge colonial power structures but also inspires imaginative explorations of interconnectedness and kinship, echoing Donna Haraway's notion of living and perishing together in unpredictable societies (Haraway 2018, 137 ff.). Through encounters with others and the attentive care of different species, I've imagined possibilities for building meaningful relationships and mutual understanding. Sharing these insights and experiences, including the act of caring for other beings, is crucial to fostering deeper connections and promoting societal well-being. To disseminate these ideas, workshops have been organised at various universities and exhibitions, such as the *AI+ Artificial Intelligence and Art 2024* at Splace Linz, as well as a *Caring and Sharing* performance at the *Ars Electronica Festival 2023*. Through these efforts, I hope to provoke reflection and inspire action towards a more caring and connected world.

Due to their special characteristics and similarity to biological incubation networks, slime moulds appear to be ideal actors to challenge the human imagination of incubation and redefine the understanding of community and cooperation in nature. This could result in profound experiences and insights into the relationship between humans and na-

9. According to a study by the University of Massachusetts, a training process for such a system emits more than 626,000 pounds, or the equivalent of more than 283,000 kg of CO₂. This corresponds to the lifespan of five US vehicles (Hao 2019, online source). This is accompanied by high water consumption and the subsequent marginalisation of indigenous tribes. Switching to renewable energy for data farms by using lithium batteries would continue to have major negative side effects (Jones & Easterday 2022, online source).

10. Bodies marked by toxicity are created by a confluence of factors, including scientific advances, industrial practices and consumer habits. Far from being static, these bodies are in constant flux. Their complexity stems from the absence of clearly defined boundaries, with influences from scientific, medical and various societal factions shaping our understanding of them. While toxic bodies carry negative connotations, they play a crucial role in feminist discourse by moving away from a simplistic dichotomy between nature and the body. Instead, they highlight the interconnectedness of environmentalism, health advocacy and social justice (Alaimo 2008, 261 ff.).

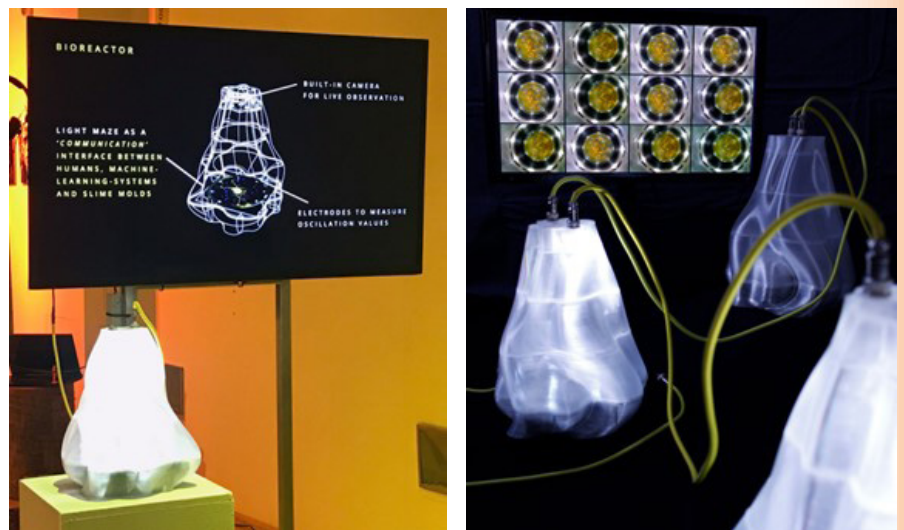
ture that go beyond conventional, anthropocentric views. Although only part of the slime moulds' experience can be understood by observing their behaviour and following their tracks, their unconventional behaviour could contribute to understanding the creative incubation process as a collaborative slimy act of becoming between different species. The philosopher Steven Shaviro has noted that the difficulty of comprehending others' experiences also applies to one's own self-reflection, and he has argued that sentience and consciousness are essentially based on fiction and stories (Shaviro 2016, 215; Reifer 2024, 121 ff.) The study of slime moulds, therefore, not only broadens our understanding of incubation processes and the natural world but also prompts profound questions about the nature of our own encounters and perceptions.

The inclusion of machine-learning in the context of *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages* is also highly important, as in today's world, machine-learning systems are deeply integrated into the processes of life and creativity. They collect data from different sources — often at the expense of communities and ecosystems⁹ (Crawford 2021; Kannengießler 2022, 56 ff.; Hepp et al. 2022, 457) — and process huge amounts of data to recognise patterns and make predictions. Machine-learning systems are thus part of a deeply rooted 'data colonialism' (Turow 2021), and they can also be regarded as 'toxic bodies'¹⁰ in the sense that Stacy Alaimo has described (Alaimo 2008, 259). The term toxic bodies is not limited to human bodies; it refers to all bodies, including machine-learning systems. According to Alaimo, the conscious inclusion of toxic bodies can contribute to understanding oneself in constant exchange with the environment and to imagining an epistemological space that takes into account both the unpredictable becoming of other living beings and the limits of human knowledge (Alaimo 2008, 262; Reifer 2024, 125 ff.) Like Alaimo, the philosopher Rosi Braidotti does not advocate technophobia as an appropriate approach and instead suggests that a balanced position should be taken that is neither fearful of technology nor blindly technophilic. It is a matter of being sensible enough to face the challenges posed by human historical development (Braidotti 2002, 146). The authors Jason Edward Lewis, Noelani Arista, Archer Pechawis and Suzanne Kite have suggested a deeper connection to machines by drawing on indigenous epistemologies. They recommend an expanded circle of relationships that considers machine-learning systems, for example, as 'Alna' (derived from the Hawaiian term for land, 'aina'). This term is intended to emphasise that these relationships should be respected as much as all other aspects of the network of life (Lewis et al. 2018, 4). They also emphasise that machine-learning systems are always interwoven with their physical materials and resources. Separating the devices from their matter would sever this connection. The relationships to the machine-learning systems are therefore always also connections to exploited resources. An ethical approach requires a critical review of the ontological status of each part that contributes to these systems (Lewis et al. 2018, 11). The comprehensive analysis of machine-learning systems requires not only the consideration of their physiological materials, but also a critical examination of the underlying infrastructural networks. These deeper structures play a decisive role, as they are often what make the impact of machine-learning systems possible in the first place (Hepp et al. 2022, 457). These findings clarify that machine-learning systems are not only toxic actors, but they also actively operate at the interface between hu-

mans and the environment. As mediators in *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages*, they contribute to gaining new insights into the multi-layered relationships between different entities by analysing data and recognising patterns. In this way, machine-learning systems act as speculative entities in the complex incubation network and open up additional ways of thinking.

In this context, the close connection with living and machine actors, which Anna Tsing has referred to as ‘contaminated collaboration’, is also used in this project with the metaphor of slime, becomes particularly significant. These actors represent unpredictability, transgression and non-alignment with capitalist interests, and they produce patterns of unintentional coordination in an uncertain environment (Tsing 2018, 40). Haraway has expressed similar views in her revision of the cyborg figure, describing cyborgs as imploded entities that express specific, diverse relationships; they are ontologically heterogeneous and historically situated (cf. Haraway 2012, 301). In this context, the author Merlin Sheldrake has argued that all entities, including humans, can be regarded as ‘symborgs’ or ‘symbiotic organisms’. This fusion of life forms and technical apparatuses, whether biological or artificial, emphasises the common existence of humans, nature and machines in a constantly evolving network of relationships (Sheldrake 2020, 141). To summarise, this research project on *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages* should provide deep insight into the complexity of interactions between different actors and demonstrate the need for a holistic view of humans, nature and technology.

Fig. 1. and 2. The left-hand image shows one *Interspecies Incubation Reactor* and the technical sketch with the respective functions at the *AI+ Artificial Intelligence and Art 2024* exhibition. Three *Interspecies Incubation Reactors* are displayed with images from inside the reactors on the right-hand side. (source: Martin Zeindl & Nadja Reifer 2023/2024)



4. Artistic Manifestations: Exploring a Mucilage Mingle of Interspecies Incubation Assemblages

A comprehensive review of existing literature alongside an examination of psychological incubation theories formed the foundation of this artistic inquiry. Experimental interviews with experts in slime mould and machine-learning research, combined with extensive exploratory and practical work, led to the creation of a speculative incubation apparatus, complemented by further experimentation. The outcome of this creative process is the development of several *Interspecies Incubation Reactors*, designed to render the intertwined processes of incubation pal-

11. Biodata sonification is the conversion of information extracted from natural sources into audible signals. This technique allows environmental or biological data to be presented in an auditory form, aiding studies in areas such as acoustic soundscapes, ecology and interspecies communication (Cheng 2022, 3).

pable through a collaborative, artistically speculative exchange involving both mechanical and biological agents (Dunne & Raby 2013). The objective is to establish a kind of communication interface bridging rational machine-learning systems, the unpredictable biological subconscious of slime moulds (*Physarum polycephalum*), and human data. Each *Interspecies Incubation Reactor* comprises a culture of slime mould and a light maze generated by machine-learning systems (specifically, Orange by Demšar & Zupan). The subdued light mazes represent human perceptions derived from sentiment analysis of diverse internet posts, with this human data transformed into a multidimensional scaling dot plot of light. Slime moulds exhibit varied responses to different light colors, thereby influencing their growth patterns. Surface oscillations of the slime moulds are measured through biodata sonification¹¹, with the resultant data converted into MIDI signals and further translated into rhythmic visualizations and music (Reifer 2024, 126 ff.). Through the creation of *Interspecies Incubation Reactors*, this project aims to redefine incubation processes by engaging both machine-learning systems and slime moulds in a collaborative artistic dialogue. By transcending anthropocentric perspectives and fostering connections between human data, biological organisms, and mechanical agents, it challenges traditional notions of incubation and invites a more inclusive understanding of creativity and knowledge production.

This artistic exploration is an attempt to convey sensual-aesthetic rhythmic experiences with the more-than-human in a symbiotic way. The aim is to reconceptualise the concept of creative incubation and to open it up to the uncontrolled and unplannable. Slime itself is not linear, and the creative process does not follow a fixed pattern, either. An exploration of different notions of time is necessary to consider incubation not only as a phase of the creative process, but also as the centre of the slime. Incubation can occur in any traditional phase of the artistic process: idea generation, when one is stuck, while waiting for slime moulds to grow and provide answers, or in the versatile translations of machine-learning systems that capture the uncontrollable. Incubation describes the lively events in the creative process, which is characterised by active and quiet phases, conscious and unconscious processes and a newly materialistic action that goes beyond the purely human—a continuous process with constant impulses from the environment.

The implementation of communication interfaces creates a space that allows people to connect with their own animalistic, slimy nature. This process is facilitated by observing other entities and especially by active listening, as Astrida Neimanis has emphasised (Neimanis 2012, 13). In this project, observation and listening not only include human sensory experiences and perceptions of time, but they also integrate the perspectives of other actors, as well as their own way of interpreting data and perceiving time.

Furthermore, in this context, the machine-learning systems function as a kind of communication interface between human Internet data and slime moulds. An image analysis was conducted of the slime mould structures grown through the light labyrinth. The fact that the resulting data of these image analysis influenced the concepts of the next light labyrinth that was generated resulted in a continuous process that was subject to dynamic tensions and changes. In summary, the *Interspecies Incubation Reactors* were used in an attempt to implement dynamic en-

tanglements in the form of various entity assemblages and make them tangible by means of various outputs, such as rhythmic visualisations and music.

Fig. 3. and 4. Both images show impressions of the *Sharing and Caring* performance during the *Ars Electronica Festival 2023* (Source Images: Alexandra Kraler, Tina Frank, and Nadja Reifer 2023).



Further exploration with the *Interspecies Incubation Reactors* is anticipated in the future, although they are briefly outlined here due to their ongoing development. Attempts will be made to involve humans in various ways to contaminate them consciously and unconsciously with the mucous rhythms. The primary focus is the incubatory interstices of more-than-human encounters, which are intended to promote a mode of knowledge production. One example of this is the attempt to make the contamination of a physical unconsciousness tangible through a trance dance performance. Another approach is to investigate interspecific encounters by speaking with the slime moulds. The users of the experimental set-up can record their voices, which play back at a specific time depending on the growth of the slime moulds. This allows the experimenters to become part of the musical performance. The final experiment involves linking the *Interspecies Incubation Reactors* with a virtual reality (VR) application. While the experimenters can immersively experience the visual and auditory fractal rhythms, the coordinates of the mostly unconscious movements are recorded and transferred to the light labyrinth. This creates reciprocal rhythmic contact between the different actors (Reifer 2024, 127). These experiments aim to blur the boundaries between human and non-human actors, challenging traditional notions of agency and participation in creative processes. By exploring the potential of interspecies collaboration and immersive technologies, this research seeks to push the boundaries of artistic expression and knowledge production.

5. Conclusion

In conclusion, this interdisciplinary research project, *Exploring a Mucilage Mingle of Interspecies Incubation Assemblages*, aims to create a space for dialogue and encounters with other species and materials in an incubator environment, while at the same time contaminating the subconscious with interspecific rhythms. By focusing on slime, the project explores the profound implications of this seemingly ubiquitous but often overlooked substance as a metaphor for complex symbiotic interdependencies. This perspective reveals that slime serves not only as a physical substance, but also as a metaphorical substrate that demon-

strates the fusion and contradictions within human and non-human relationships. Furthermore, the project goes beyond mere observation by actively experimenting and engaging in speculative dialogues with slimy organisms such as *Physarum polycephalum* (slime moulds) and machine learning devices in an incubatory space. In this process, empathy and awareness are central principles that are fostered in a networked, co-emergent environment. As an open system that relies on constant maintenance and care, the Interspecies Incubation Reactor emphasises the responsibility for appropriate engagement with all actors involved and aims to deepen the human understanding of care in relation to the more-than-human. Creating opportunities for exchange and mutual understanding between actors through artistic and mediating formats, such as sharing and caring performances or workshops in academic settings, is crucial. Furthermore, the study aims not only to make new narrative forms of symbiotic interdependencies tangible but also to reformulate them theoretically by focusing on slime. Machine learning systems play a significant role in these assemblages by enabling the discovery of collective maze structures based on extensive human datasets, allowing for unique interactions with slime moulds. Furthermore, these systems offer alternative perspectives by recognising patterns that may elude human perception. By combining scientific research and artistic practice, the project offers an alternative approach to slimy interspecies incubation assemblages. In particular, it emphasises the dynamic entanglements of different entities with subjectivity and the importance of empathy, responsibility and mutual understanding to create deep connectedness. Understanding the significance of reciprocal relationships in creative endeavors is essential, framing them as communal acts of co-emergence alongside other species. Through the interdisciplinary approach of relational thinking, the project offers valuable insights into the dynamics of interdependence and the possibilities for fostering symbiotic relationships in a world of interspecies coexistence.

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