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Composing Improvisors: Habit and Agential Responsibility

In the liner notes of his seminal album *The Shape of Jazz to Come,* free-jazz pioneer Ornette Coleman writes, "if I am just going to play the changes, I may as well write out what I'm going to play" (1959). Coleman separates improvisation from composition by its capacity for self-expression. In a similar vein, in an interview with Derrida, Coleman describes improvisation as a "democratic relationship", a heterarchical rather than hierarchical practice of music-making (Murphy 2004, p. 319). For Coleman, the spontaneity of an improvisation opens it to external factors, unforeseen tangents and unexpected interjections. Mistakes in recitation become avenues for further improvisation. Improvisors do not simply repeat an established routines but tell us about themselves as they improvise. With this aptitude for self-expression, improvisation is often linked to freedom. Despite this freedom, I argue that improvisation is enabled by intense preparation, contingent on the embedded habits of the performer and their understanding of musical elements. Given that an improvisation fails if an intention is specified prior to its execution, an improvisor must rely on their habituated skills to navigate an unpredictable environment. It is these habits and pre-existing patterns that listeners learn about when they hear someone improvise.

Theorist and pianist Vijay Iyer, defining improvisation as a "semi-transparent, multistage process through which we sense, perceive, think, decide and act in real-time" (2016, p. 74). Decisions have real-time impacts but the constraints of a scenario impact decision-making. With this reciprocal determination, Iyer cogently argues that improvisation inhabits not just music-making but a vast wealth of action such as learning and the modification of habit through trial and error. Improvisation's openness has ramifications to its significance. Adapting one's behaviour to a complex environment is improvising, at least in some minimal sense.

With this openness in mind, George Lewis proposed improvisation as a fertile field for the Turing test, developing his improvising machine *Voyager* in the 1980s. Up to this point, the study of AI and music had focussed on the recitation of composed scores. For Lewis, to satisfy

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the Turing test, a computer "had to respond to unexpected questions" (2003, p. 203). What is assessed as intelligent is the machine's capacity to modify its behaviour and respond to a complex environment. Musicians that perform with *Voyager* attest to it performing like a human improvisor in maintaining an idiosyncratic style. Like its collaborators, *Voyager* listens and adapts to the performance environment. This challenges to the view that the realm of music is the domain of humans. Given it feels human to its collaborators, *Voyager* questions whether there is a radical difference between human and machine improvisors.

Answers to this question tend to culminate in Searle's Chinese Room debate.[1] It is important to note that this thought experiment concerns intentions. Human improvisors go into performances with certain goals, but these are general in nature so as not violate its spontaneity. It is important to note that *Voyager* needs to be turned on and off. While this might seem superficial, unlike its human counterparts, *Voyager* does not recognize the end of the performance, continuing to play until stopped. This indicates that it does not have the same kind of understanding, and subsequent general intentions, about musical performances. However, unexpected interjections outstrip an improvisor's intentions, derailing prior plans, and forcing them to rely on and adapt their habits to accommodate the external impacts. The testimony of *Voyager's* collaborators must be explained. Impacting musical material and adjusting to its environment, discounting *Voyager* as an improvisor on the grounds that it lacks the relevant intentions seems unfair.

Given an improvisor's intentions are overflowed by the performance environment, this article focusses on the role of habit in improvisation. This exposes the threat of Lewis' denotation of *Voyager* as a composition. If *Voyager* counts as an improvisor, composed of pre-set routines, are human improvisors simply a series of passive habits and conditioned responses? The replication and modification a habit implicates a complex causal chain of the performance conditions and what and how the performer was taught. This reduces an improvisor's creativity, shrinking their agency and improvisation's capacity for self-expression. Notions of artistic genius or intuition are diminished. Did the improvisor contribute of their own volition or was it a causal mechanism, a conditioned response to a certain stimulus? This jeopardizes how authorial responsibility is conferred. This only tells half the story. Habit has a dual aspect. Agents are not just constituted by passive habits, but also own them, intervening and resisting falling into known tropes.

[1] Eric Lewis offers an interesting discussion about whether *Voyager* appreciates the Afrological roots of jazz improvisation to determine whether it has the relevant understanding of its intentions (2019, pp. 75-76).

The task of this article is to determine what it means to be an improvising agent and to ascertain the sense in which an agent can claim an improvisation as theirs. *Voyager* provides a difficult test case given the reports that it adapts to its environment, maintains an idiosyncratic style, and its ability to affect musical material in the same way as its human counterparts. In response to issues of agential responsibility, I propose a notion of improvisational space, based on Deleuze and Guattari's concept of territorialization. An improvisor loosely demarcates a complex playing field of musical milieux, the intersection of which gives rise to various opportunities that pull an improvisor to behave in certain ways. This provides a sense to understand how an improvisor impacts and is impacted by an improvisation, drawing out the interrelationship between the dual aspect of habit and agential responsibility.

The dual aspect of habit is explored with respect to Deleuze's notions of bare and creative repetition. Here we see glean the difference between human and AI improvisors, and how an improvisor expresses themselves. As they territorialize musical milieux, I argue that an improvisor learns about patterns in the music and about their habits, the limits and conditions of their trained skills and how these are extended by the performance environment. This demarcates the difference between human and machine improvisors. While both adapt to an unpredictable environment and renovate musical material, what is contentious is whether a machine grasps their habits and can resist their replication in the same way as a human improvisor. This also providing a framework to evaluate whether *Voyager* can be held authorially responsible for its improvisations and if any authorial responsibility should be conferred on its composer.

Improvisational Space

An improvisor cultivates an improvisational space. Jazz musicians call a tune, play a recognisable motif. The orchestra provides space for the pianist's cadenza who recapitulates their melodic and harmonic patterns. Improvising freely still involves a choice, performing certain musical elements over others. In each instance, the improvisor demarcates a playing field of musical material. This may be a conscious decision or absent-minded repetition of something they have rehearsed. Playing certain elements over others in a particular fashion delimits potential musical opportunities. These opportunities pull the improvisor to exercise their faculties in certain ways, and as they continue to play, they draw more material into the improvisational space. The initial boundary shifts and opens the improvisational space to contributions from the audience and the performance context more generally.

In *A Thousand Plateaus,* Deleuze and Guattari elaborate a processual reality of intersecting milieux, assemblages and territories. Underpinned by the interrelated notions of milieu, meter, and rhythm, territorialization responds to the problem of consistency, explaining how differential elements cohere. A milieu is not a pre-existing identity, but an assemblage, a block of spacetime constituted by a periodic repetition by a milieu-component. Deleuze and Guattari distinguish two kinds of repetition – meter and rhythm. Meter is a repetition that replicates sameness. This repetition codes milieu with a particular direction and function. Rhythm, on the other hand, is a creative repetition that emphasizes difference, that transcodes and overcodes milieux. Rhythm is composed of at least two edges. Consider a duet between violin and piano. There is an edge between the violin's sounds and that of the piano. While these sounds come together, the rhythmic edge between them highlights the difference between the two, producing the music that is the duet.

Territorialization describes the process by which disparate milieux are hierarchized and stabilized into concrete entities that make up our everyday lives. Conversely, the processes of deterritorialization and reterritorialization explain how assemblages interrelate, describing how milieux are dislocated to be rearticulated. A territory is a self-organizing assemblage propagated by an "act of rhythm". Comprising within it "vectors of deterritorialization", a territory embraces a tendency towards stability, a specific kind of organization, and to change, opening on onto other assemblages, evolving as it encounters other milieux (Deleuze & Guattari, [1987] 2013, pp. 366-367).

Deleuze and Guattari write there is a territory "when milieu components cease to be directional, becoming dimensional instead, when they cease to be functional to become expressive" (Deleuze & Guattari, [1987] 2013, 366). The transition from direction and function to dimension and expression mark the genesis of a territory, when milieux acquire a spatial range and temporal constancy. Deleuze and Guattari distinguish the difference between milieux and territorial animals with the song of the non-musician bird and musician bird. The non-musician bird's song is the result of various biological drives, the milieux of the song having a particular function and direction. Its song serves a purpose and is the response to a specific stimulus – but maintains no idiosyncratic features by which it might be identified. By contrast, although the song of the territorial musician bird may stem from similar biological imperatives, it has acquired a spatial range to become expressive of the bird itself. The musician bird is territorial in that it overcodes the milieux of the song to express itself. It maintains an idiosyncratic style so that the discerning listener can identify the musician bird from the

song alone. Opening onto other assemblages, this allows passages and relays of deterritorialization and reterritorialization, explaining how musical milieux is transformed.

In corralling musical material together, an improvisor develops a territory, a loose demarcation of material with which they want to improvise. The rhythmic edges between the improvisor, their instrument, the performance venue, and the musical milieux being played propagates the improvisational space. Like the musician bird, an improvisor wrenches disparate musical milieux from their history of sedimented usages and rearticulates them in a way that is expressive of the improvisor. Musical milieux is overcoded, serving different harmonic and rhythmic functions, expressive of the rupture from its initial assemblage and its reterritorialization in the improvisational space. The improvisor is also territorialized by the musical material in the improvisational space, pulling on them to perform particular phrases in accord with the demands of their instrument and skill. This complex interaction produces the sound organization, the determinate set of musical elements played. Insofar as deterritorialization and reterritorialization describes how assemblages open onto each other, this picture preserves the complex causal system that begat the improvisation.

The notion of improvisational space describes the activity of the improvisor. Territorialization makes sense of the improvisor's lack of control while explaining their activity, describing how their contributions impact the improvisational space and how the improvisor is pulled to play particular epithets. The improvisational space is comprised of territories, that of the improvisor, and that of the musical material. The rhythmic edge between these two territories spontaneously produces the sound organization. While an improvisor may wish to be completely spontaneous, their performances will adhere to stylistic and musical norms. What is performed recalls the habituated behaviour of a rehearsal room, how they were taught, what they have heard. In the volatile environment of an improvisational space, an improvisor uses their habituated behaviour to wrestle with unexpected interjections, as they learn about musical milieux and their own abilities, why they perform a particular phrase under certain conditions.

As a territory, improvisors express themselves through their territorialization of milieux. This helps understand why *Voyager* sounds like a human improvisor. Lewis insinuates that the reason for this is because *Voyager* maintains its "own sound" through its "interactive aesthetic of negotiation" (2000, p. 37). As noted, in needing to be switched on, it is unclear that *Voyager* possesses the relevant understanding to engender an improvisational space. However, there is no radical difference in how human or machine improvisors impact musical milieux. Like musician

birds and human improvisors, *Voyager* renovates musical elements by the same processes of deterritorialization and reterritorialization, so that it maintains a style. It is not a random note generator, but duplicates certain patterns, listening to and adapting to an improvisational space, relying on its code to navigate the terrain in the same way a human relies on their trained habits.

Creative Repetition and the Dual Aspect of Habit

Using the same processes of deterritorialization and reterritorialization, to tease out the difference between human and machine improvisors we must examine their respective territories. This section makes a parallel between the earlier distinction between meter and rhythm and Deleuze's notions of bare and creative repetition, identifying how habitual relations constitute territories. Expanding territorialization with respect to habit highlights the interrelationship between action and events and draws out the tension in the dual aspect of habit, indicating the difference between machine and human improvisors.

O'Keeffe eloquently summarizes that "habits hook us into our sense of self-consistency", setting down "a multiplicity of little anchors" into the flux of time. O'Keeffe continues that "too much routine can be bad thing. But a life with no habits is no life at all… a person without habits sticks at nothing" (2016, p. 71). Habits provide relative stability during dynamic change. Patterns within the musical material, and the improvisor's idiosyncratic habits enable an audience to discern stylistic traits and indeed hear the sound organization as musically coherent rather than noise. Of course, improvisation demands new routes be trodden, novel relationships between musical material found. The habits of an improvisor evolve as they territorialize and are territorialized.

For Deleuze, habit is a passive synthesis, a repetition of difference, productive of everyday entities. In *Difference and Repetition,* Deleuze distinguishes bare and creative repetition. Bare repetition is a mechanical reproduction that presents diverse instances of the same. On the other hand, creative repetition promotes the ontological primacy of difference, differentiating difference itself, producing a novel entity or relation. This recalls the distinction between the homogenous repetition of meter and the irregular recapitulation of rhythm. Like meter, bare repetition imbues direction and function. Similar to rhythm being productive of territories, creative repetition comprises a novel relation between milieux.

Both terms are used to explain how difference is productive. It is important to acknowledge that in *Difference and Repetition,* Deleuze's project is to uncover the conditions of thought. To capture its dynamism, he

locates this in difference itself. Creative repetition sparks thought, transforming habitual patterns that arise through bare repetition. Although describing the dynamism of an improvisational space, meter and rhythm do not illustrate an improvisor's attention and awareness detailed in the introduction. The awareness inherent in the notion of creative repetition serves to recapture the agency of the improvisor, how they select and participate with musical milieux.

Holland explores the distinction between bare and creative repetition with the example of learning a musical instrument. This involves bare repetition, practising scales and other formal musical units. The student initially struggles but with rehearsal becomes capable of repeating these scales. At a certain skill-level, they begin practising pre-composed musical works. Holland writes "this also involves a significant degree of bare repetition, since a composed piece is supposed to be performed more or less the same way" (2013, p. 8). Again, with a certain proficiency, the student can begin to improvise, drawing disparate milieux and these passive habits together "so that creative repetition replaces bare repetition" (2013, p. 9).

Holland's example identifies two aspects of habit, and indicates the link between improvisation's capacity for self-expression and its creativity. Bare repetition replicates sameness, a skill that can be executed absent-mindedly. By contrast, creative repetition demands attention and, in Deleuze's words, "forces us to think" (Deleuze, [1968] 2014, 183). Due to the fact that a territory is produced by rhythm, improvising, at least minimally, involves creative repetition. This opens up new avenues of transformation, engendering lines of deterritorialization and reterritorialization, allowing an improvisor to learn about and express themselves in novel ways.

Although Holland refers to practising scales as bare repetition, it is only bare repetition with sufficient mastery. Initially, this is a creative repetition, the individual learns to behave in certain ways at certain times. It is important to note that the term creative repetition is distinct from ordinary usages of the term and does not demand radical change or novelty. Creative repetition is creative in that it forms a relation between disparate milieux. This means that even after attaining this proficiency, bare repetition has the capacity to be creative. For instance, the expert might gain a deeper understanding of musical milieux. Conversely, what was once a creative repetition can devolve into bare repetition. It is easy to imagine an improvisor replaying the same musical shapes. What were once pioneering patterns that opened up new possibilities of transformation and other ways of thinking about musical relations, ossifying into cliché.

The comparison between bare and creative repetition and meter and rhythm highlights the interrelationship between action and events. As-

semblages are comprised of various repetitions. Opening onto other assemblages, the rhythm between milieux produces a creative repetition, allowing lines of deterritorialization and reterritorialization. This captures the complex causal system that produced the event. For instance, an improvisor might be conditioned to perform a certain melodic pattern when prompted by a particular harmonic stimulus. Repetition explains how what they were taught, rehearsed, and listened to, code the performer. It is the notion of style that underpins the concept of territorialization that helps makes sense of how an improvisor can claim their contributions to an improvisational space as theirs. They impact an improvisational space, offer creative repetitions, that express their own territorial constitution.

Agres, Forth and Wiggins expand Boden's three types of creativity to assess whether AI can be creative and artistic. They consider three kinds of creativity in humans – combinatorial, exploratory, and transformational. As the name suggests, combinatorial creativity involves an amalgamation of elements. This is readily witnessed in numerous AI systems that combine elements together. Exploratory creativity involves the discovery of novel relations, while transformational creativity "produces a shift in thought or paradigm" (Agres, Forth, Wiggins, 2016, 5). Echoing the attention demanded by creative repetition, Agres, Forth and Wiggins conclude that "evaluation is a fundamental aspect of creativity" in AI systems (2016, p. 6). Following the testament of human musicians about *Voyager,* we have explicated how machine improvisors impact musical material. The processes of deterritorialization and reterritorialization readily describe combinatorial and exploratory creativity. The notion of rhythm demonstrates how novel relations are discovered and explored in an improvisational space. Further, thinking of the improvisor and musical material as territories within the improvisational space accounts for their transformation. This concurs with Agres, Forth and Wiggin's conclusion that to be creative, "the system must be capable of reasoning about itself, either in response to external feedback or with respect to internal evaluative mechanisms" (2016, p. 6). I propose that such an evaluative function is linked to the dual aspect of habit.

Having outlined how bare and creative repetition underpin habit, we can identify that there are habits in the musical material and in the musician. Having established that improvisation involves a creative repetition, it follows that, in an improvisational space, an improvisor learns about themselves, about the musical material or both. An improvisor extends their habits as they territorialize musical milieux, learning why they exercise their abilities under certain conditions. Creative repetition opens up novel opportunities, avenues for deterritorialization and reterritorialization, transforming habituated routines ordinarily used to navigate an improvisational space.

The relationship between bare and creative repetition alludes to the dual aspect of habit and highlights the issue of agency. On the one hand, an improvisor is constrained and directed by their habits, how they think about music and other musical and stylistic norms in which their performance operates. While this explains the bare repetitions underpinning the novelty of the creative repetitions in their improvising, it does not describe the sense in which the improvisor can call their contributions theirs. This is at odds with ordinary everyday experiences in which agents, once aware of a particular passive habit, actively try to avoid it. Translated to improvisational space, although difficult, a human improvisor can break free of trained routines. A musician might realise they are repeating something inappropriate to the improvisational space and cut across absent-minded practice. Although, this will be via other habits. In this way, an improvising agent oscillates between being owned by and owning their habits. This distils the notions of attention and evaluation supposed by creative repetition, and provides a rubric to discern the difference between human and machine improvisors.

Habits of Improvising Machines

Expanding the notion of a territory with bare and creative repetition indicates a territory's internal processes and organization. An improvisor expresses an idiosyncratic style, divulging their habits, the aesthetic decision they have rehearsed, and their ability to adapt. An improvisor's capacity to engender creative repetition, then, describes the freedom for expression involved in improvisation. This section answers what kind of self-expression and creativity *Voyager* is capable of. The notion of improvisational space explains why *Voyager* sounds human, impacting musical milieux in the same way as its human collaborators. What is contentious is whether *Voyager* is capable of transformational creativity given this prerequisite of awareness and evaluation, whether it oscillates in the same way as a human improvisor between being owned by and owning its habits. This section provides a detailed analysis of *Voyager's* programming to determine whether the bare repetition that constitutes it can give rise to creative repetition, clarifying what kind of authorial responsibility it can claim for its contributions.

Colton, Pease, Gucklesberger, McCormack and Llano argue that it is necessary to consider not just the human condition but the machine condition. Initially describing machines as "software and hardware intertwined into what would normally be considered one system", they specify that a creative machine is one that can record events that happen to it (2020, p. 345). In the first instance, a machine is composed of bare repeti-

tion, more or less sophisticated causal mechanisms that dictate its operation. Able to record what happens and how its responds opens up the possibility for the machine to be creative. Reflecting the earlier intuition about awareness underpinning evaluation and execution, this enables the machine to gauge its capacities under various conditions. The machine's creativity becomes a question of whether its software and hardware is sophisticated enough to permit it to cut across certain habits.

Voyager is not an instrument used by a performer, but a player, translating musical information from its human counterparts in real-time into MIDI voices, single lines of musical data. This analysis guides "an automatic composition (or, if you will, improvisation) program that generates both complex responses to the musician's playing and independent behaviour that arises from its own internal processes" (Lewis, 2000, p. 33). While listening, *Voyager* simultaneously arranges data into various sonic groupings. *Voyager* does this with "64 asynchronously operating single-voice MIDI-controlled "players", sub-routines that govern its voice, volume, pitch, rhythm and so on" (Lewis, 2000, p. 34). These sub-routines come together in the overarching *setphrasebehaviour* and *setresponse* tasks. While *setphrasebehaviour* dictates *Voyager's* sonic contributions, *setresponse* comprises its analytic capability, and a "smoothing routine that uses this raw data to construct averages of pitch, velocity, probability of note activity" (Lewis, 2000, p. 35). While *setresponse* explains how *Voyager* listens, and makes its contributions relevant to the musical material, the *setphrasebehaviour* task means that it does not need a human performer but will begin improvising of its own internal processes. The *setresponse* task then analyzes its own contributions, another launch pad for further improvisation.

Like a human improvisor's passive habits, *Voyager's* coding facilitates improvisation. Its smoothing routine, in conjunction with *setphrasebehaviour* will "choose" from one of fifteen melody algorithms, taking notes from these sets, also making "choices" about velocity, timbre and volume. Given this smoothing operation groups musical data, mediating certain voices in the ensemble over others, it is tempting to think of *Voyager* like an orchestral conductor. Although Lewis agrees that *Voyager* is a collective, he asserts that this picture does not accurately capture its dynamism. A conductor knows what is to come next or at least has a goal in mind. *Voyager* is modelled on the Javanese gamelan ensemble where "control of musical process is shared" by all of its constituents (Lewis, 2003, p. 37). Lewis' point is not to highlight the spontaneity of improvisation, but to reiterate its heterarchical production. The intuition here, is that *Voyager* listens, not just to others, but to itself.

Voyager's coding constrains the way in which it analyzes music, demonstrating the sense in which it is a composition by Lewis. Lewis is re-

sponsible for how *Voyager* thinks about music. Its algorithm is a complex of bare repetition. It is important to note that focussing on this aspect of habit, isolates *Voyager* from the context in which it interacts. Its listening function returns its analysis to an improvisational space. With the sheer number of potential permutations that comprise its sub-routines, creative repetition is fostered. *Voyager* thus deterritorializes and reterritorializes musical milieux, impacting and transforming an improvisational space and maintaining a style. Insofar as this style emerges from its passive habits, it tells the listener about its smoothing routine, melody algorithms and pre-loaded pitch sets, preserving its complex causal history. Understanding improvisors as territories explains why Lewis cannot claim *Voyager's* improvisations as his. Describing how they affect and are affected, the processes of deterritorialization and reterritorialization illustrate the activity of the improvisor, how they can be held authorially responsible for the sound organization that emerges.

It remains to be determined whether *Voyager* realizes it is about to fall into an habituated practice and cut across it. Yet, if it cannot do this, *Voyager* is controlled by the habits that constitute it. Although sophisticated, *Voyager* would be reduced to its causal mechanisms. While territorialization captures how it impacts musical milieux, not being aware of its habits, means that it would not be authorially responsible in the same way as its human counterparts. To my mind, there is a simple test to assess this. Composed of bare repetition, various algorithms, if the circumstances of a performance were precisely replicated, *Voyager* would play the same musical material. This, however, is not the case. The interaction between *setresponse* and *setphrasebehaviour* produces a creative repetition.

Voyager's propensity to calculate probabilities in what its human collaborators will play next presupposes habits in musical material. The difference between the smoothing routine of *setresponse* and the unpredictability and processing power of *setphrasebehaviour* cuts across these patterns in musical material. Recalling the earlier notion of awareness that underpins creativity and connoted in the active aspect of habit, *Voyager* evaluates the milieux within an improvisational space and its musical contributions. It then executes a procedure to make a musical contribution to fit this assessment as best as it can. It must be noted that this awareness and transformation is of musical milieux. It is difficult to gauge whether *Voyager* maintains an awareness that its habits are extended. The habit *setresponse* seems to control its capacity to accommodate complex environments. It does not learn about its behaviour or accomplishments like a human improvisor intuits the mastery of a skill. For instance, *Voyager* will not innovate new pitch sets. The dual aspect of habit thus distils the difference between human improvisors and *Voyager.* Without the ability to recognize and manipulate its own habits, *Voyager* is not as open to trans-

formation as its human counterparts. The condition of improvisation is to renovate. In the improvisational space, witnessing the deterritorialization and reterritorialization of milieux between interacting territories, an improvisor learns about musical material or about themselves. This does not entail a radical difference between human and machine improvisors, given the countless iterations of human performance where the improvisor does not extend their faculties, except superficially.

Given its transformation of musical milieux and effect on other improvisors, AI improvisors open up new avenues for artistic collaboration. The concept of improvisational space, constituted by territories, illustrates an improvisor's activity, explaining how they affect and control milieux. Expanding the notion of territory with respect to the bare and creative repetitions that constitute habits, exposes how the improvisor is affected and controlled by milieux and patterns within the improvisational space. This explains how *Voyager* can claim credit for its contributions in improvised performances. An improvisor has some capacity to disrupt habituated practices. The execution of this ability stems from other habits. Because improvising programs like *Voyager* do not seem to have an ability to critique their own capacities, it is unclear whether they can be held authorially responsible for an improvisation in the same way as human improvisors. Humans, of course, are also constrained by their habits, and like *Voyager,* do not possess a birds-eye view of their internal composition. Besides offering insight into the interrelationship between actions and events, this demonstrates that issues of agential responsibility are entwined with the dual aspect of habit.

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The improvising machine, *Voyager*, was composed by pioneering theorist and improvisor George Lewis in the 1980s. Sitting at the nexus of action and wider events, improvisation is a fertile field in which to conduct the Turing test. Here, we see whether an AI system can convince someone it is intelligent by responding to a complex environment.

Although spontaneously produced improvisors rely on their trained behaviour to respond to unforeseen contributions. Drawing a parallel between the programming of an improvising machine and the habits of a human improvisor, Lewis' denotation of *Voyager* as a composition seemingly threatens improvisation's aptitude for self-expression and creativity.

Through the example of *Voyager,* this article examines the relationship between habit and agential responsibility. I argue that the novelty of improvisation lies in the improvisor learning about new patterns in the musical material, or about themselves, as their habits are extended by unpredictability.

KEYWORDS: Improvisation, Agential Responsibility, Deleuze, Habit, Composition, Voyager