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An Interface to the World: Evoking Environmental Responsibility in Responsive Environments

Abstract: The late twentieth-century art form Responsive Environments (REs) comprised interrelations between artist, artwork, and audience, wherein response-ability and responsibility to the social and/or physical environment of the artwork could be tangibly evoked. Wherein participants' collective behavior within an artwork-as-environment serves as a proxy for the cumulative effect of human behavior on the more-than-human environment. As an extreme form of interactive art, behavior within a Responsive Environment, both to fellow human participants and to the installation itself, thus offers an interface to the world. In so doing, this art form offers a particular capacity to address human understanding of self and other at an amoral level that can encompass the scale of the self-other/response-responsibility crises facing contemporary Western society. To articulate what this capacity entails, this article uses theoretical analysis and case studies of Responsive Environments by Allan Kaprow, Myron Krueger, Simon Penny and David Rokeby, to explore the interaction between responsiveness (the motor dimension of interactivity) and responsibility (its moral/social dimension). Such questions of selfhood and otherness, especially as they relate to responsibility, are highly pertinent to current society, where individual responsibility seems invisible, and our sense of engagement with that which is 'outside' our personal 'inside' seems severely lapsed. Wherein, the article explores how the dynamics of response-ability and responsibility within Responsive Environments actually manifest, in order to untangle where authorial responsibility ends, and the unpredictable act of participatory art begins. Therein, the article re-examines the potential of REs as an important and valuable art form moving into the twenty-first century, drawing on a body of historical artworks whose mechanics reflect some of the most pressing social, cultural, and political conversations needed in a global community facing down the Anthropocene, which apparently has no mechanism for conducting that conversation.

Keywords: responsibility; responsivity; self–other relations; interactivity; responsive environments; environmental responsibility; environmental ethics.

Introduction: art theory of responsive environments

The late twentieth-century art form Responsive Environments comprised interrelations between artist, artwork, and audience, wherein responsivity and responsibility to an other, be it the social and/or physical environment of the artwork, could

be tangibly evoked. This art form's medium was the dynamics of reaction, response, and responsibility among constantly fluctuating selves and others. In this article, we examine how the dynamics of responsibility and responsivity within REs manifest through the exemplary work of practitioners and practitioner-theorists at the peak of the art form in the late twentieth century. RE is usually denoted as interactive installation, in the form of architecture, robotics, kinetic sculptures, electro-acoustic music/sound, aural and visual literature (e.g., speech and computer-generated text), visual media (e.g., video, motion-paintings, animation, and photomedia), and hybrid recombinations.

The art form emerged during the late 1960s, with the terms Responsive Environment and Interactive Art coined in 1969 by theorist-practitioner Myron Krueger. Krueger, based at the University of Wisconsin—Madison, drew on his background as an artist, computer scientist, and academic in his practice and posited REs as immersive, interactive, electronic artworks whose technological responsiveness was fundamentally important. In his manifesto on REs, *Artificial Realities II*, Krueger posits that both artists' and audiences' responsibilities are integral to the art form. Here, Krueger argues that "when participation becomes the subject of the aesthetic work, the viewer's critical faculties are given new responsibilities" such that "their own actions complete the piece. Thus, within the framework of the artist's exhibit, the participants also become creators."¹ By contextualizing REs as principally stemming from Environments and Dada, Krueger drew from the practice established by these precedents, in that "the artist surrendered immediate control, stepped back to a higher level, and gave the actors and the audience a level of control heretofore unknown."² Before turning to how such art, media, and technology arguably changed the respective responsibilities of artists and audiences, it is instructive to theoretically analyze the same issues as they apply to the relatively non-technological art form of Environments.

The notion of artworks as Environments was introduced and pioneered by artist Allan Kaprow, beginning with the first staging of his *Environment Words*, in New York City in 1962. In the catalogue for this exhibition, Kaprow declared that *Words* "is an 'environment,' the name given to an art that one enters, submits to, and is—in turn—influenced by."³ Environments denote immersive, participatory and multi-sensory 'total works of art' in the manner of *gesamtkunstwerk*. In the case of *Words*, this involved two adjoining rooms filled with strips of words written on the ceiling and walls, with variable lighting and modifiable record players and loudspeakers. Audience participation with the content and form was central to this Environment, as attendees were invited to "turn on the phonographs; roll the rollers; [and] add your own words."⁴

The pivotal issue explored in this article, of how such evocations of responsibility constitute an interface to the world-at-large, is encapsulated in an excerpt from Kaprow's statement for the first exhibition of *Words*:

¹ Myron Krueger, *Artificial Reality II* (Addison-Wesley, 1991), 15.

² Krueger, *Artificial Reality II*, 13.

³ Allan Kaprow, "About *Words*," in *Words* (Smolin Gallery, 1962), 2.

⁴ Rose Moose, "Words About Kaprow," in *Words*, ed. Allan Kaprow (Smolin Gallery, 1962), 3.

Of course, being active, we can misuse any environment, natural or artistic. We can destroy a landscape through carelessness, and here we can refuse to consider what responses are appropriate to the nature of the idea. For instance, it is inappropriate to staple word-strips askew, onto the floor or anywhere in the smaller room; and it would be just as unfit to write with the coloured chalks in the larger room. There are freedoms for the visitor (as there are for the artist), but they are revealed only within the limits dictated by the artwork's immediate as well as underlying themes.⁵

In this article, what Kaprow referred to as “freedoms” for attendees and artists are considered ‘environmental responsibilities’: for how artists, as the instigator, create the “environment” for how participants may write, re-write, move and remove the content (in this instance words on cardboard, paper and chalk) and influence the overall dynamic of the physical environment (in this instance modify the lighting, record players and loudspeakers). In such situations, participants negotiate hybrid responsibilities: to the social environment, being fellow attendees within the *gesamtkunstwerk*, and to the physical environment, being their interventions with the material content of the space.

Collectively, environmental responsibility was evoked by participants explicitly engaging with the content of the “environment” to influence both contemporaneous co-participants and future participants. Kaprow argues that attendees and artists’ responsibilities were “revealed [...] by the artwork’s immediate as well as underlying themes”: he ceded significant responsibility to participants (via incorporating their unpredictable influences in the form and content of *Words*) within a structure of limitations whereby his authority as author was maintained (via the instructions for different participation in the different rooms). In so doing, *Words* explored the permeable membrane between immediate material responsibility and implicit or “underlying” social responsibility in participant-participant interaction. By combining these two intertwined modes of responsibility, Kaprow highlighted one of these “underlying themes”, of evoking environmental responsibility, as *Words* questioned whether people “misuse any environment, natural or artistic.”

These themes are amplified in the electronic form of REs, whose technological basis adds a significant dimension to their representation of the “misuse [of] any environment, natural or artistic.” In REs, artist and audience responsibilities grow in complexity as the artwork’s complexity increases. Through the computationally generated behavior of REs, audience responsibility is no longer *to* inert words on cardboard strips, but *with* interactive entities that may unpredictably respond to participants, such as in Krueger’s pioneering REs. However, evoking participants’ responsibility via technologically mediated responsivity creates myriad challenges for engaging participants in an RE, whose engagement is a precondition for being responsive to the artwork and, thus, responsible.⁶

⁵ Kaprow in Julie Reiss, *From Margin to Center: The Spaces of Installation Art* (MIT Press, 1999), 14.

⁶ Joshua Wodak, “Responsivity and Responsibility in Responsive Environments: Art and Interactivity on a Rupturing Planet,” *Leonardo* 58, no. 1 (2025): 24.

The central theoretical question is thus how REs may be created to evoke environmental responsibility in the interaction between artist, artwork and audience. On balance, such evocation is determined by combining three principal elements—content, form and interactivity—in an opposite strategy for the subject and context of each artwork. Content and subject matter signify what RE is about. For instance, artworks expressly about responsibility may evoke a sense of responsibility toward the artwork's physical environment through relatively simple interactivity. One such means is to combine subject matter with interactivity that encourages awareness of how participants' behavior influences the artwork. This approach prioritizes narrative over interactivity to communicate relatively 'intact' content. Such levels of interactivity allow the content to retain narrative cogency, facilitating relatively easy engagement with the subject matter through narrative. Consequently, the responsivity of such artworks is relatively simplistic, with audiences' responsibility often remaining indirect, implicit, and symbolic.

In an RE, form, structure and functionality exert strong mutual influence over one another. For instance, prioritizing form over content may facilitate greater complexity and more interactivity, through which participants may exert more nuanced and multifaceted consequences. As a result, the interactivity of such artworks may be relatively complex, so that attendees' responsibility may be relatively direct, explicit, and literal. Therein, the manner of interactivity decisively influences how participants may engage with an RE (and one another in works designed for multiple simultaneous co-participants).

As the combination of content, form, and interactivity determines the manner of responsivity, so do they also determine the associated mode of responsibility. This arises because responsivity and responsibility reinforce one another and are indexically tied in an RE. Responsivity and responsibility share a common etymology and are meaning-relative to one another, given "the ethical conception of responsibility as responsiveness to the other."⁷ Wherein, the Oxford English Dictionary defines "responsibility" as "a moral obligation to behave correctly towards or in respect of" a person or thing.⁸ For David Rokeby, widely considered the most influential and innovative interactive artist of the movement's peak period during the late twentieth century, "accepting responsibility is at the heart of interactivity", since he defines responsibility as being "literally, the ability to respond."⁹ It is this dimension of responsibility that this article concerns itself with, given the interaction between responsiveness (the motor dimension of interactivity) and responsibility (its moral/social dimension). Here it is important to explore the evocation of responsibility as distinct from 'ethics,' wherever the artists concerned favor the term 'responsibility.'

⁷ Andrew Schaap, "Assuming Responsibility in the Hope of Reconciliation," *Borderlands* 3, no. 1 (2004): 5.

⁸ Oxford English Dictionary (3rd Edition), "Responsibility," accessed February 11, 2026, https://www.oed.com/dictionary/responsibility_n?tl=true.

⁹ David Rokeby, "Transforming Mirrors: Subjectivity and Control in Interactive Media," in *Critical Issues in Electronic Media*, ed. Simon Penny (SUNY Press, 1995), 155.

Throughout his artist statements, interviews, and academic articles, Rokeby is adamant about the repercussions of interaction design in evoking multifarious responsibilities, since interfaces are material devices that relate artwork to audience and to the immaterial *processes* through which content is engaged with. For instance, he argues that “the interface becomes the organ of conscience, the mechanism of interpretation, the site of responsibility” such that “the design of these technologies becomes the encoding of a kind of moral and political structure with its attendant implicit social contract.”¹⁰ However, an important distinction must be made: while *an* interface can be programmed, the *ways* in which people interact with it cannot, *provided that* their autonomy and agency are genuinely respected.

In the above definition of responsibility, what constitutes correct behavior depends on the specific context and content of each artwork. This encompasses the potentially amoral nature of responsivity, as the article includes art that evokes ambiguous, uncertain responsibility, such as Kaprow’s *Words*, rather than the targeted use of art to induce ethical behavior. Namely, behaving responsibly in response to the interactivity required to engage with an artwork may include actions considered irresponsible under bylaws or societal conventions. This capacity for structured suspension of normative conventions is part of what makes REs so valuable when dealing with subjects that fall into ethical grey zones. Our discussion aligns with Rokeby’s argument that interacting in an RE offers “a representation of responsibility” wherein “each participant in an interaction receives the *sensation* of responsibility; each has the *ability to respond*.”¹¹ The concern is creating REs to *evoke* a “sensation” or “representation of responsibility,” as evocation is defined as bringing or recalling “a feeling, memory, or image to the conscious mind” and “the action of eliciting a response.”¹² Rather than catalyze, advocate for, or induce normative ethics. These properties highlight the artform’s value for any artist wishing to explore morally ambiguous topics or reset participants’ familiar ethical compass within the safe space of a constructed environment.

In REs, the two interconnected domains of an artwork’s social and physical environments impinge upon one another. The social environment encompasses cybernetic cycles of Human-Human interactions (artist-attendee and attendee-attendee), while the physical environment encompasses Human-Environment interactions (artist and attendee with the artwork’s physical environment). The physical environment includes the interface through which artists and attendees interact, namely, Human-Machine interaction, whereby attendees engage with the artwork. Collectively, all such domains configure how an RE may act as an interface to the world at large.

All the above categories engage in some kind of self-other confrontation and blurring the boundaries between the self and the other is instrumental in evoking

¹⁰ Rokeby, “Transforming Mirrors,” 155.

¹¹ Rokeby, “Transforming Mirrors,” 155. Emphasis in original.

¹² Oxford English Dictionary (3rd Edition), “Evocation,” accessed February 11, 2026, https://www.oed.com/dictionary/evocation_n?tl=true.

responsibility in REs.¹³ This occurs via the environment of the ‘self’ (or, in spatial language, ‘interior’), which serves as a proxy for the environment of the ‘other’ or ‘exterior.’ Therein, key practitioners, such as Simon Penny, argue that the “aesthetically manipulated quality” in such artforms is the “behavior” of the artwork and participants’ interaction with the artwork. With artists’ responsibility focused on designing the “aesthetic of behavior” he argues that “the model for this behavior must necessarily be human behavior, the way in which humans interact with each other, or with other living things.”¹⁴ As an engineered microcosm of quotidian environments, responsibility to the self may thus symbolically represent responsibility to the other.

This self-other relationship is shaped by the influence of Environments on REs. Kaprow expanded upon this self-other relationship in his essay on “The Shape of the Art Environment,”¹⁵ which articulates the central concern manifested in his work *Words*. In such a constructed context, participants’ responsibility determined their collective and cumulative “misuse” or use of “natural or artistic”¹⁶ environments. This particular Environment evoked implicit responsibility for the natural environment by prompting explicit responsibility for the artwork’s social and physical environment. In this section, the processes of actually creating REs, in tandem with reflections from practitioners on evoking environmental responsibility in their REs, will be the topic.

Between artist intention and audience experience: challenges of responsive environments

My creative process doubles as a personal critical inquiry into ideas of relationship and interaction and the ways that the explicit mechanical interactive relationships made possible by computers change, challenge, enlarge and diminish notions of relationship and interaction. (David Rokeby)¹⁷

Rokeby does not refer to his art as practice, but rather “as a public research laboratory” where “my ideas about interaction and experience are tested, affirmed, or shot down.”¹⁸ The distinction is that being *research* practice, Rokeby’s works begin with “a couple of questions” principally about interactivity and interrelationships, wherein a resultant work will entertain “a dialogue within itself” rather than “end with

¹³ Joshua Wodak, “I Interact, Therefore We Are: Mediating Relations Between Self and Other in David Rokeby’s Interactive Art,” *Technoetic Arts: A Journal of Speculative Research* 23, no. 2 (2025): 37.

¹⁴ Simon Penny, “Why Do We Want Our Machines to Seem Alive?,” *Scientific American*, September 1995, 216.

¹⁵ Allan Kaprow, “The Shape of the Art Environment,” in *Essays on the Blurring of Art and Life*, ed. Jeff Kelley (University of California Press, 2003), 90.

¹⁶ Kaprow in Reiss, *From Margin to Center*, 14.

¹⁷ Rokeby in Roberto Simanowski, “Very Nervous System and the Benefit of Inexact Control: Interview with David Rokeby,” *Dichtung Digital: Journal für Kunst und Kultur digitaler Medien* 5, no. 1 (2003): 5.

¹⁸ David Rokeby, “The Construction of Experience: Interface as Content,” in *Digital Illusion: Entertaining the Future with High Technology*, ed. Clark Dodsworth (Addison-Wesley, 1998), 33.

a finished piece.”¹⁹ For instance, Rokeby’s most acclaimed artwork *Very Nervous System* (VNS) (1982–2004) was initially inspired by the first RE, Myron Krueger’s *Videoplace* (1974–1984), wherein VNS also used cybernetic feedback between artwork and participants’ behavior. However, VNS also marked Rokeby’s departure from Krueger’s practice, as it was based on sensing subtleties and nuances in participants’ behavior, in contrast to the surveillance of presence/absence that characterized Krueger’s interaction design. Therein, his research practice shifted from what the art theorist Erkki Huhtamo termed an “unrestrained enthusiasm as an almost orgiastic celebration of the possibilities of interactivity” in VNS, to “discursive explorations” in his subsequent REs *Silicon Remembers Carbon* (1993–2000), *Measure* (1992–1994) and *Watch* (1995), such that the latter explored “pessimism or doubt” about the “changing implications of interactivity.”²⁰ These shifts stemmed largely from Rokeby’s stances on appropriate responsivity and concomitant audience responsibility: in short, the mechanics of self-other relations. Rokeby’s resolution to produce artworks *responsive* to the participant, while the participant is responsible for them, has now been manifested in over 25 years of producing re-iterations of VNS, demonstrating both the artform’s ongoing relevance and the enduring influence of Krueger’s *Videoplace*.

By evoking relations of such co-constitution and mutual obligation, Rokeby’s work provides not only prescient insights into relations between self and other, but between the responsibility and responsivity that arise through such encounters. With regard to VNS, the art theorist Ross Gibson remarks how the work uniquely explores self-other relations, including the porous boundaries between such seemingly discrete entities. Gibson observes that we find ourselves “inside—but also outside—but also inside—but also outside—but also inside. This rhythm is restless. And it’s necessary. Because the world of lived experience is restless like this, not simple, static or stable.”²¹ As Rokeby found, reflecting back on VNS almost four decades after first developing the work: “I was also exploring the relationship between the self we imagine as contained within the membrane of our skin and an enlarged sense of self that takes into account the complex bidirectional flows across this boundary as we interpenetrate with our environment.” Through so doing, he was able to explore the human self and other dichotomy by using “a computer [...] as a sort of prosthetic organ of philosophy, allowing us to ask age-old philosophical questions in new ways”, whereby “one can use the alienness of technology as a new mirror to consider ourselves in.”²²

VNS presents an exemplary evocation of self-other relations, and of the ability of REs to present an interface to the world, due to the cybernetic relationship at

¹⁹ Peter Ride, “Who Remembers What?”, catalogue essay for David Rokeby: *Silicon Remembers Carbon* exhibition, Center for Contemporary Arts, Glasgow, 4 August–15 September 2007.

²⁰ Erkki Huhtamo, “Silicon Remembers Ideology, or David Rokeby’s Meta-Interactive Art,” in *David Rokeby: The Giver of Names*, ed. Anne McPherson and Deborah Esch (Guelph, 1998), 21.

²¹ Ross Gibson, “Inside Outside,” catalogue essay for *Mirror States* exhibition, May 17–July 28, 2008, Campbelltown Arts Centre, Sydney, 33.

²² Pia Kleber and Tamara Trojanowska, “Performing the Digital and AI: In Conversation with Antje Budde David Rokeby,” *TDR: Drama Review* 63, no. 4 (2019): 107.

“the core of the work”, wherein human movements are instantaneously translated into sounds/music. According to Rokeby, this occurred because interacting with “interfaces leave[s] imprints on our perceptual systems which we carry out into the world,” with this “effect” becoming “stronger”²³ over the course of interaction. Such self-other (or ‘Inside-Outside’) relations were pushed further by unconventionally installing VNS in public outdoor spaces as well as galleries and performance spaces. Therein, the ‘Inside’ environment stands as proxy for an ‘Outside’ environment, meaning responsibility on the Inside may symbolically represent responsibility to the Outside. As Rokeby argued in 1995, during Huhtamo’s aforementioned “almost orgiastic celebration of the possibilities of interactivity”:

It is not the individual interactor who is reflected in these works so much as human behavior itself. In a sense, the responsive environment and the automaton complement each other, representing both sides of the relationship between man, and the social and natural environment.²⁴

Penny has used a similar process methodology over his long career involving an exceptionally wide skill set across disparate domains. Citing *Petit Mal* (1993–5), his “autonomous robotic artwork,” Penny “define[s] my research as ‘the aesthetics of real-space interaction’”²⁵ through which *Petit Mal* simultaneously explores Human-Computer and Human-Human Interaction. For Penny, such “research emerges from artistic practice and is therefore concerned with subtle and evocative modes of communication rather than pragmatic goal-based functions.”²⁶

However, this raises a methodological bind between artworks that require artist-audience communication and the collaboration and communication required to create such works. Namely: the disjuncture between an artist’s intention and actual audience experience of an RE. While finding collaboration “a necessity” in his process of creating REs, Penny argues that communication in collaboration is fraught with difficulties. As his production process “necessitates deep and sensitive engagement with people trained in disciplines so distant from the goals of art that conversation can, at times, seem impossible,” he argues that “solving technical problems and resolving communications issues among the collaborators is a labor in itself.”²⁷

Taking a step sideways into the processes involved in creating REs, we find that much is revealed about the conundrums of collaboration and communication when we compare different modes of writing about such work: for example, by comparing catalogue essays and artists’ statements that are usually provided at stagings. Such

²³ Rokeby, “Construction of Experience,” 31.

²⁴ Rokeby, “Transforming Mirrors,” 152.

²⁵ Simon Penny, “Embodied Cultural Agents: At the Intersection of Art, Robotics and Cognitive Science,” paper presented at AAAI *Socially Intelligent Agents Symposium*, MIT, Massachusetts, November 8–10 1997, 5.

²⁶ Penny, “Embodied Cultural Agents,” 3.

²⁷ Simon Penny, “Systems Aesthetics and Cyborg Art: The Legacy of Jack Burnham,” *Sculpture* 18, no. 1 (1999): 4.

comparison is in fact integral for understanding artists' attempts to evoke responsibility in their work, as their practice may explore ambiguous responsibility, while their scholarly writing may articulate their rationale for evoking such modes of responsibility.

As a case in point, Ken Feingold's *The Surprising Spiral* (1991), one of the first canonical interactive artworks, utilizes trammelled interactivity, which is antithetical to the intuitive interactivity that Rokeby and Penny advocate. In *Against Friendly Interfaces: Aesthetics of Trammelized Interaction*, Maciej Ozog defines trammelled interactivity as "bewildering, changeable and unpredictable forms of the artifact and/or creating unconventional forms of the interface that hinder the interaction with the artifact."²⁸ Feingold's scholarly writing details his rationale for such interactivity, wherein the "complex cause and effect structure" involved non-predictable variations between instantaneous, delayed, and cumulative consequences from participants' interactions with *The Surprising Spiral*. He designed the work for participants to be ambiguously responsible for future participants' experiences whereby "the actions of previous viewers will also affect the structure found by another viewer."²⁹ Feingold's rationale was that he "wanted these [types of consequences] to mirror our daily cause and effect experiences" which he argues are similarly complex and ambiguous. As public information at the stagings of this artwork did not mention these topics, Feingold found that "many who encountered this work were frustrated"³⁰ while the interactive art theorist Erkki Huhtamo similarly observed that "users have frequently felt puzzled."³¹

Nevertheless, Ozog, like Feingold, maintains that trammelled interactivity may viably evoke responsibility, provided "the construction of the artifact and the interface should disclose the interactor's role in the process of interaction and emphasize his/her responsibility for its course."³² This highlights the role of artists' disclosure in their scholarly or exhibition catalogue writing in emphasizing audiences' responsibility, given the discrepancies between what can be communicated solely by an artwork and writing designed to augment an artwork. Such discrepancies are widespread, given that ambiguity and indeterminacy are desired qualities in such artworks. Further, REs have particular properties that problematize second-hand information and understanding, placing primary importance on understanding the art form through first-hand experience. Therein, whether an RE features an unpredictably morphing garden maze or a hermetically sealed dataset of content, each encounter reveals different facets, literally and hermeneutically, for different participants.

²⁸ Maciej Ozog, "Against Friendly Interfaces: Aesthetics of Trammelized Interaction," in *Proceedings of the 12th International Symposium on Electronic Arts 2004* (ISEA Press, 2004), 4.

²⁹ Ken Feingold, "The Interactive Art Gambit," in *New Screen Media: Cinema/Art/Narrative*, ed. Martin Rieser and Andrea Zapp (British Film Institute, 2002), 122.

³⁰ Feingold, "Interactive Art Gambit," 123.

³¹ Erkki Huhtamo, "Trouble at the Interface, or the Identity Crisis of Interactive Art," *Framework: The Finnish Art Review* 2, no. 1 (2004): 41.

³² Ozog, "Against Friendly Interfaces," 3.

To these ends, the art theorist Beryl Graham's "hybrid and pragmatic research methods"³³ of curating and visiting artworks formed the "public research laboratory"³⁴ for her quantitative and statistical examination of audience engagement with REs. Her PhD concluded that many audiences did not reach, find, explore, or encounter significant areas of many works due to their understanding of responsivity and their associated responsibility.³⁵ This revealed a wide disjuncture between artists' intentions and audience experience, which impedes the evocation of responsibility through interaction between artwork and audience. Importantly, this disjuncture existed in these works' hermetically sealed form and interactivity, with all participant influence contained within predefined possibilities for interaction (as was the case in interactive art in the 1990s).

This disjuncture between artists' intentions and audience experience would, of course, be exacerbated in any artworks involving evolving and emergent forms, but in REs this has a greater impact due to highly variable responsivity-responsibility ratios. Yet it is precisely this disjuncture and disturbance between intention, action, reaction, response, and the shared and contrasting responsibilities that emerge among artists, audiences, and scholars that makes these artforms peculiarly appropriate for opening doors to topics that evade any direct approach. The processes of engagement, the potential for unique manifestation of self-other dynamics and the open possibility for confusion or miscomprehension can, in this way, actually be seen as part of the value of such artworks. REs require a far greater effort from all parties, from artists to audience to scholar, as their execution, exhibition, evolution, engagement and examination are all fraught with complexities that demand fluid yet critical thought and force unique forms of examination of the artwork. The following section explores what these efforts entail by analyzing the mechanics involved, from Kaprow's *Words* through to fully-computational REs.

Mechanics of responsivity and responsibility in responsive environments

The problem is [...] most successful communication involves a great deal of craftsmanship and authorship and point of view and storytelling and narrative [...] Interaction largely destroys all that. By giving the audience control over the raw material you give them precisely what they don't want. They don't want a load of bricks, they want a finished construction, a built house. (Max Whitby)³⁶

³³ Beryl Graham, "A Study of Audience Relationships with Interactive Computer-Based Visual Artworks in Gallery Settings, through Observation, Art Practice and Curation" (PhD diss., University of Sunderland, 1997), 147.

³⁴ Rokeby, "Construction of Experience," 37.

³⁵ Graham, "Study of Audience Relationships," 136.

³⁶ Max Whitby in Andrew Cameron, "The Future of an Illusion: Interactive Cinema," *Millennium Film Journal* 28 (1995): 42.

Whitby's analogy refers to the organicist basis of REs being made from a "load of bricks" that are composed into configurations. The metaphor encapsulates just how and why REs involve interfacing with such seemingly disparate worlds, given the difference between a highly interactive "load of bricks" versus, at the other extreme, a minimally interactive "built house." Therein, locating an RE along this spectrum, according to its organicist basis, is central in terms of the capacity of an artwork to evoke environmental responsibility. These units are also referred to as "primitives"³⁷ in contemporary practitioners' Jon McCormack's Artificial-Life-Based REs, or "interactive granularity"³⁸ in Karl Willis' audiovisual interactive installations. All refer to the size, form, and microstructure of the components and their associated means for being combined into macro-structures that collectively create REs. In the three most commonly used media of words, images and sounds, the smallest may respectively be phonemes, pixels and, through granular synthesis, sound particles of roughly 25 microseconds. Primitives heavily influence the evocation of responsibility as they determine the relationship between content, form and interactivity.

In his practice, Willis posits "the challenge" as being about achieving the "right balance" between the size of primitives and their corresponding interaction modalities. This balancing act requires a compromise, which Willis terms "the balance of specification,"³⁹ being the relationship between primitive size and interactive potentiality. As an example, smaller primitives permit "more functionality" and hence greater interaction difficulty, with larger primitives offering less functionality and hence "simpler" interactivity, as per Willis' "goal of empowering the user to create in diverse ways."⁴⁰

Balancing primitive size with interaction modality is not readily apparent without a guiding principle or rationale. For this article, this concerns the creation of REs to evoke environmental responsibility in the interaction between artist, artwork and audience. Applying this rationale to Whitby's analogy, REs made from smaller Lego-sized "bricks" offer greater scope for audiences to recombine them into more complex and diverse structures. In contrast, larger Duplo-sized bricks have less recombinant potential, which limits audience responsibility to interacting with relatively inflexible structures. Willis positions the innumerable options for arriving at a "balance of specification" along a "scale [where] finer granularity provides smaller individual elements with which the interactor can begin to construct and create in diverse ways" (as represented by Lego) while "coarser granularity with larger individual elements" allows for a "merely *selective*"⁴¹ interactivity (as represented by Duplo). Willis argues that smaller primitives "allows greater creative possibilities but can

³⁷ Jon Bird, "Containing Reality," in *Impossible Nature: The Art of Jon McCormack*, ed. Jon McCormack (Australian Centre for the Moving Image, 2004), 45.

³⁸ Karl Willis, "Open Interactions: The Balance of Specification," paper presented at *Biennale of Electronic Arts Perth*, Perth, September 1–7, 2004, 8.

³⁹ Willis, "Open Interactions," 9.

⁴⁰ Karl Willis, "User Authorship and Creativity within Interactivity," in *Proceedings of the 14th ACM International Conference on Multimedia* (Association for Computing Machinery Press, 2006), 20.

⁴¹ Willis, "Open Interactions," 2. Emphasis in original.

potentially create a more complex learning process”⁴² due to their greater recombinant potential. If these primitives coalesce into a narrative (such as a deliberate sequence of words, images or sounds), then smaller primitives offer engagement with their more fragmentary narratives, while larger primitives facilitate semi-cogent narratives by being relatively less interactive.

Whitby’s primitive—bricks—have relatively finite malleability (in contrast to sand or wet cement). This is at odds with artists’ common composing with mutable forms, as they do not merely repackage existing structures like bricks or Lego but rather generate the “raw materials” (in Whitby’s analogy) and the rules and tools for their recombinant potentiality. This is illustrated via the analogy of artist-audience responsibilities in REs being akin to the relationship between cooking and eating. In an RE composed of ingredients being Alphabet Soup, each primitive is a piece of pasta shaped like a letter. The contemporary interactive artist John Bird uses a cognate approach, defining “primitive” as “a basic building block of a system that cannot be derived by combining other elements. A useful analogy is to see primitives as letters of an alphabet that can be combined in different ways to form words.”⁴³ Wherein, dry letters are combined to spell words or sentences. If artists construct words and sentences that audiences re-arrange without being provided with a guiding principle or rationale, the artists effectively abrogate their authorial responsibility.

In contrast, in order to evoke participant responsibility to the physical environment of the artwork, recombinant potentiality is subject to constraints, within which artists communicate by engaging audiences through interactivity without the content being rendered ‘meaningless.’ For instance, with regard to Jon McCormack’s interactive installation *Eden* (2006), Bird argues that this RE has “the potential to display ‘combinatoric emergence’” whereby it “can explore the conceptual space defined by the primitives and the rules for combining them.” However, Bird still found the emergent behavior that such a system could manifest was limited by how “the additional ‘letters’ were selected from a pre-specified, finite list and it is a matter of debate whether a computational system such as this can transform its underlying generative system in a way that is comparable to the creative emergence evident in biological evolution.”⁴⁴

Despite seismic differences in the media and technology involved, this relates back to Kaprow’s *Words*, with which this article began. Kaprow defined the primitive as one word, so participants were requested not to chop words up into letters or to add individual letters that were not part of a phrase. He also instructed that words should only be written in chalk in the smaller room (which had chalkboards) and it was “inappropriate to staple word-strips askew”⁴⁵ in the larger room, composed entirely of words on cardboard strips. However, in REs the form of the letters themselves are also mutable, as artists seek to evoke responsibility to form as well as content. For instance,

⁴² Willis, “Open Interactions,” 2.

⁴³ Bird, “Containing Reality,” 45.

⁴⁴ Bird, “Containing Reality,” 46–47.

⁴⁵ Kaprow in Reiss, *From Margin to Center*, 14.

applying this rationale to words (symbolizing a primitive in any medium), the middle letters of words can be rearranged, but the first and last letters of each word are fixed. Within this relationship between primitive size and interactive modality, the brain can still read coherent sentences, such as the following from Hamlet:

To be, or not to be: that is the quesoutin:
Weehhtr 'tis nbelor in the mnid to suffer
The snlgis and aowrrs of ougautores furntoe,
Or to take amrs angisat a sea of tboulres,
And by oopinpsg end them?

The brain reads the first and last letters of each word, paying inconsequential attention to the order of the letters in between. This opens hermetically sealed databases to participants' responsibility for exerting novel and unpredictable influences by allowing variable levels of primitives (words and letters) and flexible, constrained recombinant potentiality (only middle letters can be rearranged), which guide participants' interactivity. This represents the approach to evoking responsibility to the physical environment of the artwork by using strategies that (ideally) balance narrativity with interactivity.

In this Alphabet Soup, artists' responsibilities are heightened when applying heat and liquid over time to deconstruct the letters, so they may be cut, molded, or squeezed into pliable, malleable shapes, or even a new 'alphabet.' Progressively deconstructing the primitives increases participants' responsibility to subsequently recombine such primitives free even from the strictures of language. At this level, there is little, if any, guidance (or responsibility) from the artists, as the primitives are at the audience's behest. While some may enjoy this freedom, others may become disengaged or feel burdened by the responsibility to do *anything* with the putty they hold in their hands. Individual letters provide the comfort of communicating by forming words but sacrifice the ability to create freeform abstract graphical constructions with the malleable primitives. This represents the approach to evoking responsibility to the physical environment of the artwork by using recipes that sacrifice narrativity in favor of greater interactivity. Therein, Willis argues that a "level of granularity" which uses "mere pixels, sound samples, words or letters" is "therefore not narrative based but instead focus on free-form creativity and play at the base level." Thus, he sees such "open interactions" as "promoting highly participatory creative experiences, rather than arranging heavily authored content into narrative-like structures."⁴⁶

⁴⁶ Willis, "Open Interactions," 2.

Conclusion

Despite seemingly divergent approaches to creating REs, the art form is generally premised on attempts to negotiate between authority and control to combine responsivity germane to the environmental responsibility of both artist and audience. The divergent attempts share a desire to maximize complexity and interactivity, while reducing artists' authorial authority (and associated responsibility) and increasing audiences' authority (and associated responsibility). The tensions between what responsibility their artworks evoke, versus what they desire their artworks to evoke, arises from the intractable disjuncture between singular authorship and collective action, and the complex processes that govern how a group moves within parameters set by an authority or norm, eventually disrupting either the group or the parameters.

During its peak period, conjectures about the future directions of REs concerned a striving for evolving artworks using dialogical interactivity to evoke environmental responsibility. And yet, even at the peak of its popularity as an art form, REs received negligible critical analysis internationally. Now, the term RE has been almost completely claimed by architecture, design, and computer science. Even though contemporary practitioners such as *FoAM* and *Transmute Collective* incorporate multi-faceted interactivity in REs involving architecture, design, and computer science, such practice remains marginal to the utilitarian forms that subsumed the original movement.

Nevertheless, as an accessible means for approaching ethically contentious subject matter within a broad public spectrum, the issues this art form raises are highly relevant to pertinent issues in contemporary culture. The artists examined above and their challenges in evoking environmental responsibility in REs have left us an incredibly relevant and valuable inheritance: a body of historical artworks whose mechanics reflect some of the most pressing social, cultural, and political conversations needed in a global community facing down the Anthropocene, which apparently has no mechanism for conducting that conversation.

In that light, REs offer a scaled-down proxy of these contestations as they play out on the planetary scale of the climate and ecological crises. That is, such evocations of responsibility constitute an interface with the world at large. In doing so, REs explored factors crucial to understanding how we got into the Anthropocene and where we might go from here, including but not limited to issues of the invisibility of impacts of individual interaction with the environment and resulting lack of responsibility, the environment as authored system versus chaos requiring order, the confusion and division arising from cumulative responsibility, issues of performative responsibility and social factors impacting individual decisions, and a genuine understanding of what it means to move within authored parameters, as well as what happens when these break down. The ambiguity, uncertainty, and complexity of the issues raised in reading response-ability and responsibility in REs is on par with the issues themselves.

Thereby, we are left with prescient analogies for the dearth of response-ability and responsibility, not only in art, but in the world-at-large. This should encourage us to re-examine the potential of REs as an important and valuable art form moving into the twenty-first century, where our paradigms of self and other, and our understanding of responsibility and response within those paradigms, have been altered, leaving our society, both collectively and individually, to catch up. Never before has such self-other understanding been more critical, in light of the fully fledged ecological and climate crisis and the dearth of understanding about the genuine nature and potential of individual and collective responsibility within human-planetary, human-ecology, and human-human relations.

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