Destruction, Catharsis, and Emotional Release in Human-Robot Interaction

MICHAL LURIA, Human-Computer Interaction Institute, Carnegie Mellon University, Pittsburgh, PA
OPHIR SHERIFF, Visual Communication, Bezalel Academy of Arts and Design, Jerusalem, Israel
MARIAN BOO, Independent Artist
JODI FORLIZZI, Human-Computer Interaction Institute, Carnegie Mellon University, Pittsburgh, PA
AMIT ZORAN, School of Computer Science and Engineering, Hebrew University, Jerusalem, Israel

The intersection between social, technical, and economic factors biases new product development to focus on utilitarian value. However, objects that serve alternative goals, behaviors and emotions have accompanied humankind for millennia. This article speculates about robotic objects for one non-utilitarian behavior and its implications: destruction. Robots and objects for destruction have a shared history of embodiment and heavily rely on their embodiment for interaction. Yet the topic of destruction is not very common in the field of human-robot interaction (HRI). Thus, we (1) present a survey of ethnographic investigations that show modes of HRI related to destruction, and (2) develop speculative concepts of interaction that demonstrate these ideas in HRI. By exemplifying a broad range of speculative uses of destruction in HRI and grounding it in literature, we hope this theoretical and conceptual article will bring a fresh perspective on alternative interactions with robots.

CCS Concepts: • **Human-centered computing** → **Interaction design theory, concepts and paradigms**; *Scenario-based design*;

Additional Key Words and Phrases: Interaction design, human-robot interaction, HRI, destruction, creation, catharsis, social robots, human-object interaction, embodied interaction, speculative design, material culture

1 INTRODUCTION

As social robots are being introduced to the market and to personal spaces, they predominently align with the current convention of what social robots should look like and what tasks they should support. The goal of this work is to challenge the current convention about human-robot interaction (HRI) by proposing alternative and plausible interactions with robots; building

on ethnographic investigations that depict a range of common destructive behaviors, we contribute a new conceptual topic for robot design—destruction of robots.

Destruction, according to its dictionary definition, is an action performed on an object to transform it to its useless fragments by rendering, burning, or dissolving it.[1] Examples of destructive expressions include everyday interactions such as tearing a letter apart or smashing ceramics, or more ceremonial interactions like the use of poppet dolls, creation of sand mandalas, and the fiery ritual at the culmination of the Burning Man festival (additional information about these and others in Section 2). In this work, we examine the notion of destruction in the context of human-computer interaction (HCI) and, more specifically, in the context of human-robot interaction (HRI).

The definition of HCI in its early period was fairly simple—"*People* use *computers* to accomplish *work*" [17]. Yet the field has come a long way since, shifting from an efficiency-focused field to one that sets out to positively impact people's lives. Rogers compared the field of HCI to the development of art movements: Classical, Modern, and Contemporary. The Classical and Modern periods focused on rigid research that primarily evaluated the efficacy of computer interfaces, but the Contemporary period of HCI is non-utilitarian, culturally oriented, and focuses its research on questions about the human condition [62].

Furthermore, the Contemporary period sets out to include a broader discussion of society's aspirations and values, and, as a result, requires a new set of methods and approaches to investigate *user values and morals* as opposed to previously researched *user needs*. Roger calls to shift the focus away from utility-based interactions to a broader understanding of the human experience [62]. This framework is also relevant to the field of HRI, which is gradually expanding beyond its initial efficiency-focused design and research.

Along these lines, we set out to further expand the research and design in HRI beyond utilitarian interaction. Non-utilitarian daily interactions and behaviors are quite common and have many roles, from establishing interpersonal relationships to shaping our identities [29]. We suggest destructive behavior, an extreme form of non-utilitarian interaction, as a concept that challenges the boundaries of interaction and brings to discourse the potential value of non-utilitarian interaction with robots in the contemporary phase of HRI. Destructive interactions with robots could bring a range of more entertaining, cathartic, engaging, and perhaps emotionally satisfying experiences than destruction of objects.

We first lay out a contextual background on the phenomenology of destruction in human-object interaction. Doing so sets the stage for in-depth exploration of meaningful destruction behaviors. In this review, we touch upon topics related to creation, rituals, and interaction with human-formed objects that might inspire human-robot interactions. In the second part of the article, we use design research methods to form a speculative design space of destruction in HRI. Through a combination of research through design [78], speculative design [19], scenario building [13], and sketching, we identify potential conceptual interactions of destruction in HRI.

The contribution of this work is twofold: (1) Stimulating discourse on the opportunities for non-utilitarian interaction in the form of meaningful destruction, inspired by human-object interaction, and (2) outlining a speculative design space that is grounded in theory and strives to question the role and design of social robots in modern society. The goal of this design process is therefore to evolve into a discussion, rather than into a prototype; we believe that the conceptual nature of this article and its integration of research through design, speculative design, and theory-based value-finding for robotic products can evoke a deeper theoretical conversation about robot design in the contemporary phase of HRI.

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[1]https://www.dictionary.com/browse/destruction.

2 CONTEXTUAL BACKGROUND

Due to the central role objects play in destructive behaviors and interactions, we set out to first extend our knowledge of fundamental non-utilitarian *human-object interactions*. Surveying a broad range of non-utilitarian and destructive interactions was a critical step that deepened and informed the design process. The following section touches upon main aspects of *human-object interaction* and their expressions in technology, followed by an in-depth exploration of the topic of destruction.

2.1 Human-Object Interaction

Human relationships with physical objects are expressed in almost every human action, and the complex nature of human-object interaction has long been investigated in material culture research. In addition to ordinary uses of objects, such as consumption, creation, and trade [52], ethnographic observations show that artifacts can encompass intellectual and emotional value [63]. Non-utilitarian interactions with objects shape our interpersonal interactions, ceremonial behavior, and the perception of our identities [29]. Below, we lay out some of the foundational non-utilitarian interactions with objects as a base for our ideation and design process.

Personal—Objects have a significant role in shaping how people perceive themselves through the objects they own and use [35]. This is also true for computers; for example, perceived phone usage was found to affect self-perception [36]. Objects can also shape identity by signifying social status to observers who share cultural values and an understanding of status symbols [60]. Objects that shape identity are common in almost every culture, but vary in their appearance, usage, and context [30].

Interpersonal—In addition to shaping personal perception and identity, objects are capable of shaping interpersonal ties and mediating people's messages over time, space, or both. Some objects enable direct communication, like phones or computers. Others are used for indirect communication, for instance, visual art allows a message to be transferred from the creator to the viewer over time and space [16]. Objects can also mediate between people through sentimental value, by bringing memories and mutual experiences to the foreground of our attention. A study found that the majority of people own and cherish at least one object that reminds them of a particular person or community [15]. An object could be associated with another person even more strongly in HCI, where a live, digital connection can be created [70, 74], or in HRI, where a person is not only remotely present, but embodied in a human-like shape [77].

Ceremonial—Non-utilitarian interactions with objects are frequently seen in rituals and ceremonies across cultures. Although many are objects for religious practice, some ceremonial objects are intended to support complex human emotions such as sadness, grief, serenity, longing, and anger [8]. For example, objects are symbolically transformed after a break-up (a wedding ring melted and re-claimed as a necklace), or the meaning of photos change in significance of letting someone go [63].

2.2 Destruction

We explore the non-utilitarian act of destruction, an inherent part of human behavior, by examining cases that exemplify potential benefits in destructive behavior that might serve human-robot interaction. Over the past several decades, studies in psychology have highlighted the importance of negative and destructive emotions in human behavior [54]. According to Chentsova-Dutton and colleagues, allowing negative behaviors and engaging with them correctly can be important for well-being [14]. We, therefore, include both negative and constructive aspects of destruction below.

Due to its radically non-utilitarian nature, the topic of destruction aims to test the boundaries of interaction that might be included in the contemporary phase of HRI [62]. The history of

destruction is strongly associated with human-like objects, as are robots; they both share a history of embodied forms, and use embodied interaction as an essential part of interaction. Destruction with a robot can create a more responsive, engaging, and perhaps a more cathartic interaction than interaction with an inanimate object.

In order to gain a better picture of the modes of destruction in humans toward the design process of destruction in HRI, we reviewed the literature about destructive behaviors found across cultures. The goal of the survey below was to surface a range of destructive behaviors and interactions that would inform the design process. The various examples were grouped by affinity in order to identify themes that would serve as a basis for developing design concepts.

This resulted in three perspectives from which we examine destruction: creation, catharsis, and emotional support. For each perspective, the survey below details multiple examples that guided the design of possible interactions. While these perspectives are not mutually exclusive, focusing on one perspective at a time enabled a broader exploration of the design space.

2.2.1 Perspective 1: Creation. A fundamental part of material culture is the concept of *Homo Faber* (Man the Maker): the human builder, one who creates the inhabited environment. People manipulate the value of objects through the art of making [1]. Destruction has been perceived throughout history as interleaved with the notion of creation—people fabricate the world they live in, but they are just as likely to destroy it [2].

Creation, unlike destruction, has been extensively studied over the years. Comprehensive academic literature on craft and creation includes fundamental work like Franz Boas's work on personal style in craft [7], David Pye's study on the unpredictability of workmanship [57], and Tim Ingold's research on the human tendency toward art, craft, and skilled practice [38]. Technology, too, has had a significant impact on creation, from digital fabrication [25] to the creation of new tools for designers [81]. In HCI, recent work has attempted to combine digital fabrication with craft, aiming to extend beyond mere technical developments and to re-introduce craft values through intimate creative practices. For example, a project intertwined 3D printing with hand-woven basketry to engage makers in the value of acceptance [79], and a customizable social robot encouraged makers to craft their own exterior for it using traditional fabrication [67].

Hannah Arendt argues that the urge to fabricate stems from an inevitable attempt to stabilize life by providing "sameness" in contrast to ever-changing nature. But as Arendt states, humans not only create, they also destroy [2]—a human tendency that has received far less attention. Creation and destruction are commonly coupled [51], and their interrelationship is the first theme of exploration.

*Creation **by** Destruction*—Destruction occasionally summons creation: some examples present instances in which people completely destroy something in hopes of full renewal. A theory by economist Joseph Schumpeter—Creative Destruction—describes a phenomenon in which industrial mutation completely destroys an old economic structure and replaces it with an alternate one [65]. Although derived from Karl Marx's writings, which emphasize the self-destructive qualities of capitalism, this phenomenon is frequently mentioned in a positive context, as an automatic renewal process [31]. A similar idea from a different domain is the Tibetan Sky Burial. In this tradition, the human corpse is dismembered and placed on a mountaintop to decompose and be eaten by vultures. Although this practice may initially seem grotesque to some people, the intention of the ritual is to illustrate the impermanence of life, and encourage one last act of generosity from which nature can grow [42]. In both cases, among others, destruction is a necessary and inevitable step toward creation and revival.

*Creation **from** Destruction*—Creation does not always begin where something else is completely destroyed as in *creation **by** destruction*—sometimes it can grow from the remains of the previous.

This idea is rooted in the Japanese Wabi-Sabi philosophy, which embraces the transience of material, accepts that nothing is ever perfect or complete, and sees beauty in broken things [46]. This philosophy led to Kintsugi—the art of repairing pottery by filling cracks with powdered gold, honoring the flaws as part of the object's uniqueness [45]. In the field of HCI and digital design, Wabi-Sabi philosophy has been suggested as a lens through which researchers can examine and design interactive objects [71]. Zoran and Buechley [80] fabricating hybrid artifacts made of broken hand-crafted ceramics and compatible 3D-printed parts to fill in the cracks. Ikemiya and Rosner [37] used broken objects as evocative cultural probes in a design process. In all of the examples above, creation originated in the scraps of destruction, and resulted in the creation of something new that incorporates the remains of the previous as part of the design.

Creation **for** *Destruction*—As opposed to the instances above that resulted in a tangible object, some instances of creation are solely for the purpose of being completely destroyed. In the Buddhist religion, *sand mandalas*, works of art made of colored sand, are created over several weeks and ritualistically destroyed once completed. Their disposal into the river emphasizes the transience of material and its inevitable release back into nature [10]. A similar notion is expressed at the *Burning Man* festival, where participants build an entire city from scratch, knowing that soon it will all be destroyed, leaving no trace behind [26]. Similar expressions of ephemeral interaction exist in play, like the creation of sand sculptures on beaches that will be destroyed by the tide, or chalk drawings on the sidewalk that the creators know will disappear with the next rainfall. In all of the examples above, destruction is the end result, and, therefore, influences the perception and interaction of creation.

By surveying the intersection of creation and destruction, we identify various relationships between them and later make use of them in ideation and development of design concepts, as described in Section 3.

2.2.2 Perspective 2: Catharsis. Literature suggests that destruction has a strong impact on humans by releasing tension, as seen in the act of burning a letter or smashing pottery [44]. In this section, we present the complexity of destruction as a form of catharsis through literature in psychology and anthropology, that later informed our design and ideation process.

According to psychological theory, the act of destruction for catharsis through objects is defined as an *arational emotional action* [28]. Some are *instrumental*—that is, they are meant to direct strong emotions to a purposeful action. An example is punching a hole in the wall in front of an opponent to convey a message. Another category of arational actions are *symbolically displaced actions*, such as symbolically scratching out the eyes in a photo of the source of anger [28], or inserting pins into a doll that represents a personal enemy [64]. The third category are *radically displaced arational actions*, such as kicking a door when angry—an action unrelated to the source of emotional charge, also known as venting [28].

The psychology behind venting and catharsis has been under debate for decades. The original theory, supported by Freud, argues that venting negative emotions can have a positive effect on one's mental state, as opposed to "bottling it up inside" [9]. Researchers have been trying to confirm or refute this theory, but findings have been inconclusive. One of the first studies on the topic asked participants to do a "venting activity" of pounding nails for ten minutes [34]. The results showed that not only was the action unhelpful for coping with anger—it amplified it. Tens of studies that followed replicated similar results [11].

Nevertheless, the theory persists in people's beliefs and is reflected in both historical and modern day expressions. Objects in various cultures were created particularly for the purpose of catharsis, mostly in effigy form. Examples include European poppet dolls, which were poked with needles [8]; dolls from Ancient Greece that were bound, destroyed, and burnt [23]; and Nkisi Nkondi idols from

the Congo Basin that intended to hunt social wrongdoers as a means of accomplishing social justice [39]. In contrast to common misperceptions, effigies were used for a variety of functions beyond aspired revenge. Researchers suggest that rituals with some of these objects enabled catharsis for people in less powerful social positions without disturbing social norms or causing harm [3].

The resemblance in design between these cathartic objects and robots evokes curiosity about the potential relevance of historical effigy artifacts to HRI. Previous work has explored ancient design of Dogū Japanese figurines for designing interaction with agents, and concluded that the detailed face design is more important than the body to represent a human [68]. Other work in HCI implemented needle insertion as user input [55, 75], but used it for a different purpose than what effigies were historically used for.

Catharsis through objects is also present in modern-day expressions. Therapeutic practices make use of catharsis, for example, drama therapy [59] and anger management [49]. Catharsis through destruction can also be found in recreational settings of Breaking Rooms [50], and even in product design (Droog Design's "Do Break" vase) [58]. In HCI research, Kelly Dobson looked at therapeutic machines, such as "ScreamBody," a portable object to scream into [18]. The object was designed as a wearable and sealed "organ" that the user can use to release a scream into, when it is socially inappropriate but necessary for the user to do so. The scream is recorded, and can later be played back and "released" as a cathartic act. Luria et al. have explored a range of prototypes for catharsis and discussed the challenges of designing for "negative interaction" [48].

The survey of objects for catharsis through destruction shows a strong tension between the thousand-year tradition of object destruction and the scientific controversy on whether this behavior is beneficial. In recent years, researchers have attempted to settle the contradiction by showing that venting does not reduce feelings of anger, but has other benefits, like improving people's mood [12], sense of fairness [47], and relieving physical pain [66]. Others suggested that physical venting combined with writing or talking about a negative emotion can improve wellbeing [56, 28]. A third approach argues that the success of venting depends on the identity of the person toward whom the venting is addressed and the response received—venting was found to be beneficial when the receiver is either the offender, or a neutral third-party listener [56]. Perhaps expressive physical motion of a robot could serve as an appropriate response—it has the potential to either symbolically represent the offender, or to serve as a third-party listener, both of which have been shown to be beneficial as part of cathartic interaction [56].

2.2.3 Perspective 3: Emotional Support. The final perspective is closely related to previous topics, but focuses on the emotional support gained through destruction. Destruction is often perceived as a way to express anger, yet it can also assist in dealing with other emotions, such as sadness and pain, through ceremonial and symbolic actions. Sas et al. interviewed psychotherapists to better understand how people use object rituals to let people go from their lives. One of the findings was a sense of emotional harmony when destroying objects related to an ending relationship (such as burning photos or letting objects drift in the river). These rituals combine physical expression of emotion (personal rituals) with cognitive expression (reflection) through the act of destruction [63].

Some of the rituals described by Sas et al. do not simply destroy an object, but *transform* a meaningful object by destroying it and recreating it symbolically as something else [63]—for example, a wedding ring that is melted into another form of jewelry as a symbol of independence.

Another example of objects that provide emotional support to their owners through destruction are transitional objects. Transitional objects are most commonly known by Winnicott's definition, as soft objects critical for the emotional development of children [76]. However, transitional objects are also common among teenagers [21] and have been successful in adult therapy [4] and in treating sexual trauma [41].

Transitional objects have the unique capacity of consoling their owner in situations of distress and fear [24], as well as providing creative outlet [76]. They are emotionally supportive because they provide their owner an object they can destroy and batter, but also cuddle. In other words, transitional objects allow the owner to project themselves onto the object, whether their current state is associated with a positive or a negative emotion [76]. Thus, an object for destruction in the form of a transitional object that is open-ended and provides flexibility can potentially provide emotional support to the user.

To summarize, the literature presents destructive behaviors using objects that can be categorized into three interleaved perspectives: creation, catharsis, and emotional support. The perspective of creation focuses on the role of creation in destruction; catharsis looks into the use of objects as a form of venting and letting out anger; emotional support focuses on the therapeutic use of objects as a method to heal and regain energy. While catharsis can be seen as part of emotional support, we separate the two to address the nuance of "releasing" negative emotion (catharsis) and the use of objects to reflect on emotion and rebuild stability (emotional support).

2.3 Destruction in HRI and HCI

In addition to the work described above, several additional projects have explored the act of destruction in HCI, HRI, and digital media. Eickhoff and colleagues have suggested destruction as a playful act that also creates value [20]. Similar playful interactions of destruction are present in entertainment media, including Hexbug Battlebots[2] robotic toys that are designed to battle and destroy each other, and the ability to turn the Hasbro Furby toy[3] evil. The PainStation game explored a related notion of causing pain to your opponent as part of the game design.[4]

In HRI research, destruction in the context of interaction with robots has previously been compared to hurting another human, which brought ethical issues to discussion. Several studies have tested participants' destructive behavior toward robots [5, 6, 69]. Similarly, an art exhibit inspired by a controversial piece on human inclination toward destruction and cruelty [22] looked at the temptation to make a robot destroy itself [61].

On the other hand, some work has suggested that technology could be a way to *deal with* destructive behavior. Goddemeyer's Smoke Doll uses the gradual destruction of a doll when exposed to cigarette smoke to express the *actual* destruction caused to children by adult smoking behavior [27]. Hoffman and colleagues designed a robotic conversational companion to mediate conflict by reacting in simple physical gestures [33]. Jung et al. used a robot to intervene verbally in situations of conflict [40].

Scholars have also proposed that devices can serve as transitional objects in both digital [43] and physical spheres [53]. Yet Turkle, a pioneer in HRI and in research on evocative objects [73] argued that relational objects such as social robots cannot be transitional objects, as they project themselves onto a child, instead of a child projecting onto them [72]. We take this argument into account when developing scenarios for emotional support in HRI.

Finally, this work builds on *research through design* and *speculative design*. Research through design allows designers to gain knowledge through the process itself of designing new interactions. Research through design sets out to explore what should be designed in the first place, as opposed to *how* to design something that might have little value [78]. Speculative design is a practice of creating prototypes and using provocative fictions about how things *could* be to understand the present and discuss the desired future [19]. Although our work is different from speculative design

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[2]https://www.hexbug.com/battlebots.
[3]https://furby.hasbro.com.
[4]http://www.painstation.de/.

in the intended outcome (mapping a design space rather than creating a prototype), it shares many ideas with speculative design: it speculates about non-utilitarian interaction, suggests scenarios that are beyond the "probable," considers complex human emotion, and promotes discussion as a primary goal [19].

3 THE DESIGN SPACE OF DESTRUCTION

A team of four design researchers explored the notion of destruction in interaction with robots through rapid ideation sessions, sketches, and discussions about destructive actions in the literature. The process of rapid ideation generated tens of ideas and sketches for destruction in HRI that were inspired by the three themes that we identified in the literature: creation, catharsis, and emotional support.

While the three perspectives are not mutually exclusive, each suggested another way to look at destruction when mapping this design space. By considering human-object interactions of destruction that are related to personal, interpersonal, and ceremonial uses, we set out to (1) examine alternative forms of interaction that are at the intersection of destruction, HRI, and ethnography; and (2) inspire discourse in the community about the boundaries of non-utilitarian uses of interactive robots.

We describe the three perspectives and speculative explorations of destructive interaction expressed in sketches, followed by scenarios that suggest personal, interpersonal, and ceremonial uses of destruction in HRI. The suggested scenarios are not necessarily the "correct" or only possible execution options, but are an initial expression of this design space in context.

3.1 Perspective 1: Creation

Destruction and creation are frequently discussed as interconnected human behaviors, each enabling the other. Thus, creation can be a benefit of destructive behavior—through destruction, robots can evolve to create something new: a new personality, a new form, or a new functionality. For example, a robot can lose its leaves, feathers, or other parts of its body over time (Figure 1(A)–(C)) or have several layers that gradually wear out and expose hidden inner layers (Figure 1(D)).
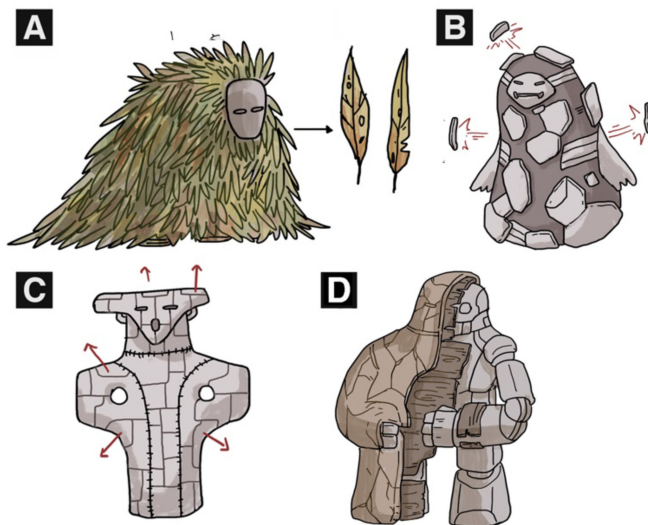

Fig. 1. Robots that are destroyed over time but create something new: a new form, a new personality or a new functionality.
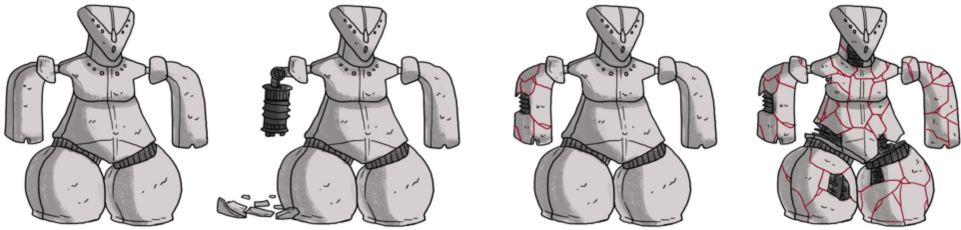
Fig. 2. A robot that breaks as a response to a negative behavior. The robot can motivate users to create a new reality by changing their behavior and fixing the robot to produce something new.

Recreating themselves through destruction can allow robots to support changes needed in interaction or sustain interest over a long period of time.

By falling apart, a robot can also visibly and expressively reflect a particular occurrence in either the user's life or the inner life of the robot (Figure 2). For instance, a robot can respond to bullying or aggression by breaking. Using this physical reaction, the robot can motivate users to create a new reality by changing their own behavior and by fixing the robot's state as a symbolic act.

Destruction can also symbolize the creation of a new, emergent state that does not need fixing. We see such interaction in mass-produced toy robots like Hatchimals, in which the toy hatches and destroys its eggshell [32]. We explore this kind of destruction-as-evolution with robots that grow leaves and weeds (Figures 3 and 4). This design presents a contrast between the perception of growth of the robot, and a process that also destroys the artifact and makes it dysfunctional. The natural decay of the robot is built into the design and can serve as a metaphor for "outgrowing" the robot as part of the interaction, or reaching a state when the robot is no longer needed.

Inspired by nature, we suggest that a robot can "grow" forms of destruction that are familiar to the user and would serve the robot's intended function. The mold and weeds that grow on the robot can symbolize the user's or the robot's development. At the same time, they change the robot's function or abort it altogether by jamming the robot's degrees of freedom.
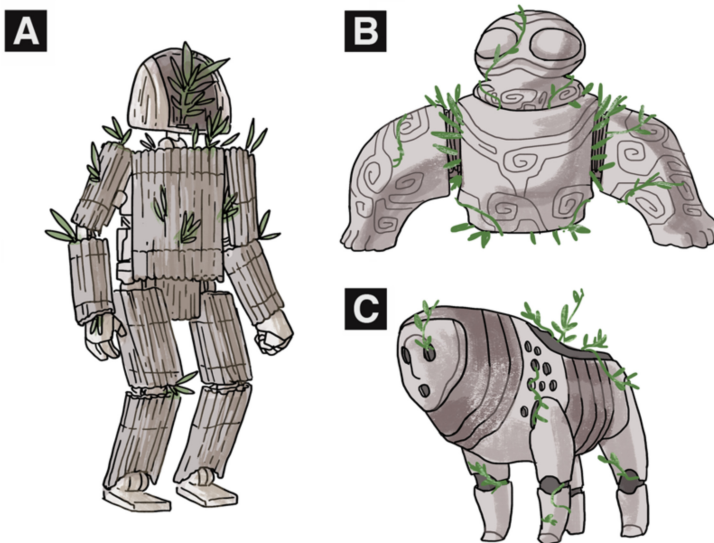

Fig. 3. A robot can grow weeds over time, in a process that symbolizes growth but also changes the function of the robot.

Fig. 4. A robot that grows weeds and mold can symbolize evolution and, in certain cases, abort the robot's function altogether.

Figures 1–4 illustrate some of the creation-related behavior that robots can exhibit using destruction. In Section 4, we ground these speculative concepts in real-life situations through storyboards.

3.2 Perspective 2: Catharsis

The perspective of catharsis focuses on the ability to release tension by interacting with objects for destruction. We started the exploration of objects for catharsis through their morphology, and based on cathartic interactions from the literature (Figure 5). As effigies for catharsis have been historically manipulated and destroyed, we determined that the direct metaphor for cathartic interaction should allow physical manipulation. We thus developed speculative concepts in which users physically interact with robots, unlike the more commonly used voice and screen-based interaction in HRI.

Our main inspiration was the recurrent cathartic interaction of inserting sharp objects into the robot as a way to release tension (Figure 5). Yet the literature suggests other forms of physical
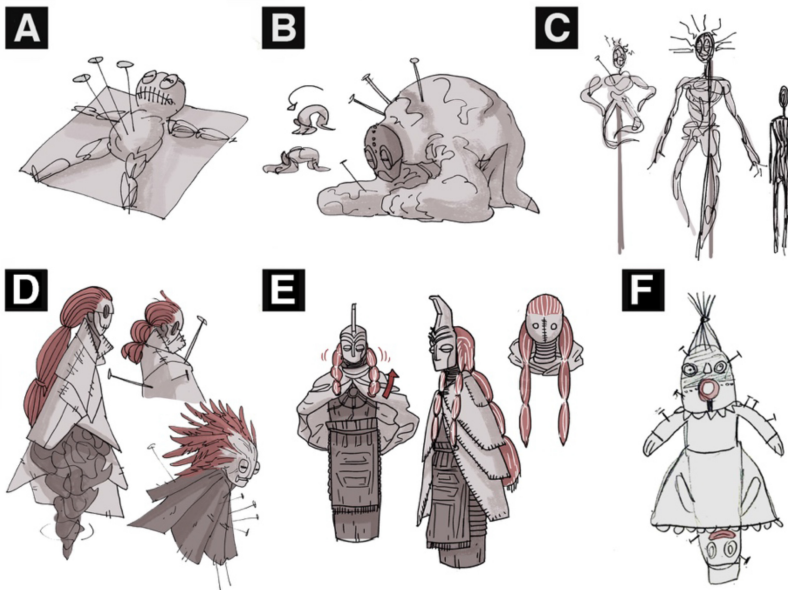

Fig. 5. Exploration of form and interaction for cathartic destruction inspired by the literature. Robots can be interacted with through nail insertion [A–B]. They can react to input by contracting their body [C], moving their garment to expose hidden layers [D–E], or alternating between personalities [F].
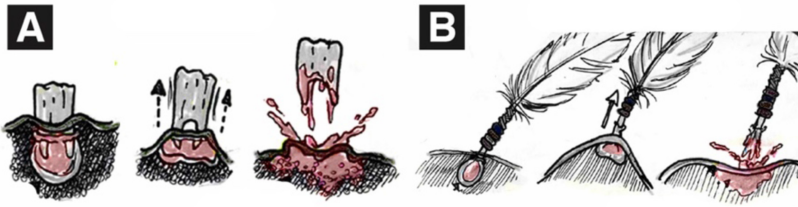
Fig. 6. Physical manipulation other than insertion of sharp objects can be used. For example, pulling out the robot's teeth [A] or plucking its feathers [B].
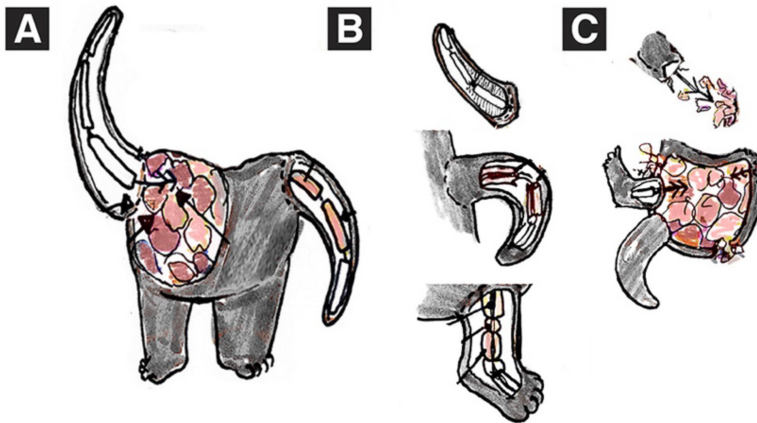

Fig. 7. Users can alter the robot by breaking its bones [A–B] or by detaching its limbs and reattaching them in alternative locations [C]. One possible result of pulling out a limb could be exposure of hidden internal layers [C].

manipulation for catharsis, too. For example, effigies were bound, written on, manipulated, and distorted. We, thus, speculate that the robot's teeth could be pulled out (Figure 6(A)) or its feathers could be plucked (Figure 6(B)). These actions can be visually enhanced using bursting ink bubbles.

An alternative form of meaningfully destructive interaction could *alter* the robot, rather than completely destroying it, inspired by the perspective of creation *through* destruction. Bones could be broken to vary the robot's shape (Figure 7(A)–(B)), and limbs can be detached and reattached in other places (Figure 7(C)).

The design of the robot's reaction to the user's manipulation is another aspect to consider. A robot could react to manipulation using facial expressions or gestures, as commonly used in the field of HRI. It can also react with contracting its body (Figure 5(B)–(C)), or movement of its garment to expose hidden layers underneath (Figure 5(D)–(E)).

Alternative reactions related to creation might include new entities within the robot that awake when the robot is manipulated (Figure 5(F)), inner parts that are gradually exposed with wear (Figure 7(A) and (C)), and a burst of ink that would leave a stain and permanently change the robot's exterior (Figure 6).

3.3 Perspective 3: Emotional Support

Lastly, we explored the perspective of destruction as a form of emotional support through meaningful relationships with material. For example, a robot designed for long-distance relationships could provide emotional support by allowing its users to break it into two individual functioning
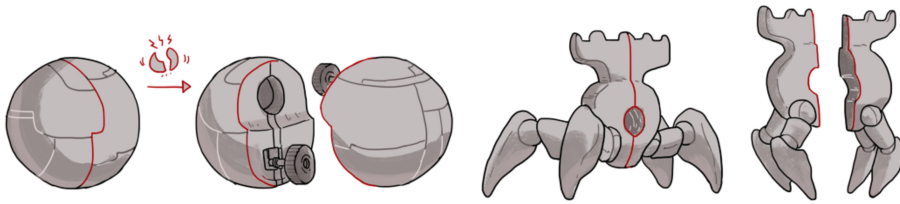
Fig. 8. A robot could break into parts to symbolize the longing for the other half, but remain functional without it.
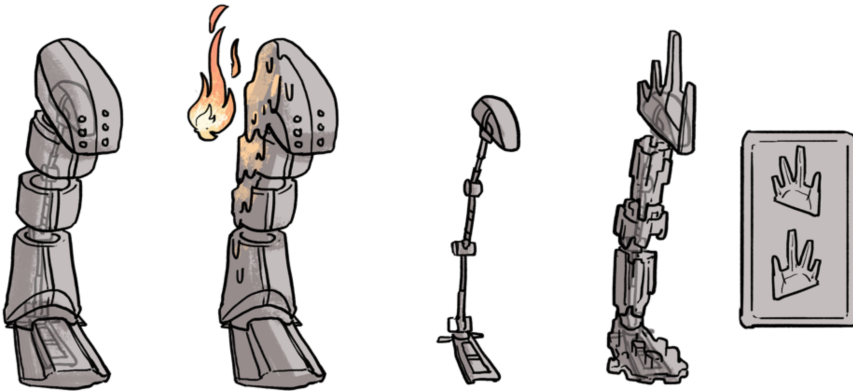

Fig. 9. A robot designed from material that can be destroyed and reformed as something new as a way to reflect the user's emotional state.

robots. Each half can then be taken by one of the two parties, but maintain affordance for being rejoined with its other half (Figure 8).

Some emotional rituals found in the literature display people's desire to ceremonially destroy an artifact and recreate it in a new form [63]. Thus, we suggest a robot can be made of pliable material that users can deform and shape into something new. This interaction is designed to accompany changes in one's emotional state (Figure 9).

An additional significant form of emotional support through objects is in transitional objects. Although social robots have been previously suggested as transitional objects for children [53], the counterargument was that robots force their personality and behavior onto the child, instead of allowing the child to project themselves onto the robot by shaping it themselves [76].

We present a concept of a robotic transitional object that is soft in material, malleable, and interacts with the child by responding to touch through subtle movement, just enough to generate a response that would communicate warmth and a sense of emotional support (Figure 10).

Fig. 10. A robotic transitional object can be designed as a soft, malleable artifact. Using subtle movement reactions as feedback, it can allow children to project themselves onto the robot.

4   SCENARIOS

In order to understand how interaction would unfold around each robot design concept, we developed scenarios of destruction that mirror human-object interactions for personal, interpersonal, or ceremonial use, and included a short description of the technical features and implementation that some of the scenarios would require. The scenarios also express the three perspectives of destruction that we identified in the literature: creation, catharsis, and emotional release.

Storyboards A and *B* (Figure 11(A) and (B)) focus on personal interaction with a robot and ways in which it can reflect on the user's identity and personal goals. *Storyboard A* presents a scenario of a personal robot that evokes motivation by growing weeds over time. The robot is attached to a goal, such as committing to physical activity. As long as the user moves toward that goal, the robot would keep growing, respectively. As the weeds grow over time, the robot would lose its capability to function, symbolizing the user's growth and eventual independence from the robot. This interaction also reflects the coupling between creation (growing weeds) and destruction of the robot's functionality and use as a result.

Central to this concept is the idea that a robot can be designed as a temporary technology, intended to achieve a specific goal. In this case, the robot would only exist as a motivational tool for as long as the user seems to need it. In the example of *Storyboard A*, the robot would help the user in the training phase, but once physical activity is routine for the user, the robot would gradually decay. From a technical implementation perspective, the robot can make use of a connection with a fitness application or device (such as "FitBit") to determine when it should "grow." As the data shows that the user is developing fitness habits, the robot would respond by developing and "growing" to reflect the user's success.

In order to control the weeds according to data, the weeds need to be made of artificial material. One solution would be to create them using pneumatic weed-like "sleeves" that would incrementally inflate over time. As they inflate, they can gradually block and limit the motion of the motors. If the user moves away from the goal, the weeds could gradually deflate and disappear. In a case of goal completion, the weeds would inflate to the extent of completely blocking motor motion. By doing so, the robot would signal to the user that it is no longer needed, but would remain as a reminder object of the user's success.
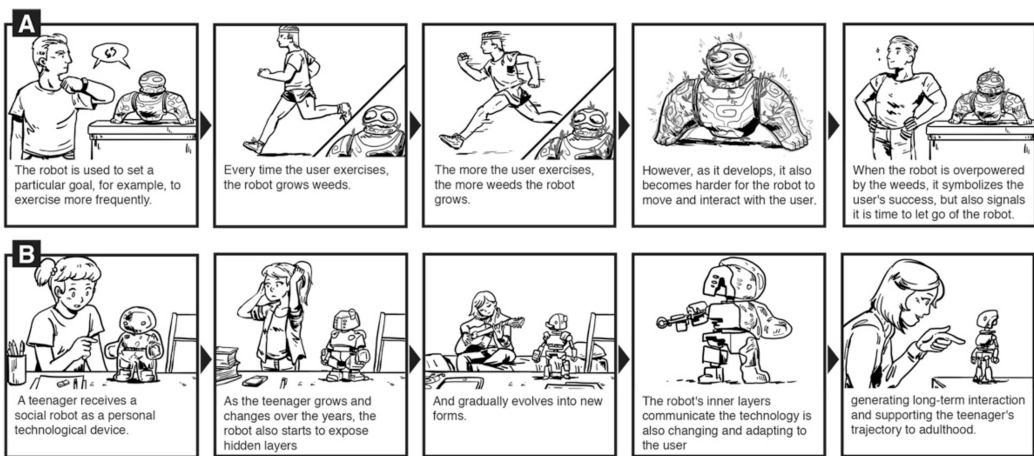

Fig. 11. Robots can serve personal interaction through destruction by growing weeds or by wearing out over time. The scenarios suggest interactions that implement the destruction of the robot as a form of creation of new habits, a new personality for the user, or a new functionality for the robot.
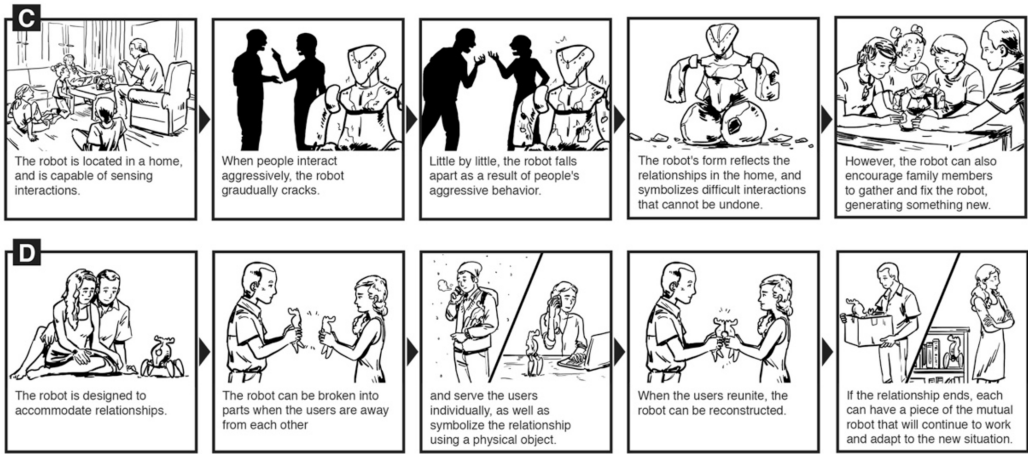
Fig. 12. The storyboards suggest interpersonal interactions through destruction. Robots can be designed to mirror relationships, while supporting a difficult situation or helping to deal with conflict.

Storyboard B (Figure 11(B)) presents a personal robot that has several inner layers. As the robot is used, its layers gradually wear out and expose a new robot underneath, *creating* something new through decay. Children outgrow objects and acquire new ones—instead, robots can be designed as evolving objects that support long-term interaction. By creating a new exterior for the robot over an extended period of time through destruction, the robot can change together with the user to reflect their evolving identity.

Storyboards C and *D* (Figure 12(C) and (D)) portray a shared robot that supports interpersonal relationships through destruction. In *Storyboard C,* the robot listens to the tone of conversation in a household, and whenever it is unpleasant or aggressive, the robot cracks. Previous work has designed a fragile robot that responds to aggressive behavior between partners by physically shaking [33]. This scenario extends this previous work by proposing that the robot's physical reaction can also symbolically reflect on relationships; if the robot breaks, it cannot be undone, just as aggressive behavior cannot. However, the visual of a cracked robot could encourage users to collectively reconstruct what they have broken as *catharsis* and as a symbol for lasting behavioral change.

Technical implementation of this scenario would include sensors that can determine when people engage in aggressive behavior, and an output that would incrementally break the robot. In previous work that attempted to sense aggression, researchers measured volume level as an indicator [33]. More technically complex options include using machine learning to identify intonation in conversation, or analysis of the content and words used to recognize aggression. For the robot output, it can be structured similarly to Hatchimal robots [32] that peck their own shell from the inside and break it over an extended period of time. This interaction could be developed even further by providing the users with a "repair kit" to apply to the cracks created by the robot. The repair would maintain the robot intact but would also modify its exterior, similar to the practice of Wabi-Sabi [46] and Kintsugi [45] discussed in Section 2.

Storyboard D (Figure 12(D)) presents a scenario is which a couple share a robot in their home, inspired by destruction practices as *emotional support* through expression of a relationship or the separation from a loved one [63]. In this scenario, the couple experiences times when they are away from each other, and the robot emotionally supports them by breaking into two functioning parts that also have the affordance to be rejoined, similarly to breakable heart jewelry. Once rejoined, the robot becomes a single, better functioning, entity. If a breakup occurs, the robot can be permanently

Fig. 13. Robots might provide ceremonial interaction through destruction, in either a personal or interpersonal settings. The robot can be a transitional object that allows a child to shape it based on their emotional state, or it can serve as a ceremonial interface that represents the emotional state of a community.

broken apart, and remain as a symbol of a previous relationship. Perhaps it can even be destroyed and reformed as a new personal object as suggested in Figure 9 and inspired by rituals of reclaiming symbolic objects from relationships that have ended (for example, wedding bands).

Storyboards E and *F* (Figure 13(E) and (F)) examine opportunities for ceremonial interaction with destructive robots. *Storyboard E* describes a scenario in which the robot functions as a personal ceremonial object, a transitional *emotional support* object for a child. This scenario attempts to take into considerations the characteristics of transitional objects according to the literature reviewed [4, 76]—the robot allows the child to cuddle it, destroy it, and shape it in any way desired. It reacts to the interaction and to touch using subtle movement as feedback, just enough to provide the child with a sense of emotional support while maintaining their ability to project themselves onto the robot.

In *Storyboard F* (Figure 13(F)), the robot is publicly exhibited and calls for interpersonal ceremonial engagement. Any passerby can interact with the robot and express their current emotional state as a form of *catharsis*. Different input objects can represent different affects. Through multiple interactions, the robot can be transformed into a collective display of emotions in a particular community. The scenario builds on centuries-long interactions with effigies for the purpose of catharsis and social change [8, 23, 39], as well as people's tendency to engage in destructive behaviors with robots in public spaces [61].

To implement such a robot, the inserted nails could close a circuit between two layers of conductive material within the robot, and by doing so send a signal to an internal microcontroller. The microcontroller in turn could respond by moving the robot's motors that create gestures, as well as make note of the nail insertion in its dataset. Different types of needles that represent a range of emotions can be identified through their conductivity through varying thickness and material. Finally, a corresponding digital interface could visually present the data collected and portray the range of emotions within a community or space.

5 DISCUSSION

In this work we outline the design space of destruction in HRI through a range of conceptual robot designs, descriptions of how they would be used in real-life scenarios, and specifications

on how some of them might be technically implemented. The scenarios all stem from the team's months-long review of psychology and ethnography literature on the topic of destruction that informed the process. The presented concepts explore personal, interpersonal, and ceremonial uses of destruction as a way to surface a fresh perspective on the possible future design of human-robot interactions.

The role of the contextual background was not only to outline the fundamental notions of destruction that inspired our ideas, but also to reveal some of the misconceptions related to the topic. First, the many expressions of destruction in a range of cultures and contexts grounds that destruction is an inherent aspect of human behavior and, therefore, can be designed for. Second, destruction is commonly perceived as something to avoid, yet the literature suggests that it can also be constructive, i.e., even when destruction originates in negative emotion, it can have constructive outcomes. Finally, although destruction is perceived as fatal, it has a reversible aspect—while the destroyed cannot be resurrected, it can be reconstructed in a new form.

Based on these realizations, we select and present a handful of meaningfully destructive behaviors, modern and historical, and exemplify them in our design concepts. We attempt to address these misconceptions through plausible interactions of destruction that leverage their benefits and highlight their constructive, supportive, and reversible aspects.

This work sets out to design beyond the instinctive human aversion toward destruction and negative emotions altogether by showing how this extreme non-utilitarian behavior can be implemented in HRI with positive outcomes. By combining the literature and our design work of sketching, scenario building, speculating and reflecting, we hope to open up a new design space for destruction in HRI.

Nevertheless, the ambiguity of destruction, which can be both constructive and harmful, challenges this work. By better understanding the complexity of the topic and the challenges that it surfaces [48], designers can generate constructive interactions that implement ideas of destruction, rather than avoiding the topic.

6 CONCLUSION

This work brings an underexplored territory of human-object interaction to the fore of HRI discourse: non-utilitarian interaction with objects through the act of destruction. HRI frequently focuses on utilitarian value and positive emotions, leaving more controversial human behaviors aside. We believe destruction could be considered along the same lines as other culturally oriented research on technology, as previously discussed by Rogers [62].

Destruction through interaction with objects has a long-standing tradition as a form of non-utilitarian use of artifacts. Thus, we began by situating our work in a survey of *human-object interactions* that are not strictly utilitarian, including personal, interpersonal, and ceremonial uses. Then, we present sketches from three perspectives of destructive behavior that emerged in the review process: creation, catharsis, and emotional support. Finally, we exemplify how such interactions of destruction could be applied to the field of HRI and real-world situations through storyboards and exploration of their technical implementation.

The contribution of this work is twofold: We probe non-utilitarian interaction of destruction with technology by going through a conceptual design process. Our first contribution is therefore a better understanding of the complexity of destructive behavior and its potential to be implemented in the field of HRI.

Our second contribution is a broader inquiry into the boundaries of what interactions are considered for HRI. By creating multiple speculations that are also grounded in ethnographical and psychological literature, we hope to inspire thought regarding what should or should not be included in the design of human-robot interaction. We believe it is critical for the research

community to re-consider the current path of robot design, and we hope to evoke critique and discussion on the topic.

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