The Right to Contestation: *Towards Repairing Our Interactions with Algorithmic Decision Systems*

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This paper looks at how contestation in the context of algorithmic decision systems is essentially the progeny of repair for our more decentralized and abstracted digital world. The act of repair has often been a way for users to contest with bad design, substandard products, and disappointing outcomes—not to mention often being a necessary aspect of ensuring effective use over time. As algorithmic systems continue to make more decisions about our lives and futures, we need to look for new ways to contest their outcomes and repair potentially broken systems. Through looking at examples of contemporary repair and contestation and tracing the history of electronics repair from discrete components into the decentralized systems of today, we look at how the shared values of repair and contestation help surface ways to approach contestation using tactics of the Right to Repair movement and the instincts of the Fixer. Finally, we speculate on roles, communities, and a move towards an agonistic interaction space where response-ability rests more equally across user, designer, and system.

Keywords – Design for Repair, Design for Contestation, Right to Repair, Agonistic Design, Algorithmic Decision Systems.

Relevance to Design Practice – This paper makes the argument that repair is not confined to physical things but follows through into the digital and algorithmic world in the form of contestation. We suggest that through this lens of repair, designers can better address the emerging problems in data-driven decision systems.

Citation: Collins, R., Redström, J., & Rozendaal, M. (2024). The right to contestation: Towards repairing our interactions with algorithmic decision systems. *International Journal of Design, 18*(1), 95-106. https://doi.org/10.57698/v18i1.06

Introduction

As Algorithmic Decision Systems (ADS) become more and more entangled in our everyday lives and futures, the ability to contest and negotiate with these systems' processes and outcomes is becoming a major concern for both the people affected and those who wish to design a more responsible way of interacting with them. As Henin and Le Métayer (2021) observe:

> Algorithms are increasingly used to support decision-making. The nature of these Algorithmic Decision Systems (hereinafter ADS) varies: some of them rely on machine learning while others do not; some of them involve a form of interaction with human users while others are entirely automatic; some of them are intended for professionals while others are aimed at the general public. Regardless of these differences, ADS are often involved in decisions that can have a significant impact on people: access to credit, employment, medical treatment, judicial sentences, etc. (p. 1)

Using the shorthand of ADS allows us to discuss these systems without getting caught up in their technicalities—ADS can be as simple as the software that runs the traffic lights at a road junction, up to planetary level interconnected networks which harvest and cross-share data on an industrial scale. Restrepo-Amariles (2020) explains that "ADS generally refer to automation by means of algorithms of multiple processes which underpin the decision-making process, including the collection and processing of data, as well as the execution of decisions with little or no human intervention." If one is treated inappropriately by any of these systems, you are less concerned about the underlying technology, but rather that it can be contested and that you have agency over its decisions, content, and/or output.

We can now see a normalization of ADS being used in automated decisions in areas such as mortgage approvals (Lee & Floridi, 2021), hiring for jobs (Eastwood, 2020), and welfare benefits (Barman et al., 2018), amongst others (Burrell & Fourcade, 2021). Many of these systems have been designed with the belief that they would be an effective automated solution for an existing problem and, as such, contestability has often been more of an afterthought. The challenge for future designers who will be increasingly dealing with such complex systems is both in how to surface contestability within these existing systems and in how to embody contestability into the design processes, while also leveraging the considerable benefits of automation and the use of data for the betterment of society.

Received February 27, 2023; **Accepted** December 3, 2023; **Published** April 30, 2024.

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The Right to Repair (R2R) movement, and the act of repair itself, provides a useful parallel to contestation. In the same way that R2R seeks to provide users with the means to repair their products through education and pushing manufacturers to open up access to their devices, so too can we look at ADS and our interactions with them as repairable, and to challenge their designers to make them more transparent and negotiable. Tracing the history of repair in electronics, through the silicon revolution and into distributed computing—the cloud, IoT, and fluid assemblages (Redström & Wiltse, 2018) reconfiguring themselves behind the interface—we can juxtapose repair with contestation, compare the values of each, and use this to explore future directions in designing for contestability. In this paper, we look at the right to repair movement and examine the values which it shares with contestability. Positioning them both in a historical and contemporary timeline, we explore what has been learnt and where these values can help in imagining how contestability can be applied for more participatory, democratic, and engaged interactions.

In *Rethinking Repair* (Jackson, 2014), Jackson states that "...the world is always breaking; it's in its nature to break. That breaking is generative and productive…" (p. 223) and that this is a condition we should accept as part of our reality and our story. This is where both repair and contestation can bridge the gap between the physical and digital, and provide both a platform for, as well as motivation to, engage in ethical innovation.

While approaches like Explainable AI (XAI) and General Data Protection Regulation (GDPR) notifications are important steps towards giving the user agency in their interactions, they still place the responsibility on the user to understand how their actions may play out within complex shifting digital networks (De Bruijn et al., 2022). On the other hand, legislation and compliance laws for corporate entities often move slowly and tend towards one-size-fits-all solutionism which serve as signposts for less than ethical strategies such as nudging and dark patterns (Lukoff et al., 2021).

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Starting with a background in the landscape of our design concerns, we will present a series of examples of contemporary repair and contestation, and what issues they reveal for new perspectives in designing for contestation. Looking deeper into such trajectories in design and use, we then trace the history of electronics repair from discrete components into the decentralized systems of today, and consider how the shared values of repair and contestation help surface ways to approach contestation using tactics of the Right to Repair movement and its ability to construct publics (DiSalvo, 2009), and the instincts of the Fixer—one who shares both a designerly and user perspective. Finally, we move on to speculate on what roles and communities might form a basis for moving towards an agonistic interaction space where rights and response-abilities are distributed across user, designer, and system to form more transparent, more democratic, and therefore also more sustainable systems.

Background

Here, we flesh out some of the concepts that we are basing our text on. Entanglement as the emerging HCI paradigm which reflects the increasingly complex and potentially existential relationship we have with technology. Contestability as the recognition of the need for agency over these decision-making systems and the emerging attempts to embed this within ADS design. The Right to Repair movement as the inspiration for contestation strategies and applications of *design after design* (Redström, 2008).

Entanglement

Dourish in 2004 noted the deprecation of the idea that "traditionally, human-computer interaction has taken place within a constrained and well-understood domain of experience—single users sitting at desks and interacting with conventionally-designed computers employing screens, keyboards and mice for interaction" (Dourish, 2004). This notion of a user at the center of their system, surrounded by devices at their beck-and-call, has been reconfigured into unrecognizable networks and assemblages of human and non-human systems—constellations (Coulton & Lindley, 2019) of users, devices, sensors, processing and storage systems, and the aforementioned ADS—and into a post-user-centered design space where focusing on the person who "uses" the computer limits our ability to perceive, let alone to design for, these other kinds of configurations (Baumer & Brubaker, 2017). Frauenberger (2020) goes further and sketches out the notion of Entanglement HCI as the next wave in HCI design to address how "the boundaries between technology and humans are increasingly fuzzy" (p. 3) and the ways in which "Social media, big data, internet of things and artificial intelligence are unlike the first computers, confined to offices, they pervade our whole existence" (p. 16).

These days, we can't simply turn our computer off if it gives us a response we don't like. Our interactions and the data they generate are persistent and waiting for us to supply another data point to inform their next decisions. Entangled as we are, it is more important now to show ourselves *the ropes* and find ways to trace and untangle them.

Contestability

In this text, the word *contestability* is being used to denote the agency the user requires to be able to openly interact with Algorithmic Decision Systems, whatever the underlying technology (AI, ML, etc.), and maintain "the ability to contest, appeal, or challenge algorithmic decisions" (Lyons & Velloso, 2021). Contestability seeks to provide a window into these systems and the agency to influence what goes on within. Any decisions that are made on a person's behalf may come back to haunt them and these hidden decisions may result in even further unanticipated consequences. The data used to provide the material upon which to make these decisions may also come back in a mutated form and from unexpected directions, having been passed around in the darkness of the black boxes and triangulated by *less-than-ethical* actors through avenues of deanonymization (Park et al., 2021), inference (Krumm, 2007), and pattern leakage (Benjamin et al., 2021).

Further examples of the need for human contestation are where AI-assisted applications simply make the wrong decisions in critical medical situations (Nyheter & Dahlberg, 2022) and "inadvertently introduc[ing] safety issues themselves" (Challen et al., 2019). Henin and Le Métayer (2021) state that, considering these potential impacts, "...expected benefits of these systems may be offset by unacceptable risks for individuals (discrimination, loss of autonomy, etc.), the economy (unfair practices, limited access to markets, etc.), and society as a whole (manipulation, threat to democracy, etc.)". The more our lives move into the digital, and the more these lives are influenced by automation, the more we will need to have this contestability available as part of our interactions. In what follows, we look towards the Right to Repair movement to see what can be learned from previous efforts in maintaining and supporting user agency when things do not work or break down.

As we will see in the Contemporary Contestation section, there are a growing number of cases where a lack of contestability has resulted in widespread suffering by members of the public, leading to recorded incidents of suicide, social stigma, and psychological suffering (Graycar & Masters, 2022). Eubanks' book *Automating Inequality* (Eubanks, 2017) goes further in this regard in exploring how these automated systems specifically affect the more economically marginalized purely by being in a position to be less able to absorb these penalties. While human-powered algorithmic decision systems are also capable of harm, the automation of these systems spread their damages far more quickly and, in the aforementioned cases, call for an existential need for contestation to be built in from the start.

A Right to Repair

In 2020, Perzanowski (2021) conducted a survey which asked the question: "Do you agree or disagree with the following statement? If I purchase a [device], I have the right to repair it myself or to take it to the repair shop of my choice" (p. 381), with the result that sizable majorities expected freedom to repair their devices as they saw fit. In a follow-up question he asked, "How else would you feel if you learned that the manufacturer of your [device] limited your ability to repair it or have it repaired?" With largely (67%) negative responses along the lines of, "I don't think [manufacturers] have any right to tell me what I can do with it after I purchase it", and that "the manufacturer is impacting my freedom to do with what I want a product that I legally own." (p. 383). These responses, from a broad representation of the U.S. population, suggest a baseline support for the right to repair the products that a person owns.

The act of Repair, until now, has manifested itself mainly in the physical world. It is about ownership of an artefact and the ability to do what you want with it—to use, change, or to fix. It also has a relationship to recycling and sustainability (Hernandez et al., 2020)—if someone throws out a piece of equipment and *unowns* it, the repairer may adopt it, repurpose it, or completely return it to its original function.

Until recently, and specifically when digital technology became more *connected*, the notions of ownership and repair have begun to become more inconsistent and dissonant with one another. While we might have the know-how to replace the battery in our phone or upgrade our laptop, the manufacturer now has more agency in denying you this luxury by remotely disabling your device, thus forcing you to return to the manufacturer for repair or to upgrade to the latest version. A specific case of this is where Apple were "remotely disabling iPhones whose screens had been repaired outside of Apple's authorized network" (Wiens & Gordon-Byrne, 2017). Until this assumption of a right to repair was challenged by manufacturers, it had never been on the radar of anyone, except perhaps market futurologists. Some would say that it was foolish to attempt to repair your car by yourself and others would say it was foolish to pay good money to have it repaired by an approved entity, but neither would contest a person's right to choose how to go about it.

Repair is about traditional ideals of ownership, shared knowledge with a hands-on approach, and a responsibility towards what you have earned and acquired. Contestability can also embody these values and desires, but it acts in a less-than-physical hybrid world of unclear ownership and outsourcing of responsibilities. With the recent successes (and setbacks) (Mikolajczak, 2020) of the Right to Repair movement, an investigation into the shared values it has with contestability and a look at how they both define and challenge ownership may lead us in the direction of a kind of participatory, ethical, and beneficial way of interacting with (and designing) our algorithmic systems and their decision making processes.

Examples of Contemporary Contestation and Repair

> Governments around the world are rushing to automate the delivery of public services, but it is the most marginalised in society that are paying the highest price. - Merel Koning, Senior Advisor on Technology and Human Rights: Amnesty International (Amnesty International, 2021).

In this section, we take a look at some recent and ongoing examples of problematic ADS implementations which call for contestability, and real-world examples of the need for ownership and agency over products through repair. In placing these examples beside each other, we can begin to see overlaps between contestation and repair—especially in how R2R tactics such as community, publics, and agency can benefit both areas.

Contestation

There is an increasing number of incidents and scandals that indicate a need for contestability in automated decision making. Two of the more prominent ones are the so-called Australian Robodebt Scheme and the Dutch Child Care Benefits Scandal.

The *Robodebt* scheme was an automated means by which Centrelink, the Australian social welfare payments program, could compare welfare payments with a person's income as recorded by the tax office, and issue debt notices for any overpayments above $1000. In 2016, human oversight was removed and the system became fully automated. In many cases, welfare debts "...were calculated solely on averaged income data provided by the Tax Office—without proper assessment of the person's actual earnings over a particular period under the applicable Social Security income test. These are known as 'robodebts'." (Media release: Economic Justice Australia welcomes robodebt royal commission, 2022). As a result of this system, many people were wrongly sent debt notices based on inexact income records. In 2019, a class action was lodged with the government on behalf of those affected by *robodebts* and the Australian Government announced that automated repayments would begin in 2020.

The Dutch Childcare Scandal arose from an algorithmic system which is used to assess whether claims for childcare benefits were in error or fraudulently applied for. From 2013 to 2019, it was estimated that up to 26,000 people had been wrongly accused of fraud by the system and had been required to pay back these benefits. Along with false accusations of criminal offence, it was also revealed that one of the *indicators* of potential fraud which the algorithm used, was that of the subject's second nationality (Thelwell, 2021). As a result, the system was identified as having a racial bias and also of discriminating against those from lower incomes—as the people most likely to need support for childcare costs. The scandal also resulted in the resignation of the Dutch cabinet of the time, although no member was held accountable and the tax office was deemed to be immune to prosecution.

As with the *Robodebt* scheme, this automation adversely targeted communities which were marginalized, low-income, and (in the Dutch case) in a precarious situation regarding full citizenship rights. All of these conditions make for a social group who are less likely to challenge decisions coming from government sources and, even if they do wish to challenge, may not have the financial confidence to go through with a legal process.

Repair

Moving over to the realm of repair, we can also see emerging examples of the separation of the owner and the ownership of their products which also have their roots in the abstracting of decisions over to the manufacturers' systems. How we repair our products, and who can repair them, is being decided by remote and automated means, locking the owner/purchasers out of their own devices, tools, and machines in ways that would have been unthinkable only a few short years ago.

The case of John Deere tractors presents a relevant example of Right to Repair activism in recent years. John Deere tractors have become increasingly less repairable by the farmers that use them—resulting in some repairs only being able to be performed by preferred John Deere technicians, when and where they are available. Farmers "...realised that when their machine breaks they are not only legally obliged to call Deere's customer service centre, which is the only entity entitled to analyse the tractor's breakdown, but they also became aware that even when the service is slow, inefficient and overpriced, they cannot do much without violating the Digital Millennium Copyright Act" (Cangiano & Romano, 2019, p. 441). In essence, a part of their machinery existed on the servers of John Deere (or another company who provides that service) and remotely decided on what repairs could be done and by who. Farmers could replace parts, but without a certified technician to validate the repair via proprietary software, the equipment would not function (Koebler & Gault, 2021). In an effort to reclaim agency and control over their machinery, many farmers and repairers turned to hacked and pirated software solutions. Eventually, farm groups banded together and have taken class action lawsuits against Deere, which have instigated a political and legal battle across a number of US states (Deere hit with class action lawsuit over right to repair, 2022).

In another emerging situation, with the car manufacturer Subaru, new owners are discovering that, depending on which state they reside in, they may or may not have access to the company's telematics system which provides certain features and diagnostic systems to the owners (Marshall, 2022). Concerns are also arising from the sensors "...that can generate up to 25 gigabytes of data per hour from sensors all over the car" (Fowler, 2019) which is transmitted wirelessly back to the manufacturer without accessible or complete means for the owner or independent mechanic to repair or contest.

Across all of these examples, the ability to access and implement repair can also be seen as a function of socio-economics, in that conditions of lower incomes, a lack of disposable income, and fundamental time pressures lend themselves to finding ways to make what you own last longer and open itself to correction. This can be seen in the example of John Deere customers turning to hacked software to enable the use of third-party parts and local mechanics, and in the continuing spread of the Right to Repair movement. On the other hand, marginalization and a lack of belonging and agency in society can discourage publics from demanding better interactions, products, and systems (Eubanks, 2017).

From Repair to Contestation

> While the transformation of production methods in the 19th century through the interchangeability of parts led to a "discipline" of repair, in the 20th century the planned obsolescence introduced a new relationship to the object that excluded any possibility of repair (Bernasconi, 2022, para. 4).

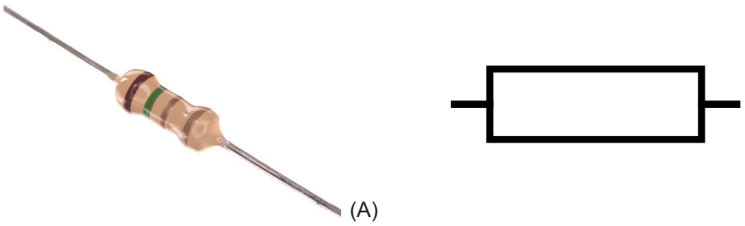
The Right to Repair movement (or rather, the desire to have full ownership rights to the tools and instruments that you possess) can be traced back much further than the contemporary manifestations involving John Deere tractors and Apple computers, drawing attention in the news media today (Purdy, 2021). For the purposes of this paper, the more modern history of electronics repair, its evolution, and its relationship to the contestability of data-driven systems provide a useful illustration.

Until relatively recently, the inherent expectation in the ownership of a tool was that you would repair it yourself, if possible, or bring it to a repairer who had the necessary skills to bring the failing tool back to its full potential. A bent plough blade can be hammered back into place; the handle of the hammer that breaks while repairing the plough can be replaced by a roughly carved piece of suitable wood. In the case of a completely broken plough blade, a repairer (Jackson, 2014), in the form of a local blacksmith, can be engaged to fabricate a new blade from raw materials and also fit it, if needed.

As technology and the tools it produced became more discrete, unobservable, or unintuitive, the ability for the average citizen or even the skilled craftsperson to engage in repair changed and became more specialized—a blacksmith could observe and understand a steam engine, but a radio receiver (even a very early design) gives little information about its inner workings and requires some training, confidence, and scientific knowledge to engage in any form of repair. In many ways, the transition from vacuum tubes to solid-state components produced the first of what we would now call *black boxes*—or, at least, devices that operate on such small (electron-ic) levels that their operations could not be observed by the human eye and their functions had to be accepted as what they purported to be. The diode allows flow of current in one direction only, and the transistor allows current to flow between two of its pins if a voltage is applied to the other pin because of the electrical properties of silicon, physics, and electrons. This abstraction is referred to in Belevitch's *History of Circuit Theory* with the example of the simple resistor "considered as a 2-terminal black box…, rather than as a physical device made of metal or carbon." (Belevitch, 1962, p. 848).

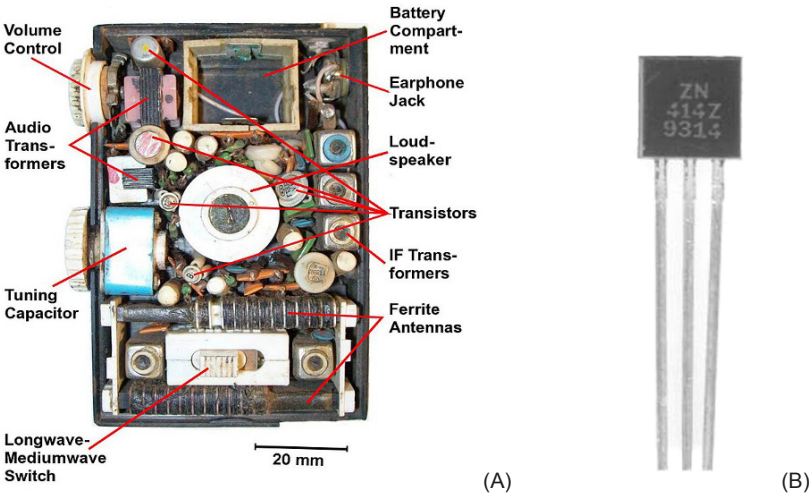
Still, like the blacksmith—with the proper tools, training, and experience—a person could become a repairer of systems which they did not completely understand, by following procedures of testing and replacing components. Not an entirely pure repair of fundamental parts, but a certain "...discipline of repair" (Bernasconi, 2022).

The next phase of black-boxing occurred with the consolidation of multiple discrete components onto silicon dies inside the literal black boxes of the Integrated Circuits (IC's) or microchips. These IC's are familiar to anyone who has looked inside an electronic device since the 1960's—a rectangular black plastic artefact with rows of metal pins along each side, with identifying marks defining its manufacturer and function. Each IC has a role which replaces an entire assemblage of separate components—logic gates, amplifiers, oscillators, even an entire radio-on-a-chip (ZN414 AM Radio Receiver IC, n.d.) which just needs a few extra components to tune and hear audio. Compare this tiny device to a 1970's radio receiver and see which one reveals more about its inner workings.



(A) (B)

Figure 1. A Physical Resistor (A) and the 'black box' IEC Resistor Symbol (B) [Creative Commons].



(A) (B)

Figure 2. Interior of transistor radio (A) and a ZN414 "radio-on-a-chip" (B) [Creative Commons].

Despite this obfuscation, each of these devices had only one fixed function and, as such, contributed to making repair easier, if less skilled. An IC could be pulled out, tested for its function, and replaced by an identical IC if the problem existed there. More importantly, testing a single-function IC is also a relatively straightforward process—when certain conditions are met at its inputs, it should always provide predictable states at its output(s). The black box of the IC could be peered into by looking at its particular data sheet, understanding its architecture, and trusting that its function was fixed and unchangeable.

Programmable Logic Devices (PLDs) are an example of discrete components beginning to blur the lines between software and hardware—referred to as firmware. Based on signals applied to certain inputs, the function of this device could be changed and rerouted on-the-fly. The addition of programmable memory, which retained its state, also allowed them to *remember* their different states and reconfigure themselves as conditions dictated. These devices are true assemblages—things whose function could not be divined by inspection or datasheet, except to know that there could be one of a number of configurations within. Field Programmable Gate Arrays (FPGAs) and the microprocessors in our phones and computers are even more familiar examples of these kinds of devices which can be reconfigured and updated at will.

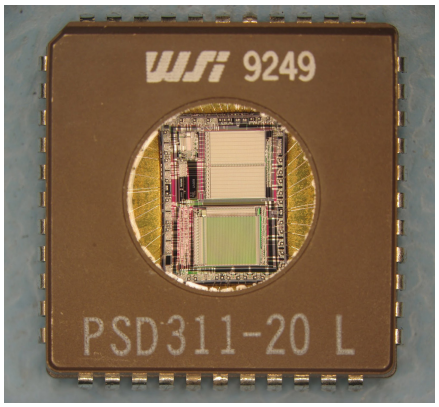


Figure 3. A typical PLD used in medical, telecommunications, and industrial applications [Creative Commons].

With all of these isolated assemblages reconfiguring themselves across the planet—microprocessors, personal computers, local networks—the benefits to introducing them to a global network were clear. Users could always be confident that their machines were up to date and centrally monitored, and the designers and manufacturers could ensure that they could still intervene with updates and patches, and even harvest information in return for that *richer user experience*. It also opened up opportunities for manufacturers to deliver pre-beta (incomplete) software and resolve issues as users bumped into them on-the-fly.

This true shift to the black box and fluid assemblages (Redström & Wiltse, 2018), is when these assemblages began to be mass-connected to the internet and products strived to be part of the Internet of Things (IoT). This can be seen as the point where repair begins to converge with contestability—where the physicality of repair moves towards the less-than-tangible contestation. First, we heard tales of software running on kettles, next, we considered the usefulness of smart-fridges, and then everything seemed to have a potential for connectedness. Here is where the functions within our black boxes begin to occur in another unseen place, outside of our direct repair and control.

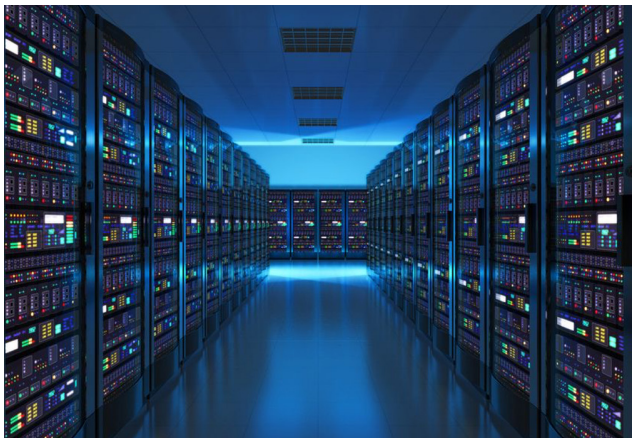


Figure 4. Servers in a Data Center for persistent data storage [Creative Commons].

What Needs Repair?

A limited but still effective ability to *repair* actions has been central to design for usability in the context of interactive systems. One illustration is the *undo* function and the possibility to step backwards in a sequence of choices, or the possibility to *revert* to the latest saved version of a file. Importantly, however, this is about *repairing* our own actions; of dealing with unwanted or unexpected results of our own making. The acts of repair addressed in this paper concern the other side of the interaction, i.e. when there is a need to correct, alter, or revise decisions, deductions, and more—done by a system acting on its own on the basis of data.

In our modern connected devices, both the functions and the repairability have been abstracted from our immediate vicinity and control. The integrated circuits inside our phones, laptops, washing machines, etc. have become wormholes into vast data centers, networks, algorithms, and automated decision making systems. The phone in our hand is now the thinnest-of-clients with minimal processing being done onboard—rather, our interactions and data are sent immediately away to be harvested, processed, and returned in another form to be displayed again on the screen. What is made available on screen and in apps is not a comprehensive presentation of the system's functionality, but rather a highly specific interface for enabling or even encouraging specific interactions. As such, what is presented on screen may also differ between users:

> Designed interactive things still typically present themselves through their interfaces as 'just' simple and effective tools that provide engaging and even pleasurable use and user experiences. At the same time, they are also key elements of larger systems built for multiple kinds of use and users that involve producing data about end users, but not for them. (Hauser et al., 2021)

The whole of the phone is only partly in our possession with the majority of its function residing within the realm of the manufacturers of the hardware and the software. While the app we use to share photographs with our parents seems to look and function the same, the manufacturer maintains the ability to completely change how it does its job and collects its data, under the hood, without any apparent difference to the user. Like a farm tractor that can change its mechanical parts at will, and make your repair tools obsolete.

These "persistent network connections…[have]...relocated the functionality" of these components and the products that they reside within (Perzanowski, 2022). With the functionality, so too has the repairability been relocated to mostly inaccessible places within the control of the manufacturer. To call back to the purpose of this paper, this is also the fundamental issue with the contestability of ADS. When a system makes a decision that needs to be contested/repaired by the user/owner, we cannot just communicate our needs to a human operator, nor can we pull out our screwdriver, open up the black box, and look for evidence of a repairable failure.

We may not, as users, individually have the lobbying power of the North American farming community in relation to the John Deere case, but there may be ways in which we can look through the lenses of both repair and contestation to design more democratic and agonistic ways to reclaim our autonomy and agency in these interactions. While compiling the kind of class-action lawsuit that is attempting to rectify the John Deere repair issues is beyond the scope of this paper, applying values of repair to the task of incorporating contestability into automated systems raises a number of possibilities and approaches to be considered.

Shared Values

In the previous section we looked at both contestability and repair as related approaches—how they have grown together in our connected environment and how repair itself has morphed from the physical into the digital and become a form of contestation. Now, to further explore this argument, we can look at some of their individual values and how they fundamentally intersect now and into their futures.

In his book *The Right To Repair* (Perzanowski, 2022), Perzanowski raises the crucial values inherent in acts of repair—"It demands analytic reasoning, strategic thinking and creativity", "helps us develop a more complete understanding of how a device operates, enriching our awareness of the world around us", and "...makes us freer, more autonomous, more in control of the world we occupy. Repair empowers us" (p. 10). He also observes how, "Successful or not, attempts at repair can teach us something. They reveal the sometimes-hidden and often-ignored mechanisms that operate just below the surface of our lives" (p. 43). Contestation can be seen to share many of these values. The fundamental acts of both contestation and repair share the same basic benefits of understanding, control, and agency over the appliances and systems which increasingly impinge upon our day-to-day lives and futures. These acts can also make up the first step in the process of surfacing and making both repair and contestability more accessible to all.

Lyons and Velloso (2021) state that "the use of algorithmic systems in decisions that significantly impact lives has also raised concerns relating to fairness and justice, human dignity, and autonomy" (p. 1) and that "the ability to contest a decision offers decision subjects some protection, allowing them to take back a little control, and to hold decision makers to account" (p. 8). They go on to highlight the importance of both accessibility ("the process needs to be clear, easy to access, and affordable") and explainability in their process and design requirements for contestability—"...[I]n order for individuals to contest an algorithm...decision-making processes should be explicable (Office of the Victorian Information Commissioner)." As with repair, accessibility gives the owner/user the ability to open up the system/box with more ease and explainability (clear schematics and flow charts) gives the owner/user a better position from which to decide on how (or if) to repair or to contest. Autonomy and agency represent stronger and broader values of both approaches, and also resonate across general human rights and minimal standards of existence and self-determination—"When we can't understand or control our devices, we cede authority to external forces" (Perzanowski, 2022, p. 41). Understanding how repair and contestation share these values allows us to start to think in other ways—familiar ways, but in different contexts.

In his 1967 guide to Marshall McLuhan (Culkin, 1967), Culkin reflected that "We shape our tools and thereafter they shape us." Important as it is that we are all represented in the shaping, or design, of our tools, it is of equal importance that we have the opportunity to repair and contest with them after they have been deployed and begin to shape us in unforeseen ways. While this relationship between repair and contestation is still being explored and defined, we can use the space to take some of the roles, approaches, and accomplishments of traditional repair and overlay them on contestation. Through this we can begin to grapple with how to approach contestation in relatable and human ways and to start to imagine a design space in which to facilitate this.

Repair Tactics for Contestation

Juxtaposing traditional forms of repair and emerging needs for contestation has not only revealed conceptual relations between the two, but importantly also pointed to new design opportunities for exploring alternative roles and relations between designers, users, and systems. In particular, the ideas discussed above suggest that there is a need to explore relationships between the designer and the user which seeks to avoid placing the responsibility for fair algorithmic decision systems entirely on either's shoulders. Instead, we might need to look for design spaces defined by agonism, questioning, and redesign. Indeed, as DiSalvo (2022) argues:

> Standard problem-solving approaches in design make it possible to treat situations in a detached manner. If a designer believes they can definitively remedy a situation or reinvent it anew, there is no need for attachment and commitment. …This is why, in the context of design experiments in civics, it is crucial to appreciate inventive problem-making as an affair that seeks audiences and vectors of

> action other than design. We, as designers, should not participate in care to legitimize and perpetuate design; we should participate in care to cultivate possibilities for communal life. (p. 169)

Beginning to explore what such design spaces might be like, we have made a series of design speculations and interventions to learn more about what kinds of designs they might afford.

Starting with a community-based tactic, we find ourselves in a repair space, which then calls for a repair person and finally a repair approach. Recognizing the importance of building community in challenging existing design systems and hegemonies, we begin with looking at the model of the Repair Café as a way to form publics around existing contestation issues—a place for people to gather, find support, share stories, and build iFixit-style libraries (Getto & Labriola, 2016) for dealing with inappropriate treatment by ADS. Within this space, we then address the need for repairers to facilitate and provide expert support to users—defining this role as the Fixer, a character (or attitude) which may be surfaced from within a broad range of non-technical backgrounds with experience in both systems and use. Finally, we look at one way the designer can facilitate a more participatory and conversational design approach, through the kind of agonism which can be seen in designing for repairability.

The Contestation Café

In many ways the Right to Repair movement reflects a very grassroots approach towards contesting big tech, capitalism, and their drive for profit over many other values—such as openness, sustainability, and accessibility to their proprietary elements. The ideal capitalist product is one that just about realizes its function and then becomes obsolete after a certain time, prompting its owner to dispose of it and purchase a replacement at regular time intervals. From a financial and/or profit perspective, this is sustainability, but from every other perspective, it is waste. The antithesis of this is a product which fulfils its role, has a robust construction, allows for repair or repurposing, and can be adapted for changes in its environment and technologies to allow for long-term ownership and use.

This tension between profitability and practicality (or producer and consumer) has been the backdrop of design since the industrial revolution set the stage for mass production—with all of its conveniences and concerns. As such, it has often faded into the background in favor of more center-stage economic events and actors, but it has always been there and regularly comes to the fore when fundamental practices must be re-examined. A recent case of this is that of the Repair Café.

The Repair Café is a self-organizing model for space where members of the public can bring their broken or damaged "clothes, furniture, electrical appliances, bicycles, crockery, appliances, toys, et cetera" (Repair Café, 2021), to be assessed by a panel of skilled repairers. Rather than a place where items are repaired for you, the café is intended to be an environment where the individual can learn to repair their own products and avail of tools, experience, and advice in these endeavors. Along with recycling and prolonging the life of products, this training and upskilling of the public feeds into the ideals of the circular economy as a "model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible" (European Parliament, 2023). Overlaying the intentions of contestation onto this model initially produces an interesting thought experiment which begins to make inroads into reality and suggests a place for participatory contestation within the community (The Contestation Café, 2022).

In a similar spirit, the Contestation Café (Collins & Redström, 2022) takes on the function of a community-based space where those who felt mistreated by algorithmic decisions bring their *broken* interactions to be cooperatively deconstructed and mapped for potential points of contestation. Within these spaces, there is also a requirement for Fixers, people with a broad range of relevant specialties (systems, design, business, legal, finance, etc.), who would provide advice, support, and the necessary tools to help the offended user to open up their particular black box, map the interior, and seek better treatment and/or justification. As with the Repairer, the Fixer would require a curious, persistent, and questioning mind, but also the cross-disciplinary knowledge of our socio-technical systems that could only exist within the networks of communities that the café would be a nexus of. Rather than Repairers, the Contestation Café has a panel of Fixers—people who inhabit the space between designers and users, with a particular knowledge of these systems and how to map and navigate them—who are there to share their experience and knowledge, and to guide the user in the ways of contestation and to become Fixers of their own futures.

Treating a problematic interaction with an ADS as a broken thing, opens it up to a more intuitive process for the user and instils ownership and agency over these previously opaque situations. This also provides a space for a more participatory relationship between the user and designer where a shared responsibility and more ethical design might emerge.

The Fixer

For every person who relishes the agency to repair and contest with their artefacts and systems, there is always another who would rather see that someone else took care of these things, for various reasons. An intermediator of sorts who belongs to neither the user's or the product's worlds, but who has experience in use, repair, and design. Someone like the local mechanic, the phone repair shop, repair café, or another character who can be the contester-on-behalf-of the user when faced with algorithmic decision systems and opaque, complicated interactions.

In his essay *Rethinking Repair* (Jackson, 2014), Jackson asks "...can repair sites and repair actors claim special insight or knowledge, by virtue of their positioning vis-à-vis the worlds of technology they engage?", and then goes on to introduce the character of the *Fixer* who might "...know and see different things—indeed, different worlds—than the better-known figures of 'designer' or 'user'". Here, we see a potential role of a repairer who sits between, and bridges, the roles of designer and user—a liaison between product and public with an activist interest in

contestability, sustainability, and a conduit for response-ability. Unlike a Maintainer, whose responsibility is to the continued function of a system, the Fixer's duty is to question the system on an ongoing basis, disrupt its function when necessary, and to also offer design alternatives in the ethical interests of all stakeholders.

Although Repairer and Fixer could be used interchangeably and both are steeped in social engineering, in the context of repair and contestation we would consider the Repairer to be the physical representative (hardware, technician) of the more digital/systems and intangible character of the Fixer. We are also using capitalization to reflect the character (*the Fixer*) rather than the act or verb (*to fix*). As a user themselves, they also represent and provide a perspective from the user's position within the system and help to facilitate participatory contestation between users, designers, and the 'broken' parts of a system. Along with legislature, the Fixer could be a presence and consideration right through the design process and on to the users' experience and rights.

This *special insight or knowledge* which Jackson refers to can be seen in the examples of the independent tractor and laptop repairers who have been at the coal-face of the Right to Repair movement. These actors, by virtue of their positioning and knowledge, have first-hand experience of how trends in reducing repairability threaten the rights, agency, and autonomy of the user. Fixers are also in a position to see and recommend where repairability is most useful and also where it may be less beneficial. As the definitions of contestability, and even the terminology around algorithmic systems, are still being defined (Henin & Le Métayer, 2021), it may be an important time to incorporate this role and other analogues of repair into our thinking around the design and applications of more-than-human systems (Stead & Coulton, 2022; Wakkary, 2021). At the very least, the extra trust around the role of repairer could provide a way through the dystopian thinking that surrounds each new technology application that rolls out, and create a focus for healthier socio-technical imaginaries.

Modularity

The previous tactics looked at how users or publics can try to meet and engage with contestation on their own terms through the lens of repair and community-based self-organization, but we have yet to look at how the designer/producer might facilitate this approach, engage with the needs of the user, and open up space for the Fixer. One possibility might be to think of the realm of use as a kind of space which supports values of repair and contestation, with affordances and handles, which opens itself to negotiation and participatory (re)design. For such a *design space* to be manageable, it would have to be simplified. Taking inspiration from previous technologies and areas which have benefited from accessibility to repair and redesign, we can think of *modularity* and *standardization* of components as two dimensions that give the repairer the ability to replace parts without having to understand the deeper workings of the device or its system. Transposing these concepts over to contestation, we can see intersections with both electronics repair and efforts at making large systems easier to diagnose and rectify by less skilled operators.

The more modular an assemblage is, the less you need to know about its deeper functions and the quicker it is to find the offending part and swap it out. In a modular architecture, if your phone stops being able to take pictures, you can assume that the camera module is faulty—and find out by changing it—without having to turn to the technical manuals and specialized tools required to diagnose faults in a monolithic design. Examples of this include the Fairphone (Waag, 2014) ethical and owner-repairable/upgradeable phone, the Framework (Framework, 2022) modular DIY laptop, and the inherent necessity of modularity in servers and server farms—a solution that cares less about the need for the technician to understand the problem, rather that they can locate and replace the offending component as quickly as possible.

A Right to Contestation motivated push for accessibility to the underlying components of ADS has the potential to open up this design space for a more agonistic relationship between designers and users–with designers being more aware of users' perspectives, and users respectful of the fine line between the openness and proprietariness of the technology. Although this examination of the benefits of modularity is only one approach towards a more agonistic space, further practical exploration of repair, the roles of the Fixer and of community contestation has the potential to surface other approaches and tactics.

Towards an Agonistic Design

An Agonistic Design approach sees solutions as something to strive towards, but never to reach. Instead of solving problems *once and for all*, literally, it celebrates the struggle and aims to facilitate the kind of conversation which is inherent to the act of repair and in designing for repairability. To define a new design space is beyond the scope of this paper, but it is an attempt to take a look at how some aspects of design have facilitated agonism, and how this might be transposed again into practical design approaches for contestation.

To clarify the concept of an agonistic design space, we can read from Miessen's conversation with Mouffe—*The Space of Agonism* (Miessen et al., 2012)—Mouffe envisages "the agonistic struggle as such: a struggle between different interpretations of shared principles, a conflictual consensus—consensus on the principles, disagreement about their interpretation" (p. 13). She clarifies further in that "a conflictual consensus suggests that we are working together towards a common aim", calling up Derrida's (2005) concept of "democracy to come" rather than the solutionism of a democracy here-and-now:

> The moment we say democracy has been realised, we pretend to be in a situation in which we can say: now perfect democracy exists. Such a democracy would cease to be pluralistic because there would no longer be any possibility for discussion or conflict. (Mouffe, p. 14)

In the same way, we can see the process of Agonistic Design as chasing a *design to come*, always moving towards a distant solution, but focusing on the conversation and its facilitation in the present. Rather than producing a solution to a perceived

problem, before the broader ramifications can be understood—letting it embed itself into society before revealing its deeper problems, while *pretending* that it has still solved the problem—we can start to design with the assumption that this will only be the start of the struggle, conversation, and conflict which takes us towards better horizons.

Jackson's (2014) *broken world thinking* concept supports this further. Viewing our designs as broken imbues them with a freedom to make themselves open to contestation and iteration, and provides inroads for agonistic interactions which encourage publics to form and engage with more confidence. This approach is especially relevant in how AI and algorithmic decision systems are being implemented and hailed as solutions for society's problems.

In recent years, we have seen examples of broken algorithmic decision systems being introduced as ways of resolving tax and benefits fraud—the aforementioned Robodebt and Dutch childcare support—to be revealed to have systemic biases and racist design features only after they have been implemented and caused harm. In the case of the Dutch Childcare Benefits scandal, the same algorithm design which had been identified as problematic resurfaced in other areas of the Netherlands and again in Denmark (Geiger et al., 2023).

Designing these systems while also acknowledging their inherent brokenness is not an admission of failure but a recognition of how these systems can never fully solve a problem and may even be a source of harm or disruption as the world changes around it, or in the ways that it is used. All of these terms which are being associated with agonism—conflict, struggle, disagreement, and even discussion and brokenness—may strike the reader as difficult or at least as adding effort and complexity to interactions, but we would argue that they are the necessary and positive attributes of a thoughtful and responsible socio-technical relationship which is very much needed if we are to thrive in this Anthropocene.

Intentionally designing for unmakeability suggests an invitation by the designer to unmake and remake their systems in a multitude of ways which can combine and recombine in an ongoing variation of ways and adapt to unpredictable circumstances.

Concluding Remarks

In reclaiming ownership over our interactions, demanding justifications from these systems, and assuming agency and contestation, we can learn from the motivations and methods of the Repairers who have gone before and are still fighting for those same values.

A constant questioning, maintenance, repair, and improvement is not something distinct from *use*, but inherent to it. Indeed, also for the benefit of society at large, and to evolve more advantageous applications of algorithmic decision systems, there is a need to not just affirm them as they are, but to continuously challenge them from the many different kinds of perspectives that people bring when encountering them. As these systems are explicitly designed around feedback loops between (re)designing and using, what interactions such feedback loops entail becomes critical for making these technologies evolve in beneficial ways. Indeed, this needs to become part of what the notion of machine learning in a wider sense actually refers to. In a sense, how the realm of systems using automated decisions evolves is a shared responsibility, with actions and interventions being necessary across the range from legal frameworks to individual decisions during use.

Looking through the lens of repair as a way to anticipate ways and points of contestation is not an absolute solution to this rapidly growing realm of problems, but it can be one way of treading a path. Having access to the right tools, knowing where the box is held together, and having the confidence to open it all up and look inside is the first step in any repair. We just need to figure out what the *tools*, *boxes*, and the *insides* are when we are dealing with the accumulated results of the data we generate, rather than the physical things we use.

Acknowledgements

This work is part of the DCODE project. The project has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No. 955990. The authors would like to thank all of the DCODE PhD cohort and supervisors for their support and conversations throughout this research project.

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