Journal of Cleaner Production 278 (2021) 123875

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

From quick fixes to repair projects: Insights from a citizen science project

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ARTICLE INFO

Article history:
Received 27 May 2020
Received in revised form
19 August 2020
Accepted 20 August 2020

Handling Editor: Cecilia Maria Villas Bôas de Almeida

Keywords:
Repair
Citizen science
Product lifetime
Sustainable consumption

ABSTRACT

Repair initiatives have attracted increasing attention as a potential source for addressing a variety of sustainability challenges. Less evident are social scientific analysis about people repairing objects at home. This paper aims to provide insights into how people, who come together to fix objects in repair initiatives perform domestic repair. It does this by drawing upon works within sociological theories of consumption and media studies that concern themselves with examining the performance of everyday routines and how people adapt, integrate, use and/or reject objects in everyday life. Empirical data derived from a citizen science project reveals several phases of repairing objects at home and restorative acts connected to them: quick fixes, routine fixes, serious fixes, and repair projects. The paper highlights the importance of people's competences, feeling of self-efficacy and everyday routines when it comes to carrying out domestic repair. More broadly, the paper shows how the integration of (repaired) objects into people's daily routines is part of ongoing processes where the valuation of repaired objects and performances of repair play a key role in influencing the useful life of objects.

1. Introduction

The current linear systems of production and consumption are unsustainable. The necessity of extending objects' useful life in industrialized societies is widely recognized as it makes better use of existing natural resources and creates less waste (e.g. Bakker et al., 2014). Addressing the lifetimes of objects is important for a circular economy, resource efficiency, waste reduction, and low-carbon strategies for sustainability. Within these debates, the call for the 'right to repair' has become ever louder, arguing that people should be empowered by giving them more possibilities to repair their objects at home instead of discarding them (e.g. Dewberry et al., 2016). The maintenance and repair of objects throughout their lifetime are acts that extend their useful life and contribute to a slower rate of consumption. Rather than considering consumption to stop at the point of acquisition, an examination of repair in everyday life points to the domestication of objects (e.g. Haddon, 2011) i.e. how they are acquired, integrated, used and/or rejected in people's homes.

Repair initiatives (e.g. Repair Cafés[1]) have experienced a significant upswing in many industrialized countries in recent years (e.g. Keiller and Charter, 2014; Graziano and Trogal, 2017). A growing number of people fix their own objects through visiting monthly repair meetings in their neighbourhood. Within these initiatives, repairing and making is perceived as an emancipatory act where people claim their right to repair things, since – as the Repair Manifesto teaches us – 'if you can't fix it, you don't own it'.[2] The initiatives are involved in a variety of practices that go beyond fixing and making objects to include experiments in principled ideas of object's useful life, circular economy and collaborative consumption (e.g. Dewberry et al., 2016; Isenhour and Reno, 2019). Initiatives enable repair of goods, whilst culturally engaging in repair is argued to cultivate post-consumerist values through stronger associations with the repaired objects (Rosner, 2013; Ratto and Boler, 2014).

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https://doi.org/10.1016/j.jclepro.2020.123875
0959-6526/

[1] A Repair Café is a space where people regularly come together to collaboratively repair household electrical and mechanical devices, bike, clothes and other household items. Repair Cafés are located in neighborhoods. They are often held at a fixed location and organized by volunteer repairers.

[2] https://d1ulmmr4d4i8j4.cloudfront.net/static/images/manifesto/ifixit_self-repair_manifesto_11x17.pdf.

Social scientific analyses of repair initiatives have started to emerge where repair is considered to be a collaborative act (e.g. Houston et al., 2016); however, less evident within these studies are questions relating to repairing objects at home (Gregson et al., 2009). A small group of research scholars concerned with the sociology of repair (e.g. Henke, 2000; Martinez, 2017; Jackson, 2019) have investigated repair, maintenance and ridding activities at home (e.g. Gregson, 2007, Gregson et al., 2009; Bix, 2009; Carr, 2017). In this paper, we draw on literature concerned with the performance of everyday practices (e.g. Maller, 2015) and the domestication of everyday technologies (e.g. Haddon, 2011) to go beyond early moments of acquisition of objects in people's homes and interrogate moments of repair. Building particularly on the work of Gregson et al. (2009) the paper draws attention to several phases of repair: diagnosing, fixing and integrating (or ridding) objects that show how objects are part of recurring processes of adoption, use and integration.

In order to contribute further to the sociology of repair and link it to research on sustainable consumption in everyday life, the paper addresses the following research questions: What forms of repair work is performed at home and how are these performances linked to notions of prolonging the useful life of objects?

With these research questions in mind, the analysis draws on empirical evidence grounded within a citizen science research project on repair that brought together academic researchers, practitioners from repair network organisations, and regular visitors and fixers from Repair Cafés.

In the following, we briefly position the paper in the existing research on repair work at home before we present the conceptual framing of the research project. Then, we outline our methodological approach, drawing on citizen science research. This is then built on in the next section to detail the empirical findings, providing insights into repairing objects at home. Finally, we discuss the relevance of examining repair in everyday life and offer concluding reflections on its links to prolonging the useful life of objects.

2. Background and conceptual framing: Researching repair in daily life

Before we turn to the conceptual framing of the paper, we review some of the existing literature on repair to position our work. For a long time, maintenance and repair activities "have been neglected by nearly all commentators as somehow beneath their notice" (Graham and Thrift, 2007:1). Jackson (2014:227) has similarly argued that "maintenance and repair constitute crucial but vastly understudied sites", pointing towards the often "productivist bias" when scholars have studied production and consumption cycles. Moments of repair and ridding are as common in everyday life as instances of production and acquisition and therefore deserve further investigation (Gregson et al., 2009). Even studies that look at the uptake and use of objects (e.g. Haddon, 2011) frequently examine early encounters of people interacting with objects in their homes rather than paying attention to maintenance, repair and ridding (Gregson, 2007; Jackson, 2014).

Growing academic and policy interests into creating circular economies and more sustainable consumption patterns have led to increased investigations into reuse and repair (e.g. Wieser and Tröger, 2018). As part of this work, some researchers have stressed to move away from purely instrumental understandings of repair e.g. as ways to fix broken objects to reduce waste (e.g. Rosner, 2014). In particular, researchers concerned with the sociology of repair have highlighted the skills, emotions and sensual knowledge involved in these activities (Dant, 2010), encompassing "creative, innovative and reconstituting capability and sensibility" (Spring and Araujo, 2017:20). Repair does not only entail fixing an object i.e. restore them back to their old condition but also improvisation and innovation (Graham and Thrift, 2007) and care and emotional labor (Houston, 2019). Moreover, researchers have drawn attention to the cultural and social values attached to repair, questioning existing social, political, technological, and economic relations (e.g. Jackson and Kang, 2014; Graziano and Trogal, 2017), for example, critiquing design and manufacturing practices that do not regularly allow for objects to be repaired. McLaren (2018:136) has pushed this argument further, assigning a central role to the "ethics of repair". He sees repair as a process by which humans engage with the past and future, by reconstructing and restoring their environments (or objects within them) to their original purpose or by reconciliating or reconfigurating materials to new purposes.

Similarly, Gregson et al. (2009:248) have identified several "restorative acts" related to repair at homes: a) quick-fix mask, b) restoration, and c) refabrication, highlighting how domestic repair goes along with both an object's devaluation and revaluation. For example, the quick-fix mask means that an object is repaired but not fully returned to its previous condition (e.g. aesthetics and function). For Gregson et al. (2009:248) the quick-fix mask can be "socially problematic" as it can be "signaling the devaluation of objects". Such devaluation might not occur if people restore objects to their previous pristine state i.e. repair as restoration. Refabrication can actually increase the value of objects. Here, objects are not just restored but also improved; for example, a new, expensive material is used to fix the object or a different technique. As also pointed out by Graham and Thrift (2007:6), repair "does not have to mean exact restoration", drawing attention to notions of "improvement, innovation, and even growth" that can be linked to acts of repair.

In addition to drawing attention to the restorative and creative dimensions of repair, some of the literature has interrogated notions of care (Houston, 2019) and emotional attachment (Chapman, 2005; Errázuriz, 2019) through investigating repair activities. Repairing objects cannot be fully understood without embedding it into the socio-material conduct of everyday life, including daily routines. Normative and emotional activities are enacted through repair that can be experienced as being empowering but also these activities can be inherently fragile and vulnerable. Errázuriz (2019:56) has described repair of objects as "commitment in action" that generates a close relation between people and objects and can lead to long-lasting relationships. According to him, repair works as a strategy to conserve the value and affirm the function of objects within people's homes. Everyday care also implies recognising objects' fragility i.e. being in a state of functioning but also submitted to increasing wear and tear.

The fragility of objects can lead to repair and ridding activities, influencing the useful life of objects in people's homes. Moreover, the "physical failure and deterioration" in objects "have implications for actualizing practices, disrupting and intervening habitualized ways of doing particular activities" at home (Gregson et al., 2009:250). For example, a puncture in one's bike no longer allows people to cycle to work. Objects need to be replaced or repaired to be able to continue to perform daily practices (e.g. cycling to work). Repaired (and functioning) objects ensure that daily practices can be performed and therefore is "central to the stability and order of particular homes" (Gregson et al., 2009:268). Our research builds on the sociology of repair (mainly the work by Gregson et al. (2009)) through investigating repair activities in people's homes. It allows us to examine the different "restorative acts" in relation to people's differing engagements with repair. We particularly focus on how repair sits within the domestication of objects and performance of daily practices in people's homes.

We take procedural perspective on repair and assume that the performance involved in repair stretches across phases of diagnosing, opening up and fixing objects. Such performances entail physical demands and mental abilities, including working out whether something can no longer be used and how it could potentially be fixed. People often draw on shared ideas and meanings surrounding whether an object is no longer functioning (or not), worth fixing (or not) and/or safe to use after it has been repaired. Whilst performing these practices, people make use of a variety of tools and competences, such as screwdrivers and rags to be able to open up and/or fix objects. They also experience several emotions such as feeling disappointment with the no longer functioning objects and/or anxious about breaking the object even more during the fixing process.

For the purpose of this paper, we conceive repair as being performed in everyday life. Looking at these performances has aided the process of examining them empirically; still, they have not necessarily allowed an understanding of how objects are taken up and used and, in particular, whether repaired objects are reintegrated into people's daily routines. This reintegration is integral to prolonging an object's useful life. Some of the research within media studies has interrogated people's interactions with objects; for example, the domestication approach is grounded in examining the adoption of technologies in everyday life (e.g. Silverstone et al., 1992). Influenced by Norwegian researchers, the approach was increasingly linked to concepts derived from the social shaping of technology literature (Sorensen, 1994; Lie and Sorensen, 1996). Researchers were interested in examining how people make sense of objects, asking questions such as how they experience objects and how do people make use of objects to perform daily routines (for a review, see Haddon, 2011). The co-shaping of objects and people was frequently the focus of these studies, examining how the shaping process continued once objects were used and why and how they "emerge in the form they do" (Haddon, 2011:312).

Domestication commonly refers to the incorporation of objects into daily routines, transforming "unfamiliar, exciting, and possible threatening things" (Oudshoorn and Pinch, 2005:14) into familiar ones. Sorensen et al. (2000) have argued four dimensions that make up the domestication approach when investigating the uptake of objects in daily life. Such dimensions are part of a "[m]ulti-dynamic process in which the artefact must be acquired (that is, bought or made accessible in some other way), placed (that is, put in physical space as well as in mental space), interpreted (in the sense that it is given meaning within the household or the local context, and given symbolic value to the outside world), and integrated into social practices of action" (Laegran, 2005:82). Such an approach attempts to move away from the idea of a passive consumer and aims to examine what happens when objects are consumed at home (Sorensen, 1994). Here, the incorporation of technologies is considered to be part of a dual process where objects can redefine existing routines and daily life activities shape these objects over time (Oudshoorn and Pinch, 2005).

Thus, in addition to considering the literature on the sociology of repair, we draw on sociological theories of consumption and media studies that concern themselves with the performance of daily practices and ways people use, adapt, integrate and/or reject objects at home to better understand the performance of repair and the domestication of broken/to be repaired/repaired objects. In the next section, we outline the methodological approach of the research: citizen science research.

3. Research methodology

The findings presented in the paper are drawn from a citizen science research study into repair. Citizen science has been described as the involvement of people in science processes, who are not institutionally bound to a field of academic science (Richter et al., 2016). Frequently, citizen science approaches have been grounded in collective data collection activities rather than co-designing research projects' aims, methods and analyses with citizens (Dickel and Franzen, 2016). The aim of our research study was to collaboratively collect data and analyse it with people derived from repair communities (i.e. visitors and members of Repair Cafés and Makerspaces) to be able to collectively examine experiences, competences and knowledge related to repair in everyday life. The research team consisted of thirty-eight citizen scientists, four academic scientists and four practitioners (who work with repair and making initiatives).

Our citizen science research was grounded in a mix of three methodological approaches that drew on a 1) cultural probe methodology[3] (e.g. Gaver, 1999), 2) eight participatory research workshops in repair and making workshops, and 3) seventeen follow-up in-depth interviews with some of the citizen scientists. In doing so, it draws on the principle of triangulation which postulates that valid findings can only be brought forward by a combination of different methodological approaches that systematically cater for the shortcomings of the respective other method (Flick et al., 2004). The project started with an open call for participating in the research that was distributed through several mailing lists and conversations with local organizers, members and visitors linked to repair and making networks. The recruitment process was mainly organized by the four practitioners in the research team. The team made use of a self-selection sample strategy within the repair and maker community where anyone was able to participate in the project. Thirty-two citizen scientists expressed an interest and took part in the research at four Repair Cafés and Makerspaces across Germany between March 2018 and September 2019. The sample of citizen scientist was diverse in age, socio-economic background, roles taken in the initiatives (including frequency and amount of visits) and repair skills.

Data collection and analysis for the project drew on the cultural probe methodology (e.g. Gaver, 1999). Probes are designed, creative tasks that make up a pack of probes (e.g. maps to complete, thoughts to be recorded, diaries to be kept, and/or cards to fill in), which is sent to participants in the research (see Fig. 1, depicting the project's pack of probes). Participants engage with and work on these tasks in their own time over a period of time before sending them back. The idea is that the researcher can get to know people's everyday lives, experiences and emotions in creative ways (Gaver et al., 2004). Our aim was to appropriate the method for citizen science research. Instead of inspiring the academic researchers, the cultural probes were re-designed so that the citizen scientists could engage in a "study of the self" (Rapport, 2007:257) as well as a means to enable a co-production of knowledge between citizen and academic scientists. First, we co-developed sixteen creative tasks with the citizen scientists during workshops that were integrated into our introspection pack (see Fig. 1). Second, the citizen and academic scientists lived and worked on the introspection pack for around three months (see annex 1 for a list of the introspection tasks). Third, we came back together in participatory data analysis workshops to collaboratively develop some research findings, and finally, we created an exhibition about repair in which some of the

[3] Cultural probe were developed by a design group led by Bill Gaver as part of an EU funded project in 1999 to be able to engage with people and their everyday life through a design research process in an empathic way (in particular where designers/researchers are unable to immerse themselves in these everyday life settings). Since then, cultural probes have been used and adapted for design and social science research.

Fig. 1. Our pack with tasks send to the citizen scientists.

findings have been shown to the public (see Table 1, for an overview of the research process).

The data collected from the introspection packs consisted of drawings, object stories, photographs, different types of written documents (e.g. diaries and narratives), small handcrafted items, and transcripts from workshops and interviews. Some of the tasks in the introspection pack had a more experimental dimension e.g. writing an obituary for one of their objects that had been recently thrown away. These tasks were aimed to encourage the citizen scientists to reflect upon their repair activities and objects at home in a new light. Other tasks required less interpretive work and enabled more informational data to be collected e.g. keeping a repair diary. Fig. 2 shows an example of one of the creative tasks.

Two consecutive participatory research workshops were conducted in four locations (in total eight workshops). The first workshops were conducted prior to sending out introspection packs. The aims were to introduce the project, discuss its aims and co-develop the method for collecting data about repair and making. The second workshop took part after the data-gathering phase as part of qualitative group analysis. Citizen and academic scientists created groups that looked across the collected data to review and explore it, develop themes, and sometimes derive at initial research findings. Additionally, unstructured, face-to-face-interviews were conducted with individual citizen scientists, who wanted to continue with the analysis. After the workshops, some of the citizen scientist felts like they wanted to continue the analysis process of

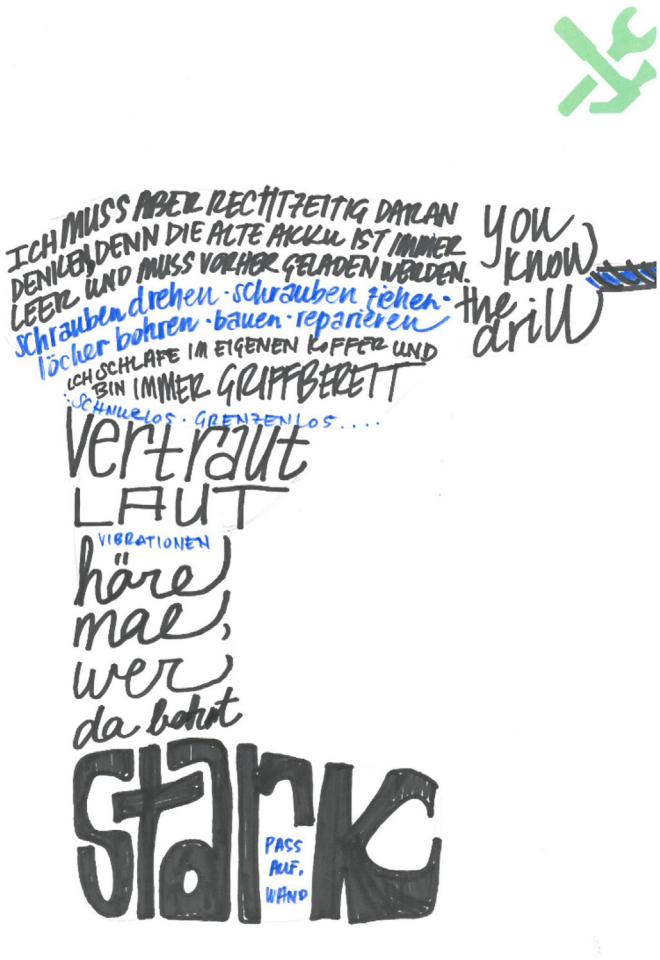

Fig. 2. Task: Draw and tell a story about your favorite tool.

their own introspection pack. The interviews allowed the academic and citizen scientist to delve more deeply into the data that had been produced, collected and analysed by the citizen scientists.

The workshops and in-depth interviews provided the main themes for the analysis that is comparable to the phase of open coding in the grounded theory methodology (Corbin and Strauss, 2014). The grounded theory methodology offers an approach for the systematic collection and analysis of primarily qualitative data

Table 1
Outline of the research process.

	Research process and activities	Data collected and type of analysis conducted
1	Participatory research workshops between citizen scientists, practitioners and academic scientist to introduce and further co-develop the methodological approach, for example, creating the tasks in the introspection pack	Personal stories and narratives around repair Tasks within the introspection pack
2	Self-observations and diary keeping through citizen scientists, practitioners and academic scientist living with and working on the tasks in the introspection pack	Qualitative accounts of repair in daily life through working with the tasks within the introspection pack
3	Participatory data analysis workshops between citizen scientists, practitioners and academic scientist where the collected data was presented and collaboratively analysed	Collective, comparative qualitative analysis of accounts in the introspection pack, developing hypothesis and research findings on performances of repair
4	Bilateral exchange based on unstructured interviews between academic scientists and individual citizen scientist about their introspection pack	Qualitative data on repair in daily life through in-depth interviews
5	Open, Inductive and deductive coding of all of the qualitative data collected by academic scientists	Qualitative, thematic analysis
6	Summary of results for different audiences	Physical and virtual exhibitions, practitioner reports and academic papers

with the aim of generating theory. It is not a single method, but a series of interlocking and iterative phases. It usually starts with a phase of open and inductive coding where interpretation, codes and categories are developed very close to the empirical material. The initial findings were deepened and further elaborated as part of several analytical steps conducted by the academic scientists. These steps included, for instance, the use of concepts from the existing literature on repair to meaningfully structure the heterogeneous data that had been collected (e.g. pictures, diagrams and stories). The insights presented in the paper are results derived from inductive and deductive coding of the research materials. They are presented in the next section.

4. Empirical findings

This section makes use of the empirical data on repair in people's homes derived from the citizen science project. First, we interrogate the different phases of repair, looking particularly at diagnosing (i.e. establishing that an object is in need of repair and identifying the defect), fixing (i.e. making time to look at the defect and repair the object), and integrating (i.e. integrating objects back into people's daily routines) objects. Drawing on the domestication literature, we are able to show how the adoption and use of objects in daily life is not finite but rather part of recurring processes. The integration of (repaired) objects into people's daily life is key to prolong an object's useful life. Second, we identify and examine different "restorative acts" (Gregson et al., 2009:248) that emerge through interrogating several repair activities in everyday life. These are quick fixes, routine fixes, serious fixes, and repair projects. The aim of this section is to better understand how the different restorative acts relate to people's existing repair competences, daily life routines and readiness to integrate the repaired object back into daily life.

4.1. Diagnosing, fixing and integrating objects at home

4.1.1. Diagnosing objects

During the research process, it became apparent that repair activities often start way before people make their way to a toolbox. There are several daily activities in which people order (e.g. clothing in wardrobe), clean (e.g. surfaces on coffee machine), and use (e.g. cycle to work) objects. They provide moments in which objects get implicitly or explicitly pre-diagnosed i.e. assessing the aesthetics and functions of an object. The defect might make itself visible. The hole in the jeans has become too big to wear it. The broken handle of the frying pan makes cooking with it difficult. The tap in the garden has started to leak. These are only a few descriptions from the fieldwork but they start to illustrate how objects are *moved (rather than placed)* and *re-interpreted* (see *domestication dimensions*) from being able to use them as part of people's daily routine to making it more and more difficult to do so. As argued by Gregson et al. (2009:250), "objects are continually becoming in the course of their lives in the domestic. They are, then, neither finished nor inviolable forms at the point of production and acquisition". In the process, the value of the object can change from being functional to no longer being able to use it, increasing the likelihood people getting rid of the object. As highlighted by citizen scientist A.

"I had looked at my bike panniers. They had increasingly deteriorated due to the weather. They're not that old but I had left them outside on the bike in every type of weather. Where the pannier is attached to the bike, holes have formed on the edges. And then I thought, all right, I have to take them off and fix them" (citizen scientist A).

Our findings have shown that people often try to lengthen the time between diagnosing and fixing the object through quick fixes to be able to continue their daily routines. Not all objects break and then no longer can be used. Innovative ways to lengthen this time were identified during the workshops (e.g. using safety pins for holes in clothes). One of the citizen scientists called a safety pin his favorite tool. It seems that people live with quite a few quick fixes i.e. half fixes and half working objects around them. Until the point of intolerability is reached or there is a bit of spare time to fix the object or even have it fixed.

"I also do a lot of half fixes where I do something because I can still use it [object] but I have not actually repaired it. A quick solution … I do not have the time to properly repair it and just do it half-heartedly until it becomes so bad that I have to repair it" (citizen scientist B).

What becomes apparent is that phases of pre-diagnosing, diagnosing and fixing are somehow fluid. Jeans can be worn until holes become too big and people feel so irritated that they do something about it. Scanners/printers are just used for scanning if they no longer allow us to print something. A touch screen of a smartphone can still be used even if it has cracked (see Fig. 3). What it means to use the object and its use-value gets *re-interpreted* whilst at the same time trying to keep it *integrated* in daily practices as long as possible.

Some of our objects get pre-diagnosed more regularly than others, depending on where they have been *placed* in the home. For instance, jeans get worn, washed and folded into the wardrobe. They are rotated through our homes and are regularly inspected. Other objects, such as, garden taps that have a more seasonal use get diagnosed far less often. The domestication of objects into people's homes does not seem to be a finite process. Objects that are in need of repair show that different domestication phases (i.e. placed (moved), interpreted and integrated) are re-enacted over time and influence the object's lifetime.

4.1.2. Fixing objects

Collaboratively analyzing the tasks during the participatory research workshops, it quickly became apparent that fixing objects sometimes is an integral part of people's daily lives. People

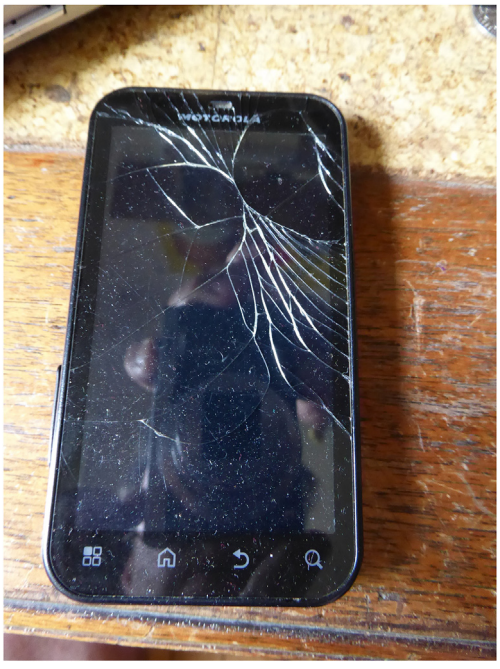

Fig. 3. Citizen scientist C's current smartphone.

Fig. 4. Example of citizen scientist's repair calendar.

regularly conduct routine fixes (such as sewing ripped trousers, gluing the soles of a shoe, and repairing a bike puncture). Keeping a monthly repair diary, citizen scientists were surprised how many objects they fix on a regular basis (see Fig. 4, showing a repair calendar where the red stars = objects that broke on the day, green stars = objects that have been repaired on the day, and yellow stars = objects that have been maintained on the day). One of the citizen scientists argued.

"For a lot of people, there seems to be a smooth transition into repair … they start with one thing, e.g. you learn to adjust bicycle brakes, stick the sole back on your shoe or drill a hole into the wall and then, something else comes along that you fix … I think these life hacks are small steps into repairing objects" (citizen scientist D).

Although people fix objects, they do not necessarily consider these as repairs. Fixing objects often needs to be perceived as disrupting daily routines, for instance, requiring specific tools or taking time to be considered repair. For instance, citizen scientists debated about what types of tools are used to repair objects rather than enabling other types of domestic work.

"A pair of scissors can also be considered to be a tool to repair objects. I do not consider it to be a tool … for me … a tool is something different like a screwdriver … I wouldn't think of manual work [e.g. sewing a button on a shirt] when it comes to tools. Let's put it this way, as a craftsman, if you tell me 'bring a tool box' then I would never bring along a sewing box" (citizen scientist E).

Other routine fixes can consist of exchanging parts that are broken or missing, for instance, replacing a broken washer from the water sprinkler or changing a light bulb. These fixes depend on people getting or having the necessary spare part. People, who regularly repair objects, have a slight advantage (see Fig. 5). They often have collections of spare parts at home and do not have the additional trip to the shop before fixing the object, drawing attention to the tools and spaces needed to do repair. It seems that the placement, interpretation and integration of objects within routine fixes somehow are fluid. People have existing tools in the home to fix objects (e.g. needle and thread) and have the competence to repair them. Moreover, spare parts are kept in the home (e.g. light bulbs) and people have existing places where they keep the object in need of repair (e.g. next to the washing machine) so that the fixing activities become part of people's daily routines.

Diagnosing can take time and even start to overlap with fixing. For example, the hobs on the electric oven can no longer be turned on. The oven needs to be opened up and specialist tools can help to identify the potential electrical problem. Most of the citizen scientists, who were regular fixers in Repair Cafés talked about ways to trace the diagnosing/fixing process. They take pictures of each step and draw, for instance, electrical circuits to be able to identify the defect but also put the object back together once it has been repaired. Objects that need to be opened up can be "disrupting and intervening habitualized ways of doing particular activities" (Gregson et al., 2009:250). For example, food can no longer be cooked. Objects can no longer be integrated into people's routines, increasingly the likelihood of them losing their place in the home. These fixes can take days because people might need to buy the part and often require persistence, effort and competences as highlighted by citizen scientist F's story.

"The tablet could no longer be charged. At the store, a sales assistant told me that I would not be able to get a replacement for the charger and therefore need to buy a new tablet. I could not believe it. I went home and looked up whether I could find a replacement charger on the Internet. A few days later, it arrived through the post. After charging the tablet, I realized the battery would no longer properly charge. I found a video that showed me how to repair it. I prepared the kitchen table and actually repaired the tablet" (citizen scientist F).

Such serious fixes can often take several days and sometimes costs people a lot of blood and sweat, diagnosing and fixing start to overlap, specialist tools might be required and spare parts might need to be bought. For some of the citizen scientists, diagnosing objects started from an early age. "You are so destructive. You always destroy things that I have bought", this is what citizen scientist H's mother used to say to him when he was curious about

Fig. 5. Citizen scientist G's bench to repair objects and store spare parts.

how the radio looked like from the inside. Other citizen scientists who are regular fixers in Repair Cafés went through some formal training, stressing the need for competences (e.g. Gregson et al., 2009; Dant, 2010) to be able to *interpret* the object to be not broken beyond of repair and consider it 'normal' and not feel anxious to open it up and look for the defect. As argued by Dant (2010:103), "repair work … often develops in unpredictable ways" requiring a wide range of gestures, tools and competences and also emotional engagement. Self-efficacy has been a recurring theme for the citizen scientists, where the active engagement with objects is linked to pursuits of one's own capabilities.

Quick, routine and serious fixes can also turn into repair projects. Citizen scientist I (a highly skilled amateur repairer) has a collection of computer parts and power tools in his room that have not been functioning when he *acquired* them. Now, they are being fixed in stages. Most of them have become projects because rather than being *integrated* into his daily routines (e.g. working on the laptop), he likes to fix these objects, creating their own regular activities (i.e. tinkering with objects). Often he tries to fix one of the objects and after a while gets stuck because he runs into a fixing issue that he cannot solve. He puts the object to the side and tries it again a few days later. Sometimes one object becomes a spare part for another. It is this swapping of parts and rhythm of getting stuck and solving a problem that he enjoys. Graham and Thrift (2007:5) have suggested, "when things break down, new solutions may be invented".

These types of repair projects do not necessarily need to derive out of serious fixes. Some of the citizen scientists documented quick fixes that seem to have taken a life of their own. Deteriorating bars of a drying rack were either soldered back on or replaced by clotheslines, including some skillful knotting over long periods of time (see Fig. 6). Jeans were stitched up with patches and yarn several times to keep them alive for years. As argued by Gregson et al. (2009:267), such "refabrication" of an object can move it from "being an ordinary consumer object … to becoming a higher value object". These objects become repair projects that consist of regular cycles of fixing and using them i.e. tinkering with the object becomes as integral to people's daily life as using it.

Fig. 6. A drying rack that has become a repair project.

4.1.3. Integrating and ridding objects

After the fixing phase, objects can potentially be *integrated* into people's daily routines (such as a fixed bike puncture allowing the person to cycle to work again). It becomes again an integral part of keeping daily practices alive. Such integrations are not necessarily a given and people sometimes get rid of recently repaired/unrepaired objects. Citizen scientist J talked about an old typewriter that he had recently fixed.

"I could make a lot of small adjustments to improve the typewriter. I find it exciting to make these adjustments. But once I have repaired it, I don't know what to do with it. It would probably stand around and catch dust … I just enjoy seeing whether I can fix it" (citizen scientist J).

One of the citizen scientists argued that people sometimes have their objects fixed in Repair Café and rather than taking them back home, offer them for free to the organizers. They would say that they had already bought a replacement. Here, the need of the object to be able to perform daily routines often is greater than waiting for the object to be fixed. Rather than waiting for their broken hoover to be fixed, people sometimes buy new ones to continue their weekly hovering routines. One of the citizen scientists explained that people would not necessarily be unhappy if their object could not be fixed in the Repair Café. People were glad to know that someone with repair skills tried to fix it but also failed. As argued by citizen scientist K.

"I often see that most people are still thankful that someone else has taken the time to fix their object. Even if it is not fixed, they can dispose of it with a good conscience" (citizen scientist K).

Some of the citizen scientists regularly pre-diagnose and *acquire* objects that have been left on the street and auctioned on the Internet. These objects have therefore never been integrated into their daily lives. One example is citizen scientist I, who regularly auctions objects in need of repair for a small price in order to fix them. He has collections of computer parts and power tools that have been waiting to be repaired. Similarly, citizen scientist L has recently found a broken ladder on the street. He fell in love with it; it looked somehow "Italian" for him. Some objects in need of repair are newcomers to someone's home. Once the object is fixed, new practices need to be developed so that the object can be integrated into people's daily lives. In citizen scientist L's case, the ladder (even after fixing it) was too dangerous to be used by others. The example demonstrates that some objects do not really fully get repaired. Some functions might be recovered but not all. Although the loss of function might be considered to be a devaluation of the object, it does not necessarily mean that people get rid of it. People can alternate the use of the object and its functions and/or make use of it as spare parts for another object in need of repair.

Along the described phases of repair, we have identified different acts of repair: quick fix, routine fix, serious repair and repair project. Within the literature on the sociology of repair some similar acts of repair have already been identified (Gregson et al., 2009). Still, our findings can advance some of the analytical work surrounding these acts of repair. We discuss similarities and differences between the existing work on repair and our findings in the next section.

4.2. From quick fix to repair projects: Restorative acts in everyday life

Gregson et al. (2009) have identified two distinctive modes of domestic repair: 1) quick-fix mask and 2) refabrication. Quick-fix masks are activities of repair that do not fully restore the object to its original function, aesthetic and purpose. Refrabrication not only restores the object to its original condition but also transforms it through making use of novel materials and developing additional purposes (Gregson et al., 2009). Gregson et al. (2009:267) have also shown how objects, "move between value regimes within the home; as a means to both devaluation as well as revaluation". Our findings draw attention to similar restorative acts i.e. quick fix and repair project. As part of our work, two additional acts have been identified: routine fix and serious fix. This section examines these restorative acts in more detail with the aim to better understand how they are linked to people's competences and existing daily routines and valuations of objects as part of these processes (see Table 2). Moreover, reflections are provided on the re-integration of repaired objects into people's daily life as it is considered to be a key element to prolong the useful life of objects.

4.2.1. Routine fixes and serious fixes: Restorative acts

Repair used to be an inherent part of daily life in pre-industrial households, nowadays these activities have fallen into the background often due to the mass availability of objects. Nevertheless, our findings have shown that there are various forms of repair people still conduct but they seem to be somehow hidden in people's daily routines and have become routine fixes. As shown in section 5.1, routine fixes can also be invisible for the actors themselves. As argued by Campbell (2005:26) people are not mere "dupes", who purchase "quantities of aethetically uninspiring standardized products" but they put work into domesticating and maintaining these objects at home. Campbell (2005:23) has outlined the concept of "craft consumption" and describes it as an "activity in which individuals not merely exercise control over the consumption process, but also use skill, knowledge, judgment, love and passion to their consuming". Repair as craft consumption draws attention to existing everyday work that goes into repairing and maintaining objects in everyday life.

Serious fixes make apparent the amount of skills and competences that can go into fixing objects at home. Rather than being part of people's daily routines, such repairs disrupt people's daily lives as the repair takes time, resources and competences. Our findings show that such competences are often linked to years of tinkering with objects and/or formal training programs. Dant (2010:1) has argued "the work of repair takes ingenuity in identifying the problem and then a wide range of skills and tools to make the object useable again". Our findings have also shown that in addition to competences, nerves, a fearlessness and literally blood and sweat go into repair work. Citizen scientists have talked about a perseverance to stick to a repair job that does not go well and bravery to just open objects that others would not look into. As highlighted by Dant (2010:3), "the work of repair does require a complex repertoire of gestures, a variable and responsive emotional tone, and a developed capacity for gathering knowledge of particular objects through all the senses". Through sometimes dismantling of objects, people can gain knowledge about them. This knowledge might not be enough to be able to repair the object but can create a material closeness to the object and its associated production process.

Investigating the defect within a broken object draws attention to people not purely using objects in daily life but rather taking a more active consumption role. The quasi-scientific approaches of creating drawings during serious fixes to better understand the object seems to put into question existing knowledge productions (e.g. what should be industry and common knowledge). This is not to say that these activities are necessarily acts of empowerment. It rather shows that the idea of a passive consumer, even when conducting inconspicuous everyday routines is being challenged. Moreover, objects can show a kind of resistance to be opened up, making it hard to fix them because the producer has, for instance, glued components together. Getting to know the inner life of objects has therefore got the potential of people starting to question how they are made and some producers impede domestic repair processes.

4.2.2. Quick fixes and repair projects: Transformative acts

Gregson et al. (2009) has argued that quick fix masks can be socially problematic because this type of restorative act devalues the repaired object. The trace of damage to the object cannot be fully erased, increasing the likelihood of it being thrown away. Our findings have shown that devaluation of objects within quick fixes

Table 2
Acts of domestic repair.

	Acts of repair	Competences	Routine live	Valuation of objects
Quick fix	Easy diagnosis as defects are often visible. Diagnosis, fix and integration processes are often fluid.	No need for specialized repair competences.	Often carried out to be able to keep daily routines going for as long as possible.	There is a likely devaluation of objects (unless it develops into a repair project).
Routine fix	Diagnosis, fix and integration are often part of everyday life. These fixing activities are regularly part of cleaning and maintenance routines.	Some specialized repair competences that have become part of daily routines.	Fixes often are part of daily routines and therefore have minor influence on the performance of daily routines.	Object keeps its value as it is being restored to its original condition.
Serious fix	Diagnosis and fix are often part of one process, as defects might not be visible and objects need to be opened up. The fixing process is often structured by specific procedures (e.g. taking pictures). Specialized tools and spare parts are often needed.	Several repair competences are needed for these fixes. In addition, trust in one's own abilities that often derive from early socialization processes.	The repair process influences the actualization of daily routines and therefore disrupts people's daily life.	The valuation of the object can depend on the outcome of the repair: Devaluation if it cannot be fixed and keeping its value if it is restored. Revaluation is possible if an object becomes a spare part for another 'broken' item. Repair activity can become a repair project.
Repair projects	The fixing process can often differ. The repair process sometimes becomes more important than actually fixing the object.	Mix of repair competences needed, depending on the repair project. In addition to repair competences, creative thinking and time to engage in longer repair projects is required.	Performances linked to fixing the object often become equally important as fixing the object to be able to perform daily routines. Disruptions are minor.	Objects are likely to become higher value items over time. This value creation is often not only linked to restorative acts but also creative ones.

is not necessarily a given. The citizen scientists made use of the quick fixes to prolong the use of the quick fixed object before finding some time to fully repair it. For example, objects were taped together until a replacement part was bought to fully restore it. Other quick fixes can also turn into repair projects (see Fig. 6, drying rack). These repair projects do not necessarily require specialized competences but rather a willingness to engage with objects. Spring and Araujo (2017:19,20) have argued "for a much richer notion of repair, one that encompasses a widespread, creative, innovative and reconstituting capability and sensibility, rather than a narrowly delineated process of restoring a given object". Here, repair is more than an object-related activity to restore functionality. Rather, it is also perceived as a form of empathic turning towards the world.

As part of repair projects, engagements with objects and performances linked to repair can become equally important as fixing the object back to its previous aesthetic and functions. It is not just about having a repaired object at the end but also the engagements with the object themselves are meaningful. During this process new functions for the object and associated value can be discovered. As argued by Houston (2016:1411), people who repair it see it "as a form of valuing in and of itself". Working on the objects enables the material experience of one's own effectiveness and contributes to a multidimensional understanding of values and experiences linked to repair. Such values lie in people experiencing a sense of self-efficacy rather than purely in the revaluation and devaluations of objects when repairing them (as argued by Gregson et al., 2009).

Examining the activities of fixing collectives, Houston et al. (2016:1404) have made a case for reorienting "how we think about values, from static achievement or fixed set of affordances … towards a more fluid and emergent model that treats value as an active ongoing process". The linear value creation logic i.e. considering values as universal properties that assign the highest value to the finished and unused object is refuted by the fact that repair work on the object is rendered valuable by the citizen scientists. As part of these processes, objects are given personal value because of the energy, sweat and work that goes into fixing them. Repairs are not only seen as restoring the previous functionality of an object but also carrying out care and emotional work (Houston et al., 2016) and redefining its function at the same time. It is important to point out that not everyone will get as much meaning from fixing objects and feel up to the demands of creativity and perseverance. Still, the citizen scientists point to an empirical understanding of values in repair and linked objects that goes beyond the devaluation and revaluation of objects over time. Considering the valuation of objects as part of an ongoing process that is influenced by people using and engaging with them, has potentially wider sustainability significance, in particular, when thinking about the useful life of objects.

Wider sustainability implications become apparent through the empirical findings of this paper. The repairs of objects throughout their lifetime are acts that extend their useful life and contribute to a slower rate of consumption. Although serious repairs are no longer as widely practiced in daily life, what becomes apparent is that people still spend time to care for their objects at home in the form of more 'hidden' repair and maintenance work. This work is often connected to emotional engagements with the object that can be enhanced through 'getting' to know its inner life through repair activities. Rather than considering consumption to stop at the point of acquisition, an examination of repair in everyday life points to different consumption practices linked to objects and their lifetime such as caring, storing, keeping, opening up, and re-integrating. This paper contributes to creating a better understanding of these practices connected to object's lifetimes and sustainable consumption practices.

5. Conclusions

This paper examined the performance of repair at home and how people adapt, integrate, use and/or reject objects in everyday life, drawing on the sociology of repair literature. Our empirical findings have shown that repair activities often follow particular phases, starting with the phase of pre-diagnosing/diagnosing the object in need of repair, followed by the fixing process that is not always straightforward, and finally, if the fixing process was more

or less successful, the re-integration of the object in everyday life. Different restorative acts become visible when examining these phases that draw attention to several acts of repair at home. These are quick fixes, routine fixes, serious fixes, and repair projects. These acts of domestic repair and associated processes of valuation and integration of objects might be of interest to scholars working on repair and the useful life of objects for several reasons.

First, examining in particular quick fixes and repair projects, our findings have shown that the performances of repair work can become equally important as restoring the object's functions. These findings substantiate Houston et al.'s (2016:1411) argument that people who repair objects consider the act of repairing as a form of value "in and of itself". Working on the objects enables the material experience of one's own effectiveness and contributes to a multi-dimensional understanding and experience of value linked to repair. Self-efficacy has been a recurring theme during our fieldwork where the active engagement with objects is linked to pursuits of people's own creative project. Although devaluation and revaluation of objects within acts of repair are important to consider (as argued by Gregson et al., 2009), our findings have shown that the performances of repair work can become equally important as fixing the object's functions. Rather than objects as part of quick fixes being considered to be socially problematic, they can become part of repair projects where the fixing process is an integral part of the revaluation of the object. The value of the fixing process prolongs the useful life of the object. To make use of this finding within the work of Repair Cafés, a possible recommendation would be to draw as much attention to the repair process as to its outcomes when communicating about the workshops. This could be done by making the repair process prominent in the final outcomes of repair work i.e. through visible mending techniques (Maycroft, 2015).

Second, examining routines fixes and quick fixes, our analysis has shown that people fix quite a few objects in their daily life. These acts of repair are not necessarily considered to be a repair job because they are considered to fall under routine maintenance activities. It might be possible to suggest that these activities currently feel somehow hidden. These might not be serious fixes but they still require time, resources and care. In terms of recommendations for repair communities, notions of repair might need to be broadened to encourage closer links between routine fixes and serious fixes. It might be hard to imagine everyday life settings within current industrialized countries, where large numbers of people start to engage in serious fixes, practicing and learning the necessary competences to prolong the useful life of their objects at home. Nevertheless, increasing the visibility of routine fixes can serve as an entry point for people to take up serious repair. Through engaging, opening up and dismantling objects, people can gain knowledge about them. This knowledge might not be enough to be able to repair the object but rather draw attention to existing unsustainable production and consumption practices that frequently impede people to repair objects (McCollough, 2009).

Third, our empirical findings have shown that research studies concerned with the prolonging of an object's useful life need to look beyond individual moments of production and acquisition. Jackson (2014:227) has argued that "maintenance and repair constitute crucial but vastly understudied sites", pointing towards the often "productivist bias" when scholars have studied production and consumption cycles. We would argue that the interrelations between these moments are as important to understand than different acts of repair. Drawing on the domestication approach, we have shown how the adoption and integration of objects in daily life is not finite but rather a recurring process. The integration of fixed objects in people's everyday life is not always a given but a key aspect when examining how to prolong the useful life of objects. Studies have started to emerge that try to better understand ridding and keeping practices related to objects in people's homes (Gregson et al., 2009; Woodward and Greasley, 2015), our findings show that integration processes linked to repair deserve further attention in future studies of sustainable consumption.

Considering that the citizen scientists were made up of visitors and repairers derived from existing making and repairing communities, it might be questionable to assume that many people will feel up to the demands of time, creativity and perseverance associated with domestic repair. Still, citizen science projects, such as this one, can open up discussions about how repair at home and within community workshops embody new ways of thinking about and acting upon sustainable consumption issues. The acts of repair – from quick fixes to repair projects – demonstrate that alternative narratives and practices of care, self-efficacy and valuations of objects exist. These practices and narratives do their part in re-imagining existing linear systems of consumption and production. This re-imagining of linear systems point towards the need for further work on repair, in particular, explorations concerned with studying the wider transformative potentials of repair. This work might also need to build an understanding of how existing production patterns impede and/or enable domestic repair. The limitations of this research include that the data analysis for this paper mainly focused on repair at home rather than studying the interrelations between visiting a Repair Café and/or Makerspaces and repairing objects. Future work could study these interrelations to build a better understanding of how visiting a workshop influences (or not) people's repair activities at home, potentially creating more sustainable consumption patterns through creating less waste.

CRediT authorship contribution statement

Sabine Hielscher: The paper is based on collaborative work between the two authors. **Melanie Jaeger-Erben:** The paper is based on collaborative work between the two authors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The research presented here is part of the transdisciplinary citizen science project "REPARA/KUL/TUR" [cultures of repair] and the junior research group "OHA – Obsolescence as a challenge for sustainability". REPARA/KUL/TUR runs from September 2017 to December 2020 and is funded by the Federal Ministry of Education and Research as part of the Citizens Research funding area. The interdisciplinary researcher group OHA is funded from 2016 to 2021 by the Federal Ministry of Education and Research within the framework of the Research for Sustainability programme.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2020.123875.

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