Reconfiguring repair: Contested politics and values of repair challenge instrumental discourses found in circular economies literature

Duncan McLaren[a,*], Johan Niskanen[b], Jonas Anshelm[b]

[a] *Lancaster Environment Centre, Lancaster UK, and Department of Thematic Studies, Linköping University, Sweden*
[b] *Department of Thematic Studies, Linköping University, Sweden*

A B S T R A C T

The treatment of ideas of repair in circular economy literature is critically reviewed, revealing instrumental understandings of repair as a tool to extend product life-spans and reduce waste. These framings are interpreted as an expression of the dominant technocratic and post-political discourses of circular economy as an intervention to sustain industrial capitalism in the face of sustainability constraints. The review contrasts these understandings of repair derived from a review of circular economy literature with richer and contested interpretations found in sociological, ethnographic and political literatures examining material repair in practice. Drawing on the emerging sociology of repair and applying more distinct concepts of restoration, remediation, reconfiguration and reconciliation derived from these literatures, the paper argues that the understandings of repair in circular economy literature are limited and restrictive, generally supporting a view of repair as sustaining, consumerist and nostalgic; and thereby overlooking potentially transformative, political and future-oriented roles for repair in a circular economy. In the restorative and remedial modes most commonly understood in the circular economy, repair is seen to enable new forms of capitalist commodification, notably of waste and domestic labour. Learning from contestation in other arenas of repair by contrast, understanding repair as encompassing ideas for reconciliation and reconfiguration, and adopting values of integrity, care and legibility, opens up repair in the circular economy to constructive critical discussion and reflection and offers new insights for policy makers.

Introduction

Repair of products has become an increasingly important element of waste and resource management policies in many countries. For instance in EU policy on waste and circular economy, repair - along with reuse of products - is prioritized over recycling or waste-to-energy as a waste management and prevention method (European Commission, 2019; European Parliament and Council, 2008; European Parliament and Council, 2012). A circular economy (CE) is typically understood as a normatively desirable deployment of a series of tools to close material loops in economic activities, thus reducing waste, pollution and resource consumption (EMF, 2019; Webster, 2017). The literature on circular economies is expanding rapidly, but there has been little critical attention to the role of repair (indeed relatively little attention at all). This review seeks to fill that gap. We ask 'how is repair understood in circular economy narratives' and 'what cultural and political implications might arise from different framings and understandings', drawing on cultural political economy

(Tyfield, 2012; Jessop, 2004) which understands socio-technical systems as coproducing and reconfiguring social and political regimes (and vice versa).

As an inner loop in circular economies, repair ideally extends product life-spans and reduces new product purchases (Webster, 2017). It is understood as motivated by consumer savings (avoided expenditure on new products), and sustainability values (avoiding waste). In market-based government interventions, typically endorsed by businesses, such as tax incentives for repair, repair is seen as an instrument of 'green growth' (Savini, 2019).

This dominant instrumental vision of repair will be shown to be located within a broadly technocratic and post-political vision of a CE. In other words, the issue is seen as one which can and should be managed using technological expertise, rather than as a socially or politically contested practice (Valenzuela and Böhm, 2017; Niskanen et al., 2020). Despite the broadly normative stance taken by CE advocates, our review examines the extent to which the problems of linear economies are presented as technical matters of resource flows

---

and environmental impacts from waste, rather than as issues of social injustice arising in the impacts of industrial and consumer society, expressed through practices such as resource extractivism, land-grabbing, and labour exploitation.

In this review we explore the extent to which such an instrumental and technocratic view of repair (found in circular economy literature) diverges from that in other academic literatures examining repair and maintenance (of material objects and infrastructures), which, as one of us has previously demonstrated (McLaren, 2018), suggest a broad diversity of intentions, motivations and values. We aim to put the narrow instrumental understanding of repair into dialogue with these richer framings and insights from sociological, ethnographic and political studies of material repair in practice, so as to both enhance CE policy and practice, and contribute theoretically to the sociology of repair. This is done through a critical review of broader CE discourses to understand how they might embrace or be challenged by alternate conceptions and narratives of repair. We particularly consider whether the application of 'repair ethics' to CE practices might transform or 're-configure' rather than sustain or 'restore' industrial society.

By introducing the contestation of meanings and norms revealed by the sociology of repair we hope to offer a richer understanding of repair to CE policy makers, academics and practitioners which could help them deliver both fair and just environmental and social goals. We argue that, depending on context and approach, repair might be a future liberating force, but that it can also act to sustain unjust social relations.

In the next section we present the methodology and the material used, before analyzing repair narratives in the CE literature. We then introduce a broader understanding of repair contrasting 'reconstruction' (or restoration); 'remediation'; 'reconciliation' and 'reconfiguration' as distinct forms of repair (a categorization based on Sennett (2012) and McLaren (2018)), and outline key debates in the broader literature on repair. We subsequently transpose this political and cultural contestation of repair to the CE arena, and finally conclude with some thoughts on a possible reconfiguration of repair in the dominant instrumental CE narratives.

Section 1: CE and repair

A search of Scopus and Web of Science using the terms 'Circular Economy' and 'Repair' returned 208 items using these terms in the title, abstract or keywords After eliminating duplicates and erroneous hits, 119 items remained. These are listed and categorised in the Supplementary material, and summarised in Table 1. We undertook a literature review to establish a consistent foundation for our analysis of circular economy narratives around repair. In subsequent steps we will supplement this with interviews and deliberative workshops. Here we present findings based on the literature review only.

The use of Scopus and Web of Science in parallel provided a broad sample of scholarly research on the topic. While Google Scholar may have identified a bigger sample of social science or business material, particularly in the form of books or book chapters, the lack of an abstract and keyword search facility in Google Scholar made it unsuitable for our purposes. The search terms were chosen because the 'Circular Economy' is a widely used term and keyword, distinguishing this literature. And the term 'repair' is commonplace in CE definitions (Kirchherr et al., 2017), widely used by proponents (Webster, 2017), and in government policies, and has even spawned an activist movement (the right-to-repair movement: https://www.ifixit.com/Right-to-Repair/Intro). Repair is thus a key concept through which CE narratives might be understood. The abstracts, and where necessary, the full texts, of the papers were read to identify those treating in more depth on repair, and to categorise them as set out below.

This review process ensured that the papers considered here are illustrative of the main narratives of repair in CE literature. Narrative analysis focuses on the ways people make and use stories (and other

Table. 1
Summary of 'CE and Repair' material reviewed

Total items	119 publications
Most frequent journals publishing	Journal of Cleaner Production (15 articles)
	Resources, Conservation and Recycling (10)
	Sustainability (10)
	Procedia CIRP (International Academy for Production Engineering) (5)
	Journal of Industrial Ecology (3)
Location of study (where specified)	EU (11 cases)
	Netherlands (6)
	China (5)
	Sweden (5)
	Denmark (3)
	Latvia (2)
	Italy (2)
	Portugal (2)
	United Kingdom (2)
	USA (2)
	Russia (2)
	Australia, Austria, Spain, Germany, Belgium, India, New Zealand (1 each)
Sector / product focus (where specified)	Electrical/electronics (27) including …
	ICT (14), including …
	Smartphones (8)
	Clothing/fashion (4)
	Additive manufacturing (3)
	Civil engineering/transit (2)
	Medical devices (2)
	Chemicals, Education, Household durables, Flooring, Food, Luxury goods, Plastics, Power plants, Pulp and Paper, PV modules, Shipbuilding, Steel, Windows (all 1 each)
Methods (where specified)	Reviews (including systematic and bibliometric) (16)
	Proposals (for metrics, taxonomies etc) (13)
	Modelling (12)
	Case studies (12)
	Interviews (of consumers, businesses etc) (11)
	Life-cycle or Material Flow analysis (10)
	Survey (9)
	Legal or policy analysis (9)
	Business model analysis (6)
	Data analysis (of pre-existing data) (5)
	Experimental (3)
	Deliberative workshops (1)
Significance of repair to aim of paper	Central (a main topic) (12)
	Significant (necessary to the analysis) (29)
	Incidental (peripheral or mentioned only in passing) (78)
Definition/conception	Repair as one tool for circular economy (112) including …
	Repair as an inner loop in the circular economy (15)
	Other/unspecified (7)
Motivation/purpose (of repair)	Repair described in instrumental terms (75) including …
	Repair specifically as a means of product life extension (20)
	Repair as means of adding value in CE (18)
	Repair described as motivated partly or wholly by non-instrumental values such as identity or social connection (16)
	Unclear/unspecified or not relevant to paper aims (28)

narratives such as excuses, myths, reasons for doing and not doing) to organize our experience and interpret the world (Bruner, 1991). Narratives therefore place objects and activities into a purposeful or consequential framework. We use narrative as a term here to highlight the meaning, role and purpose attributed to an activity (such as repair) by those talking or writing about it. In categorizing the articles we have

therefore paid close attention to the purposes attributed to repair, whether explicitly, or through context. To understand narratives about repair in relation to other circular economy narratives, it is important to consider papers in which repair is presented incidentally, as well as those in which it features significantly. Our data set includes 78 items in which the treatment of repair is incidental, and 41 in which it is significant (29) or even central (12) to the aims of the paper.

The literature was mainly published in journals focused on resources, clean production and sustainability (see Table 1). However, the set also includes journals from management, marketing, engineering and law, providing a broad overview of treatments of the topic. It is notable, however, that the circular economy literature identified here does not particularly extend into sociological, ethnographic or science and technology studies journals. Even though there are articles in such journals on other aspects of the circular economy (e.g. Hobson and Lynch, 2016; Gregson et al., 2015; van den Berg et al., 2020), these rarely focus on repair.

The earliest paper returned was from 2010, and numbers increase year on year to 47 in 2019. The geographic and sectoral spread of papers is broad (see Table 1). The overwhelming majority of these papers (112) mention repair as one tool or contributor to a circular economy (confirming Kalmykova et al. (2018) characterization of repair and maintenance as one amongst 45 circular economy strategies). Many do so only in passing, as a tool for waste reduction, alongside reuse and recycling: this 3R triptych (reduce/reuse/recycle) is typical of definitions of the circular economy (Kirchherr et al., 2017; Reike et al., 2018). Some consider variants on a 3R model, including 5R (Yan et al., 2011), 6R (Ci, 2010), 9R (Fassio and Minotti, 2019) and Re-X (Sihvonen and Ritola, 2015), but few focus on repair specifically. A small minority (15) of the papers we reviewed highlight that repair constitutes one of the inner loops of a circular economy (e.g. Nussholz, 2017; Milios, 2018): the paucity of such mentions emphasizes the value in Reike et al. (2018) suggestion that contemporary circular economy advocacy should focus more closely on such – currently poorly-closed – inner loops. Our focus on repair means that our searches may not have captured all papers focused on remanufacturing or refurbishment (which are in some respects close proxies for repair, though not normally undertaken by the end user or owner of the product, and distinctive in terms of tax, logistics and product standards (Liu et al., 2016)). However the sample does include several papers focused on remanufacture (Jansson, 2016; Migliore et al., 2020; Dominish et al., 2018; Sinha et al., 2016; Liu et al., 2016).

In the literature reviewed here, there is a huge predominance of implicit instrumental understandings of repair, as *a tool primarily deployed to extend the useful residence time of resources in the economy*. Our categorisation exercise identified such an understanding in more than four-fifths of all the papers we could categorise (including those mentioning remanufacturing as well as those mentioning repair). This understanding is typically described in terms of extending product life, increasing resource efficiency, or preventing waste. In a circular economy, waste and environmental impact is reduced through the application of 'science' and 'systems' thinking (Webster, 2017). Ideally, by repairing products instead of replacing them, both waste and resource extraction can be reduced (e.g. EMF, 2019; Milios, 2018; Ludeke-Freund et al., 2019). Only a small minority of papers (we counted 16) suggest or even hint at potentially non-instrumental motivations for repair, such as stimulating creativity, attachment or solidarity (Spring and Araujo, 2017; Mendoza et al., 2019; Mugge, 2017; Dermody et al., 2020; Hobson, 2019). Some such papers make particular reference to venues such as repair cafes, and makerspaces (Williams et al., 2017; Prendeville et al., 2016; Ghisellini et al., 2016) which feature more heavily in sociological and ethnographic literatures on repair (as we shall see below). Very rarely, authors bring cultural or emotional considerations to the centre, typically divorcing repair from consumer behaviour: Dermody et al. (2020) explore worldviews and identity factors in self-repairers, while Hobson (2019) suggests that

repair behaviours can reconfigure "everyday material relations from one of use and disposal to one of care and stewardship" (p12).

More typically, even repair-centred papers presume a rational consumer influenced by cost and convenience, and thus focus on obstacles to repair such as lack of information, expense, restrictive warranties and poor design (Flipsen et al., 2016; Hernandez et al., 2020; Milios, 2018; Tecchio et al., 2019; Pozo Arcos et al., 2018; Peiro et al., 2017; Singh et al., 2019). Others examine technological means to enable repair, such as modularity (e.g. Nissen et al., 2017) or additive manufacturing (e.g. Leino et al., 2016; Sauerwein et al., 2019), without ever questioning the purpose or desirability of repair. Some papers focus more closely on consumers (Mugge, 2017; Ackermann et al., 2018; Wieser and Troger, 2018; Cherry and Pidgeon, 2018; Diddi and Yan, 2019) exploring their emotional attachment to products, their willingness to repair, or their reactions to product-service systems, through focus groups, surveys or interviews. These analyses remain largely instrumental in the sense that consumer involvement in repair is taken as an assumed good, motivated by the economic savings from extended product life. But there are some who raise questions about potential mismatches between consumer and public values and motivations, and the circular offerings of businesses (e.g. Wieser and Troger, 2018; Stal and Jansson, 2017; Cherry and Pidgeon, 2018; Hobson, 2019).

Around a half of the papers reviewed concern a specific sector (see Table 1) and around a third address business models for circularity (e.g. Ludeke-Freund et al., 2019; Nussholz, 2017), in particular, product-service systems (e.g. Yang et al., 2018; Cherry and Pidgeon, 2018; Stal and Jansson, 2017) and 'gap-exploiting' (creating new businesses undertaking repair activities) (e.g. Riisgaard et al., 2016; Whalen et al., 2018); or relevant principles for such businesses, notably design for repair or for disassembly (e.g. Iacovidou et al., 2019; Vanegas et al., 2018; Peiro et al., 2017). Again, like the papers focused on consumers, these focused on business take an instrumental view of repair as a tool for helping deliver circular business objectives and profitability. Product service systems particularly are often suggested without consideration of the potential cultural or social implications of the associated changes in ownership (Kaddoura et al., 2019; Poppelaars et al., 2018; Tsanakas et al., 2020). In contrast, despite focusing on economic opportunity and business models, a cluster of papers examining local repair and reuse operations also begins to raise questions about cultural and relational aspects of repair. For example, Riisgaard et al. (2016) and Türkeli et al. (2019) highlight features of mobile phones which increase consumer demand for local repair, not just the cost of replacement, but sunk investments in set-up and customisation, and requirements for swift and confidential repair. Steuer (2016) reveals the relationship between electronics repair and domestic sources of waste in China, contrasting this with the recycling of imported waste.

Methodologically, the sample is diverse (see Table 1), with many case studies, interviews and surveys – all of which could, in theory, have documented or revealed values and motivations (but either did not do so, or did not report on such matters). There were also multiple papers involving modelling, numerical Life-Cycle or Material Flow Analysis, and analysis of – or proposals for – legal, policy or business models.

There are a few noteworthy exceptions to the instrumental framing. Repair is sometimes seen as regeneration (Egle et al., 2015; Diez et al., 2016) or even a generative process of innovation (Spring and Araujo, 2017). Egle et al. (2015) present 'repair' as something being done to the resource cycle (rather than to the product), in the case of phosphorus recycling and water treatment. This reflects a subcurrent in circular economy literature which understands renewable resource *regeneration* as part of the challenge – but typically without connecting it to *repair*. As part of a biological material cycle, the EMF (2019) presents regeneration of natural systems as the outcome of valorized (composted) organic wastes returned to land, which returns minerals and nutrients to food and fibre production, while reducing waste going to

incineration and landfill. But repair is considered separately by the EMF as part of a technical material cycle.

Another common theme in the broader circular economy literature is about potential employment benefits (Cambridge Econometrics et al., 2018; Webster, 2017). Somewhat unusually, Diez et al (2016) present maintenance as central to the necessary skill-base for a circular economy as a whole, in a 'paradigm of regeneration'; and repair as a critical contribution to (social and economic – not ecological) re-generation. More typically, repair features only as one – typically low-skill – opportunity for job creation. Burger et al (2019) present re-newable energy, repair, re-use of materials and the sharing economy as key sectors for CE employment. Repair is considered a manual and technological low-skill occupation in service of preservation and ex-tension of the life of resources, exemplified through the installation, maintenance and repair of computers. Burger et al anticipate repair jobs to increase in number to maintain circular economy operations, but do not assess the social or personal implications of such a shift in demand. For the European Commission, the circular economy is expected to give "a new boost to jobs" with CE activities from 2015 to 2018 putting the EU "back on a path of job creation" (COM/2019/190:1) but repair activities are not singled out. More widely, the circular economy is typically defined in ways that highlight goals of economic prosperity, and to a lesser extent environmental quality, rather than social equity (Kirchherr et al., 2017).

In line with the dominant instrumental framing described above, Spring and Araujo (2017) carefully analyse repair as a 'loop-closing' tool of 'restoration' for sustainability. But they also "*argue for a much richer notion of repair, one that encompasses a widespread, creative, in-novative and reconstituting capability and sensibility, rather than a nar-rowly-delineated process of restoring a given object to a certain specification in the context of a dyadic relationship between manufacturer and user*" (p.133). Their suggestion that repair could be generative of innovation and new opportunities not only reflects the insights of ethnographic studies of repair we refer to in Section 2 below, but also echoes Sennett (2012) understanding of repair as 'reconfiguration' (see also Fig. 1).

Broader visions of the role of repair are therefore not unknown in the circular economy literature, but remain very much subordinate to the instrumental understandings of repair as a tool to extend product lifespans.

There is, however, a subtext pervading the literature, that the linear economy itself is broken, and that the closing of loops and the creation of a circular economy is an act of repair. As Ellen MacArthur puts it "*to move on from the dysfunctional linear economy model requires ... a co-herent framework ... The circular economy provides this*" MacArthur (2012). This understanding was present as much in precursors of cir-cular economy thinking such as industrial ecology and sustainable product design (Stahel, 1982; Cooper, 1999; Braungart and McDonough, 2002; Reike et al., 2018; Nakajima et al., 2019) as in contemporary expressions. Amongst CE proponents there are also

exceptions who conceptualize repair as mending human-nature rela-tions, involving means such as soil restoration: "*Humanity is now called upon to revive the soils and restore the basis of human survival through a new [circular] system of production, nurturing, and caring*" (Nabudere, 2013:14). However, such views rarely appear as an explicit inter-pretation, leaving deep ambiguity over the extent to which the appli-cation of circular principles might *sustain* (restore) or *transform* (re-configure) society.

Despite rhetoric regarding the transformative potential of circular economy approaches as a tool to promote environmental sustainability, the dominant social and economic narratives of the circular economy are technocratic and post-political (Valenzuela and Böhm, 2017; Niskanen et al., 2020). In the advocacy of the EMF, and its adoption by leading businesses the circular economy suggest new business models and government interventions to reshape incentives and markets which would enable and sustain the continuation of both industrial consumer society, and of economic growth (with potential material and emissions rebounds) (Ghisellini et al., 2016; Makov and Font Vivanco, 2018; Gregson et al., 2015). Moreover, in seeking to reshape regulations and incentives, corporations are not only reducing their dependency on resource supply chains, but also sustaining or expanding their power over labour and consumers in new circular business models, an ex-pression of resilient capital (Niskanen et al., 2020). By contrast the circular economy tends to sideline arguments which suggest a social transformation – involving an end to consumerism, a transformation of the relations of work, or an end to material growth, for example – would be needed to deliver sustainability (Isenhour and Reno, 2019; Graziano and Trogal, 2017; Valenzuela and Böhm, 2017; Jackson, 2009; Hickel and Kallis, 2019).

In the next section we review how repair is treated in other litera-tures, revealing its political and cultural broadness and the extent to which its impacts and potentials are actively contested in ways in which they are not within the hegemonic understandings of the circular economy.

Section 2: Political and cultural contestation of repair

Here we turn from the circular economy *per se* to consider narratives from literatures more focused on repair. To identify broader under-standings of the repair concept we reviewed a range of academic dis-ciplines where repair has long histories. Here we extend and modify a categorization of repair concepts based on Sennett (2012) and McLaren (2018). This is a sophisticated methodology focusing on identifying qualitatively different understandings of repair (in a broad sense) rather than presenting a comprehensive literature review. Sear-ches were conducted using the Web of Science data base but the word repair is too commonly used (in the sense of 'fixing something') for a quantitative analysis to be relevant. Instead a qualitative review of results from searches for repair, reconstruction, restoration,

	Past-oriented (purpose similar)	Future-oriented (purpose different)
Sustaining (materials the same)	**Reconstruction/ Restoration**	**Reconciliation**
Transforming (material different)	**Remediation**	**Reconfiguration**

Fig. 1. A categorization of forms of repair

reconciliation and reconfiguration was supplemented with a snowballing methodology applied to the bibliographies of the most relevant sources (notably: Jackson, 2014; Jackson, 2019; Henke, 2000; Henke, 2019; Martínez, 2017; Martinez, 2019; Graham and Thrift, 2007; Sennett, 2012; Sormani et al., 2019). Through this we identified around 60 peer reviewed articles elaborating a conceptual focus on repair that we judged potentially relevant to the circular economy. This was not intended to represent an exhaustive or systematic review of the use of the repair concept in social science research, but rather a reasonable illustrative sample of the field (we therefore do not provide a categorised table summarising this literature). Different researchers using the same methodology might therefore reasonably identify other distinct understandings of the repair concept. However, this limitation reinforces, rather than weakens, our main argument that repair in the circular economy has so far been understood in a too narrow a manner.

In contrast to the CE literature engaging with repair, these articles, mostly published since 2007, are typically found in anthropology, ethnography, sociology and STS journals (or edited collections within these fields). They primarily cover experience with repair and maintenance of artefacts and infrastructures directly relevant to circular economies, including clothes, bicycles, transit networks, mobile phones, buildings and medical devices, but extend also to repairs of communities, relationships and ecosystems. They explore such activities in domestic, commercial, professional and non-profit settings (such as maker-spaces and repair cafes), often with a focus on the participants and their diverse identities. The methodological approaches reported a predominantly ethnographic, observational fieldwork and theoretical sociological analysis of practices and discourses, drawing on ethics and philosophy; and also commonly on interviews, and case studies.

Perhaps unsurprisingly, with multiple disciplinary approaches, and the still developing nature of the topic, this literature reveals diverse and contested narratives and framings. Some of these debates reflect narratives occasionally surfacing in the CE literature, but mostly they represent a much richer, and sociologically thicker consideration of repair and its implications. In part this is a simple reflection of disciplinary approaches and paradigms, yet it has important implications for the development of policy, where the scientific and technical literature reviewed earlier is more influential. Here we highlight and seek to broadly categorise some of the central repeated themes of contestation in the repair literature. In this literature 'repair' and 'maintenance' are sometimes distinguished, although they remain closely related and both are encompassed by the meanings of repair in CE settings. We include literature considering 'infrastructures' as well as products not least because circular economies can themselves be understood as infrastructures – of waste management, and resource supply.

The emerging sociology of repair (Henke, 2000; Sennett, 2012; Martínez, 2017), centres on the ways in which repair and maintenance not only engage with material artefacts, but with social and political values and systems. Here therefore, we consider three key dimensions of repair contestation: is repair a sustaining or transforming process; is the temporal focus of repair backward- or forward-looking and the activity of repair personal or political? Of course, these are not simple dualisms, but posing the questions in this way helps us identify deeper implications of repair beyond the instrumental narrative in CE. Our intent is to illustrate critical dimensions of contestation, which reinforce the sense that concepts and norms of repair have more to offer to CE policy and practice than just the instrumental benefit of extending a resource cycle. And, in line with the ways in which these debates are presented in the repair literature, we aim to present decisions about repair as choices in how to engage with (and in some cases, transcend) these binary questions. In this understanding, repair is not some abstract objective process, the outcomes of which scholars might seek to apprehend and describe, but a way of acting on the world which co-creates cultural values, social and economic relations and material outcomes.

Drawing on Sennett (2012) and McLaren (2018) we seek to particularly contrast 'reconstruction' (or 'restoration'); 'remediation'; 'reconciliation' and 'reconfiguration' as distinct forms of repair (Fig. 1).

Reconstruction (or *restoration*) is repair which focuses on returning its subject to its original functioning and purpose, using traditional materials to achieve an authentic appearance. We suggest this embodies a temporal orientation to the past, and a sustaining motivation. *Remediation* retains a focus on original purpose, but relaxes conditions on material and appearance, potentially thereby improving functioning. Remediation retains an orientation to the past but permits a motivation of transformation. *Reconciliation* on the other hand deploys original materials or components to a new end, focused on repairing the social relationships involved. It is future oriented, yet typically sustaining in motivation. Finally, *reconfiguration* might involve both new materials and novel purposes, and thus has the greatest potential to be both transforming and future oriented. It is important to note that these categories do not necessarily carry a normative weight. Reconfiguration might be desirable in some circumstances, but reconstruction might be the ethically preferable option in others. Similarly, political stances such as conservative or progressive might map on to these in many circumstances, but not all.

Sustaining or transforming?

Scholars of repair largely agree that repair is necessarily relational, and directly as well as indirectly affects social relations and identities as much as it has material consequences (Henke, 2000; Sormani et al., 2019; Sennett, 2012; Rosner, 2014). With this realization comes a question of how any given repair affects social relations. Is repair normalizing and reinforcing the status quo or is it disruptive and reconfiguring? And in the latter case, does it generate more socially equal relations?

As Henke demonstrates in a series of ethnographic studies (Henke, 2000; 2017; 2019), repair practices involve activities located within social and institutional relations, and are essential to the maintenance of existing patterns of social relations (Schubert, 2019; Carr, 2017). Yet repair practices can also reconstitute or disrupt power hierarchies and social orders both within the workplace and beyond it (Graham and Thrift, 2007; Gregson et al., 2009; Jackson, 2014; Jacobs and Cairns, 2012). At the grand scale, maintenance of infrastructures is critical to dominant political regimes (Ureta, 2014; Jackson, 2019; Graham and Thrift, 2007; Jacobs and Cairns, 2012). Ureta highlights how "*Understood as normalization, repair practices can be seen not only as contributing to the long-term survival of a system but also as a key strategy for the maintenance of power, … However, failures make [infrastructures] visible … opening the black box of infrastructural power to possible questionings and/or transformations by actors who might feel disenfranchised from it*" (Ureta, 2014:371).

Repair and maintenance may alternatively challenge technocratic models of progress and growth, especially if made visible (Ureta, 2014; Broto and Bulkeley, 2013; Jackson, 2014; Zwier et al., 2015), providing '*a vital source of variation, improvisation and innovation*' (Graham and Thrift, 2007: 6). Repair ethnographers (Henke, 2019; Sormani et al., 2019; Denis and Pontille, 2019; Dant, 2019) highlight the indeterminacy in situations of breakdown, which therefore demands improvisation and innovation in response, with a commensurate demand for high skill levels, in contrast to those recognized in the CE literature (Burger et al., 2019). The indeterminacy inherent in breakdown further creates situations ripe with opportunity (Sormani et al., 2019) and opens up possibilities for questioning the suitability of existing arrangements. This is arguably one reason why repair directed at sustaining existing social relations is so often kept invisible.

Notably the kinds of innovation pointed to by repair scholars are typically those of grassroots (Seyfang and Smith, 2007) or jugaad style (Prabhu and Jain, 2015), improvised, and focused on immediate needs, not the disruptive innovations of Silicon Valley (in its quest to 'move

fast and break things'). The latter might be disruptive and future-oriented, but still profoundly sustaining of the overall social order, in the same vein as Schumpeter's profit-oriented creative destruction (Schumpeter, 1950), and the shock doctrine described by Klein (2007).

The general point here is that repair is understood as situated, contextual and relational, and its outcomes are not simply determined. Rather they demand reflection and debate if repair is not to be co-opted into sustaining inequality.

Personal or political?

Ethnographic studies of repair tend to focus on individual practitioners yet highlight collective venues such as workplaces and repair cafes. Such studies raise important questions about the motivations and modalities of repair. Is repair a rational individual consumer action, or a form of collective political resistance to consumerism? The 'Right to Repair' movement bridges this space, mobilizing collectively to defend individual interests. But repair cafes and maker-spaces offer collective, shared responses, which contrast in this respect with producer responsibility approaches which mediate repair through a corporate-consumer relationship (Graziano and Trogal, 2017).

While product service systems as corporate offerings are one way in which repair can be depoliticized, equally depoliticizing is a narrative in which repair becomes a personal responsibility as part of a 'sustainable consumer' lifestyle (Middleton, 2014). Thus even the promotion of repair cafes and other community level expressions of repair may remove the idea from the arena of political contestation. However, both lifestyle and community repair activities can alternatively be linked to an explicit collective or counter-cultural politics of repair (Shaw, 2018; Graziano and Trogal, 2017; Jackson and Kang, 2014; Podkalicka and Potts, 2013; Dewberry et al., 2016; Luke and Kaika, 2019; Middleton, 2014; Schwenkel, 2015; Shareable, 2018).

This tension is fought out in the various ways that fashion and habitus are constructed as social signifiers. Repair and reuse can be seen as elements of an emerging eco-consumer habitus (Carfagna et al., 2014; Podkalicka and Potts, 2013; Appelgren, 2019), available to well-off, middle-classes, and closely paralleled by processes of urban gentrification in which the localized repair and renovation of property or of local public services is accompanied by profound social exclusion (Lees, 2008; Luke and Kaika, 2019). Repair is sometimes invoked by the term 'reuse' as the former often facilitates the latter, but in a CE context they often refer to different practices (for example, tailors undertaking repairs as against second-hand clothing stores enabling reuse). Repair can be part of gentrifying consumer habitus or a political activity, for instance, undertaken by squatters rather than as an investment by property owners (Martinez, 2014). Such tensions are also seen in debate over the intersection of reuse and repair with fashion.

In some ways repair can be an expression of fashion, a new short-term preference, which, regardless of motivation remains implicated in reproducing consumerism (Shaw, 2018; Appelgren, 2019; Gregson et al., 2009), while in others it signifies a political rejection of fashion and consumerism (Graziano and Trogal, 2017; Watson and Shove, 2008; Podkalicka and Potts, 2013; Sugiura, 2019). Anti-consumerism, sustainability and anti-waste values might seem to flow together; but repair often triggers more consumer behaviours. Commodifying the 'repair' urge and using it for marketing purposes is a predictable response from business. Repair as a 'fashionable activity' is also implicated in the growth of consumer markets for tools and equipment (Bix, 2009; Watson and Shove, 2008), although tool libraries and shared repair facilities offer an alternative route implying more limited material rebound effects. For Graziano and Trogal, such collective approaches are key to a political mobilization of repair: they have "*the potential to make the effort for this redefinition of time not about private lifestyle choices reserved to the urban creative classes. Instead of mythicizing individual efforts, … they have the chance of intervening more significantly in the collective political imaginary by positing this challenge as*

a common one" (Graziano and Trogal, 2017: 654).

While repair might yet be motivated by individual demands, it is not necessarily a product of rational consumer economic calculus. The personal can still be political. Indeed much of the repair literature highlights the importance of emotional attachment and care as a significant motivation for repair, rather than the instrumental value (Isenhour and Reno, 2019; Berry et al., 2019; Bohlin, 2017; Dewberry et al., 2016; Houston et al., 2016; Callén Moreu and López Gómez, 2019; Rosner, 2014; Vinsel, 2017). Mobilising repair through mechanisms that focus on instrumental value, such as product service offerings, or tax-breaks for repair might therefore be less effective than engaging with deeper motivations, even if presented to support environmental sustainability. Moreover, attachment and care offer one potential mechanism for building collective, socially progressive, political forms of repair (Young and Rosner, 2019; Bix, 2009).

As with the tension between sustaining and transforming, the tension between personal and political is not a simplistic dualism, but a contested and debated space, helping shape the sophisticated and situated interventions needed if repair is to achieve both social and environmental goals.

Past or future?

As well as being economically and politically sustaining, repair can be culturally and socially nostalgic (Vinsel, 2017). Alternatively it can be forward-looking, intended to transform norms in a progressive mode (Jackson, 2019; Graziano and Trogal, 2017; Isenhour and Reno, 2019). As Jackson puts it: "*On the one hand repair may be conceived as conservative and backward looking, oriented to returning broken objects and systems to prior state of function. On the other, repair may be viewed as forward-looking and progressive, a site of in situ creativity and innovation that reworks the landscape of inherited situations to sustain and project value (and values) into the future*" (Jackson, 2019: 343). Of course, such political and normative stances may map differently in different circumstances and contexts.

The implications of repair for work and employment illustrate this tension well. Advocacy for repair can reify craft skills and artisanal production as morally superior and fulfilling (Sennett, 2012; Dant, 2010; Vinsel, 2017), despite risking reconstituting unequal gendered roles (Rosner, 2014; Isenhour and Reno, 2019), and thus might also help reinvent work in new forms such as 'prosumers' and self-provisioners (Bix, 2009; Carfagna et al., 2014; Kosnik, 2018; Graziano and Trogal, 2017). For Graziano and Trogal, "*the 'right to repair' expresses … a frontline in the struggle to the right to access to independent livelihood, but at the same time … [repairers] put forward an aspiration of sociality … that prefigures a de-centering of work altogether*" (Graziano and Trogal, 2017: 653-4).

The tinkering and improvisation highlighted above implies artisanal or craft skills, which some see as a valuable counter to the alienation of industrial and office work (Sennett, 2012). Skill sharing in repair cafes and workshops offers opportunities to revalorise the skills of redundant engineers (Young and Rosner, 2019). Yet in the same settings, repair practices can sustain gendered divisions of labour, and personalise (rather than politicise) feminist efforts to challenge established relations (Rosner and Ames, 2014; Bix, 2009). Promoting repair in the context of the circular economy may appropriate individual care-work and domestic labour in support of individualised market oriented solutions (Isenhour and Reno, 2019; Carr, 2017; Young and Rosner, 2019).

The nostalgia involved in repair extends more widely (Vinsel, 2017). In evoking the durable, repairable bespoke products and comfortable social arrangements of days gone by, narratives of repair may also unintentionally invoke the gendered and ethnically unequal social relations of personal service. Such nostalgic images not only draw a veil over the extent to which repair is not a voluntary choice for many, but rather a response to need (and to enforced state austerity policies),

but also obscure the ways in which repair (as thrift) can act as a form of investment in future production and consumption, facilitating rebound effects rather than conserving resources (Podkalicka and Potts, 2013). As investments, the practices of repair are voluntary, rational and future oriented but may do little for sustainability; in the case of immediate need, they are forced, inequitable, and present-oriented.

Again, the repair literature does not suggest that there is a single best resolution of the temporal tensions involved but recognizes that they exist and merit reflective analysis. It highlights that there is no simple baseline time or state to which repair can return, and that choices must be made and justified (Sennett, 2012). Less rose-tinted visions of the past might expose and seek to eliminate injustice, yet a future-orientation may still pull the veil over existing structural injustices, or be used to justify 'breaking things' now, because they can be restored or repaired later, in the way extractive industries can justify mining in ecologically sensitive areas on the grounds of subsequent habitat restoration (Katz, 2000; McLaren, 2018).

Contesting repair

So, to summarise the literature reviewed earlier in this section, in contrast with its appearance in the circular economy literature, scholars of repair find it to be an intensely political and contested concept. The purposes, motivations, and values involved in repair are not simply about restoration of material objects to an authentic past state for instrumental economic and environmental reasons. They involve attachment, relationships and efforts to redefine values and ethics, in the face of the threat of co-option by neoliberal capitalism, variously constituting repair as a part of individual responsibility in response to imposed austerity politics; as extended corporate control over property, as financialization of consumer goods in product service offerings; as a means to commodify waste, further marginalizing those dependent on it in informal waste economies; as a means to further commodify domestic labour and care; and to create new fashionable consumption norms rooted in nostalgia for imagined pasts.

These emanations of repair might be understood as damaging forms of reconfiguration, as much as they are forms of maintenance and restoration of existing relations of dominance and exploitation. But resistance to such co-option can be seen in a further narrative of repair as reconciliation – repairing fabric of society or repairing relationships between social groups and between people and planet. As Graziano and Trogal argue: "*collective repair practices are pedagogical sites that also bring many other relations that need to be 'fixed' to the fore, particularly around gender and the construction of expertise as constitutive elements of subjectivity*" (2017: 654)

Nonetheless some norms, values or ethics come to the fore as desirable in the broader repair literature. We suggest, echoing McLaren (2018), that these norms, values and ethics suggest visions of repair as a tool to create spaces for social innovation, rather than to maintain existing social relations; in processes motivated by care for the subject of repair and as a legible, deliberated, interpersonal, co-produced process, rather than something mandated but backgrounded, with its values and motivations taken for granted.

Section 3: Discussion - Transposing repair contestation to the circular economy

Section 2 described some of the ways in which repair is an arena for contestation of visions and values. If repair is a politically contested practice, based on different interpretations of past and future, under threat of co-option as a tool to sustain existing power arrangements; what does this mean for the CE? Can we see similar dimensions of contestation behind the dominant discourses of the circular economies, and how might they emerge?

As noted earlier, the dominant circular economy narratives are sustaining, and consumerist. The circular economy "*is more often*

celebrated than critically interrogated … [it] circulates as an idea and ideal, exemplified by industrial symbiosis and extended product life" (Gregson et al., 2015). The dominant narratives reduce politics to administrative management of the arrangements for effective markets in line with the advice of leading businesses. Temporally they call on the environmental interests of the future to defend the social and economic arrangements of the present. Here we explore how these narratives might be themselves reconfigured by engagement with transforming, political, and historically informed, but future oriented forms of repair. We seek particularly to highlight emerging tensions that might enable deeper debate and repoliticize circular economy debate.

Despite the near hegemonic post-political views, there may well be very different values, distributed amongst erstwhile allies on CE (Niskanen et al., 2020). That both green political parties and major corporations alike promote circularity implies tensions. These might become most obvious over extraction, growth and consumerism. Hobson and Lynch (2016) critique the circular economy as an ecomodernist rebranding of existing corporate activities: "*whilst CE proponents claim their agenda is 'radical' … [it cannot] address many deeply embedded challenges around issues of consumption and the consumer, echoing as it does the problematic (and arguably failed) agendas of sustainable consumption / lifestyles*" (2016: 15). But as part of a new paradigm for society/social relations, CE is also cited in discourses promoting basic income (Citizen's Basic Income Network Scotland, 2019), making and self-provisioning (Lowe, 2016), sharing (Matofska, 2016), new models of work (Graziano and Trogal, 2017), and as a goal for small scale initiatives rooted in sociality and sharing (Hobson, 2019; Norris, 2019).

This is not to claim that such alternative discourses are necessarily preferable, even in social terms, nor entirely immune to co-option by neoliberal capitalism. Problems such as poor labour standards in 'gig' versions of the sharing economy, and exacerbated inequalities in housing access resulting from the growth of Airbnb (McLaren and Agyeman, 2015) make that clear. But it is important to acknowledge that visions of both past and future social and economic relations can be opened to contestation in consideration of repair.

This is limited in the circular economy literature, but not unknown. Savini (2019) summarizes how in circular city discourse in Amsterdam waste has been redefined as part of a new 'regime of accumulation'. The Repair cafés movement began in Amsterdam and these activities have now become part of a public-private partnership narrative of a circular city based on urban mining, the private logistics sector and a key role for city residents as prosumers. In Savini's work, repair becomes one of several activities justifying "*the circular economy as a model of city-regional economic growth*" (Savini 2019: 685).

Taking lessons from the repair literature suggests a more critical stance is required. Read in this light Savini's work exemplifies how repair may be co-opted by new circular business models and government interventions, in which sociality is displaced, waste commodified and industrial consumer society sustained. This is only one way in which circular economy discourses sideline the social in relation to waste and extractivism. Whether relating to those workers or communities impacted by mining, oil and forestry; or those involved in waste disposal or waste recovery (all typically industries inflicting serious environmental injustice, as well as providing employment), CE discourses tend to treat implications for people elsewhere as secondary to implications for consumers and the environment. A richer, relational, reading of repair would apply it to the relationships between consumers and the workers and communities impacted by extractivism and waste management, seeing the extension of circularity as an opportunity for environmental remediation, social reconciliation and political reconfiguration.

The instrumental approach to waste, central to circular economy discourses turns waste into a resource, opening it to commodification in ways that are sustaining for existing political and social relations. The division between biological cycles and technological cycles visible in the work of the EMF (2019) is illustrative of this instrumental view of

material flows. Here the 'purity' of material flows is the gauge for CE effectiveness as clean materials are considered productive materials. This view – in which circularity purifies and commodifies wastes, actually displaces social relations. It ignores the great entanglement of organic and technological materials and social relations in the modern world. Such entanglement is made visible in 'repair' understood more broadly, which in contrast could imply an explosion of new relations of production and consumption in the economy. Similar possibilities emerge from the fact that, unlike recycling, repair suggests *avoiding* waste rather than turning it into a resource. Repair also implies slowing product turnover and resisting the cultural and physical redundancy that operates in the modern economy to maintain material flows and growth. In such respects repair perhaps offers a wedge for a more progressive and transformative discourse.

Commodifying waste under capitalism (Eriksen and Schober, 2017), and creating a new arena for capital accumulation (Harvey, 2010), won't halt the production of waste, and might even increase it (Makov and Font Vivanco, 2018) as a result of rebound effects. The dominant approach turns it into a commodity for remanufacture and new profits, in an ever-growing economy, matched by forms of repair that extend *leased* product lifespans and thus profit margins. Product service systems might be ways of encouraging repair, but the added commercial value goes to the corporation, and indeed the whole conception is firmly within capitalist social relations, rather than promising any transformation. It threatens to extend corporate control over the repair economy, currently of particular value to small-scale and informal workers, often of diverse ethnic origins (Houston, 2019). Such commodification (and formalization) of waste cycles also risks further exclusion of marginalized workers in waste management, such as waste-pickers, or their increased dependency on corporate management (Isenhour and Reno, 2019; Ta, 2017; Gregson et al., 2015).

We see these problems not only as a product of depoliticization of circular economy discourse, but also in part arising in its nostalgic, sustaining framing of repair, and its integration into a middle-class habitus of sustainable consumption and gentrification. As Isenhour and Reno argue: "*what is perhaps new about today's circular economy imaginaries is that they signal the growing commodification and formalization of waste materials and reuse practices, raising important questions about the potential gentrification of reuse, and potential exclusion*" (Isenhour and Reno, 2019: 4). Responding to such concerns requires an understanding of repair as a tool for reconfiguring social and economic relations, and as a tool for reconciliation, recognizing and making recompense for past injustice, and negotiating forward looking relations that are socially just and fair.

Repair clearly offers more potential for future-looking, political transformation if it is seen as something more than a tool focused on the material products of the inner loop, vulnerable to economic rebounds. As we saw earlier CE discourse includes claims of fixing resource cycles to establish a regenerative economy. But lacking lessons from debates within practices of repair, these remain not only hubristic but also technocratic and post-political, still rooted in a social imaginary in which capitalism (perhaps tamed and reformed, but still capitalism) is the only option for managing society, and in which futures are administered as adjustments from the past, rather than imagined as potential (revolutionary) dislocations. Instead we see more potential in treating the economy as the subject of repair, and the prescription as reconfiguration, not reconstruction, nor even remediation.

Repair as reconfiguration implies much greater potential than instrumental narratives of reconstructive repair. But reconfiguration is not *necessarily* more sustainable, nor more just, than reconstruction. As we have also seen, disruption can take many forms. To ensure the social dimension of repair is integrated, narratives and policies need to weave in the fourth understanding of repair, as reconciliation.

Conclusions: reconfiguring repair

Our approach in this paper was to bring circular economy narratives of repair into normative dialogue with conceptions of repair from a broader set of arenas and disciplines. We identified key narratives through literature review, with a focus on scholarly literature of policy relevance. We do not therefore claim to have exhaustively characterised the circular economy understanding of repair. In future work we intend to use interviews and deliberative stakeholder engagement to enrich this picture, and to stimulate further reflection by both scholars and policy makers.

Nonetheless, this critical review of the discourses of repair and circular economies suggests that the instrumental narrative of repair is predominant, yet may not even deliver its anticipated role in the circular economy. Instrumental adoption of repair could instead aid and abet a neoliberal co-option of the circular economy, which and undermine its underlying normative intent (shared by the present authors) of enabling sustainability. Co-opted into narratives of sustaining growth, repair seems vulnerable to material rebound effects that will also sustain extractivism and waste. In such forms, circular economy discourses will likely continue to sideline the social and justice dimensions that the relational norms of repair bring to the fore.

We have hinted that introducing the contestation typical of discourse regarding repair in other arenas and disciplines into circular economies might be generatively disruptive. But we have also highlighted that disruption alone may not deliver a more just, more sustainable outcome. A move from the hegemonic (singular) *circular economy* to the recognition that there may be multiple potential configurations of *circular economies* (plural), some more just and sustainable than others would seem to be an essential precursor to that goal, to be linked to new and richer understandings of the possible implications of narratives of repair. In this respect, we suggest that the three norms or ethics of repair proposed by McLaren (2018) – integrity, care and legibility - might be helpful here too.

In developing policy and governance for circularity decision makers (and researchers) should ask what is being repaired? Is it simply products? Or the economy? Does the ambition of repair extend to consumers relations with those impacted by extractivism? Or to the relationship between people and the planet? This would imply adopting a norm of *integrity* – understanding the subject of repair as something with more than instrumental, anthropocentric relevance.

A richer understanding of repair allows us to see it as potentially transformative (in a world where inequality and unsustainability demand transformation); but to deliver such reconfiguration, rather than simply delivering disruption, implies imbuing repair with an ethic of *care* for all those affected and involved.

Similarly with a richer understanding we might begin to deliver the benefits of bringing repair out of the shadows, using the exposure it gets as a part of circular economy policy to establish measures that enhance recognition of repair and maintenance and the practitioners involved, so often women, or people of colour. A norm of transparency or *legibility* of repair is a key mechanism to do this.

For policy making on circular economies then, it would seem strongly desirable to have a better understanding of the contested dimensions of repair and underlying differences and diverging orientations of reconstruction/restoration, remediation, reconfiguration and reconciliation. The normative stances involved in repair remain complex, and can be contradictory: repair can simultaneously be an expression for a positive form of attachment, and a reified expression of oppressive gender relations. Taking a normative stance doesn't necessarily mean always seeking reconfigurative expressions of repair. But being more aware of political and ethical debates in repair, and therefore of what repair might reconstruct or reconfigure - beyond the material intervention concerned - would challenge circular economy scholars, practitioners and policy makers in ways that should help them to design and deliver interventions that genuinely reinforce social and

environmental sustainability.

Research into repair in circular economies therefore needs to become more inter- and trans-disciplinary, linking political, cultural, economic and technological investigation. In particular, researchers could do much more to understand non-instrumental motivations for repair, especially considering individual actors as more than consumers; to examine the relational, social, moral and cultural implications of business models such as product service systems; to assess who wins and who loses from different configurations of repair; and to explore the political economy of business approaches to repair and circularity, as well as the potential for policy mechanisms that could reframe repair, for instance as part of degrowth, or within novel forms of capitalism or even non-capitalist social relations.

Our findings and approach should also be of value to scholars working with the emerging 'sociology of repair'. Our critical analysis sharpens the normative questions the sociology of repair raises, while bringing a cultural political economy perspective into this space highlights that way in which socio-technical practices are co-produced with political regimes. Such scholars might productively examine the ways in which the metrics, taxonomies and models constructed in circular economy scholarship condition or constrain political and social imaginaries of repair. And in bringing repair and maintenance into cultural political economy, we push the latter to broaden its understanding of technological practices, innovation regimes and their interactions.

A richer, reconfigured idea of repair calls on us to think about the relationship between past and future that we are configuring by undertaking repair; how the change is brought about; and whether that new relationship sustains or transforms unequal social relations. The circular economy thereby becomes a venue for political contestation over imaginaries of past and future; and a potent venue for present politics to engage with justice and sustainability.

Support

Data Availability Statement

A table of items included in the review is provided as supplementary material.

Author contributions

DMcL and JN conducted the literature reviews, DMcL wrote the manuscript, with support and written contributions from JN and JA.

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

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.rcrx.2020.100046.

References

Ackermann, L, Mugge, R, Schoormans, J, 2018. Consumers' perspective on product care: An exploratory study of motivators, ability factors, and triggers. Journal of Cleaner Production 183, 380–391.

Appelgren S. (2019) Building Castles out of Debris: Reuse Interior Design as a 'Design of the Concrete' *Worldwide Waste: Journal of Interdisciplinary Studies*, 2: 1-10.

Berry, B, Bonnet, J, Isenhour, C, 2019. Rummaging through the Attic of New England. Worldwide Waste: Journal of Interdisciplinary Studies 2, 6–12.

Bix, A., 2009. Creating "Chicks Who Fix": Women, Tool Knowledge, and Home Repair, 1920–2007. WSQ: Women's Studies Quarterly 37, 38–60.

Bohlin, A., 2017. 'It will Keep Circulating': Loving and Letting Go of Things in Swedish Second-hand Markets. Worldwide Waste: Journal of Interdisciplinary Studies 2 (1), 1–11.

Braungart, M, McDonough, W, 2002. Cradle to Cradle. Remaking the Way We Make Things. North Point Press, New York.

Broto, VC, Bulkeley, H, 2013. Maintaining Climate Change Experiments: Urban Political Ecology and the Everyday Reconfiguration of Urban Infrastructure. International Journal of Urban and Regional Research 37, 1934–1948.

Bruner, J., 1991. The Narrative Construction of Reality. Critical Inquiry 18, 1–21.

Burger, M, Stavropoulos, S, Ramkumar, S, et al., 2019. The heterogeneous skill-base of circular economy employment. Research Policy 48, 248–261.

Callén Moreu, B, López Gómez, D, 2019. Intimate with your junk! A waste management experiment for a material world. The Sociological Review 67, 318–339.

Cambridge Econometrics, Trinomics and ICF. (2018) Impacts of circular economy on the labour market. European Commission; Brussels.

Carfagna, LB, Dubois, EA, Fitzmaurice, C, et al., 2014. An emerging eco-habitus: The reconfiguration of high cultural capital practices among ethical consumers. Journal of Consumer Culture 14, 158–178.

Carr, C., 2017. Maintenance and repair beyond the perimeter of the plant: linking industrial labour and the home. Transactions of the Institute of British Geographers 42, 642–654.

Cherry, CE, Pidgeon, NF, 2018. Why Is Ownership an Issue? Exploring Factors That Determine Public Acceptance of Product-Service Systems. Sustainability 10.

Ci FY. (2010) A Study on the Formation Mechanism of Circular Economy Competitiveness in the Metropolitan Region. The Second China Energy Scientist Forum, Vol 1-3, 509–513.

Citizen's Basic Income Network Scotland. (2019) How could a Basic Income support a Circular Economy?Available at: https://cbin.scot/2019/07/23/basic-income-and-the-circular-economy/.

Cooper, T., 1999. Creating an economic infrastructure for sustainable product design. Journal of Sustainable Product Design 8, 7–17.

Dant, T., 2010. The Work of Repair: Gesture. Emotion and Sensual Knowledge. Sociological Research 15, 1–22 Online.

Dant, T., 2019. Inside the bicycle: repair knowledge for all. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies. Palgrave, London, pp. 283–312.

Denis, J, Pontille, D, 2019. The dance of maintenance and the dynamics of urban assemblages. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies: Revisiting Breakdown, Relocating Materiality. Palgrave Macmillan, Singapore, pp. 161–185.

Dermody, J, Nagase, Y, Berger, W, 2020. Theorizing self-repairers' worldview–personhood to advance new thinking on extended product lifetimes. International Journal of Consumer Studies. 44 (5), 435–444.

Dewberry, EL, Saca, L, Moreno, M, et al., 2016. A landscape of repair. Sustainable Innovation 2016. Circular Economy Innovation and Design. Towards Sustainable Product Design. The Centre for Sustainable Design. University of the Creative Arts, Epsom, Surrey, UK, pp. 76–85.

Diddi, S, Yan, RN, 2019. Consumer perceptions related to clothing repair and community mending events: A circular economy perspective. Sustainability 11.

Diez, L, Marangé, P, É, Levrat, D, 2016. Maintenance best way for meeting the challenge of regeneration. IFAC-PapersOnLine 49, 49–54.

Dominish, E, Retamal, M, Sharpe, S, et al., 2018. Slowing" and "Narrowing" the Flow of Metals for Consumer Goods: Evaluating Opportunities and Barriers. Sustainability 10.

Egle, L, Rechberger, H, Zessner, M, 2015. Overview and description of technologies for recovering phosphorus from municipal wastewater. Resources Conservation and Recycling 105, 325–346.

EMF, 2019. Completing the Picture: How the Circular Economy Tackles Climate Change. Ellen MacArthur Foundation and Material Economics, Cowes.

Eriksen, TH, Schober, E, 2017. Waste and the superfluous: an introduction. Social Anthropology 25, 282–287.

European Commission, 2019. Report From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions On The Implementation Of The Circular Economy Action Plan. European Commission, Brussels.

European Parliament and Council. (2008) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.

European Parliament and Council, 2012. Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment. WEEE.

Fassio, F, Minotti, B, 2019. Circular Economy for Food Policy: The Case of the RePoPP Project in The City of Turin (Italy). Sustainability 11.

Flipsen, B, Bakker, C, Gv, Bohemen, 2016. Developing a reparability indicator for electronic products. 2016 Electronics Goes Green 2016+ (EGG) 1–9.

Ghisellini, P, Cialani, C, Ulgiati, S, 2016. A review on circular economy: the expected

transition to a balanced interplay of environmental and economic systems. Journal of Cleaner Production 114, 11–32.

Graham, S, Thrift, N, 2007. Out of Order: Understanding Repair and Maintenance. Theory, Culture & Society 24, 1–25.

Graziano, V, Trogal, K, 2017. The politics of collective repair: examining object-relations in a postwork society. Cultural Studies 31, 634–658.

Gregson, N, Crang, M, Fuller, S, et al., 2015. Interrogating the circular economy: the moral economy of resource recovery in the EU. Economy and Society 44, 218–243.

Gregson, N, Metcalfe, A, Crewe, L, 2009. Practices of Object Maintenance and Repair: How consumers attend to consumer objects within the home. Journal of Consumer Culture 9, 248–272.

Harvey, D., 2010. The Enigma of Capital and the Crises of Capitalism. Oxford University Press, Oxford.

Henke, CR., 2000. The Mechanics of Workplace Order: Toward a Sociology of Repair. Berkeley Journal of Sociology 44, 55–81.

Henke, CR., 2017. The Sustainable University: Repair as Maintenance and Transformation. Continent 6, 40–45.

Henke, CR., 2019. Negotiating Repair: the infrastructural contexts of practice and power. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies. Palgrave Macmillan, London, pp. 255–282.

Hernandez, RJ, Miranda, C, Goñi, J, 2020. Empowering Sustainable Consumption by Giving Back to Consumers the 'Right to Repair'. Sustainability 12, 850.

Hickel, J, Kallis, G, 2019. Is Green Growth Possible? New Political Economy 1–18.

Hobson, K., 2019. 'Small stories of closing loops': social circularity and the everyday circular economy. Climatic Change.

Hobson, K, Lynch, N, 2016. Diversifying and de-growing the circular economy: Radical social transformation in a resource-scarce world. Futures 82, 15–25.

Houston, L., 2019. Mobile Phone repair Knowledge in Downtown Kampala: Local and Trans-local Circulations. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies. Palgrave, London, pp. 129–160.

Houston, L, Jackson, SJ, Rosner, DK, et al., 2016. Values in Repair. CHI Conference on Human Factors in Computing Systems (CHI '16).

Iacovidou, E, Velenturf, APM, Purnell, P, 2019. Quality of resources: A typology for supporting transitions towards resource efficiency using the single-use plastic bottle as an example. Science of the Total Environment 647, 441–448.

Isenhour, C, Reno, J, 2019. On Materiality and Meaning: Ethnographic Engagements with Reuse, Repair & Care. Worldwide Waste: Journal of Interdisciplinary Studies 2 (1), 1–8.

Jackson, SJ., 2014. Rethinking Repair. In: Gillespie, T, Boczkowski, P, Foot, K (Eds.), Media Technologies: Essays on Communication, Materiality and Society. MIT Press, Cambridge MA.

Jackson, SJ., 2019. Repair as Transition: Time, Materiality and Hope. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies. Palgrave, London, pp. 337–348.

Jackson, SJ, Kang, L, 2014. Breakdown, Obsolescence and Reuse: HCI and the Art of Repair. CHI'14, Toronto.

Jackson, T., 2009. Prosperity without growth? The transition to a sustainable economy. Routledge, London.

Jacobs, JM, Cairns, S, 2012. Ecologies of Dwelling: Maintaining High-Rise Housing in Singapore. In: Bridge, G, Watson, S (Eds.), The New Blackwell Companion to the City. Wiley-Blackwell, London, pp. 79–94.

Jansson, K., 2016. Circular economy in shipbuilding and marine networks - A focus on remanufacturing in ship repair. IFIP Advances in Information and Communication Technology. 661–671.

Jessop, B., 2004. Spatial Fixes, Temporal Fixes, and Spatio-Temporal Fixes. Department of Sociology, Lancaster University, Lancaster UK.

Kaddoura, M, Kambanou, ML, Tillman, A-M, et al., 2019. Is Prolonging the Lifetime of Passive Durable Products a Low-Hanging Fruit of a Circular Economy? A Multiple Case Study. . Sustainability 11, 4819.

Kalmykova, Y, Sadagopan, M, Rosado, L, 2018. Circular economy – From review of theories and practices to development of implementation tools. Resources, Conservation and Recycling 135, 190–201.

Katz, E., 2000. The Big Lie: Human Restoration of Nature. Throop, W (Ed.), The Big Lie: Human Restoration of Nature. Enviromental Restoration Ethics, Theory and Practice 83–93.

Kirchherr, J, Reike, D, Hekkert, M, 2017. Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling 127, 221–232.

Klein, N., 2007. The Shock Doctrine. Penguin, London.

Kosnik, E., 2018. Production for consumption: Prosumer, citizen-consumer, and ethical consumption in a postgrowth context. Economic Anthropology 5, 123–134.

Lees, L., 2008. Gentrification and Social Mixing: Towards an Inclusive Urban Renaissance? Urban Studies 45, 2449–2470.

Leino, M, Pekkarinen, J, Soukka, R, 2016. The Role of Laser Additive Manufacturing Methods of Metals in Repair, Refurbishment and Remanufacturing – Enabling Circular Economy. Physics Procedia 83, 752–760.

Liu, WQ, Mo, JY, Gu, CK, 2016. The Development Situation, Future and Counter Measures of Remanufacturing Industry in China. Frontiers of Engineering Management 3, 123–131.

Lowe A. (2016) Maker skills - a new hope for the Circular Economy? Royal Society of Arts, Available at: http://www.greatrecovery.org.uk/resources/maker-skills-a-new-hope-for-the-circular-economy/.

Ludeke-Freund, F, Gold, S, Bocken, NMP, 2019. A Review and Typology of Circular Economy Business Model Patterns. Journal of Industrial Ecology 23, 36–61.

Luke, N, Kaika, M, 2019. Ripping the Heart out of Ancoats: Collective Action to Defend Infrastructures of Social Reproduction against Gentrification. Antipode 51, 579–600.

MacArthur, E., 2012. A circular economy tackles the root problems of overconsumption. The Guardian. January 31st.

Makov, T, Font Vivanco, D, 2018. Does the Circular Economy Grow the Pie? The Case of Rebound Effects From Smartphone Reuse. Frontiers in Energy Research 6, 39.

Martinez, F., 2019. Introduction: Insiders' Manual to Breakdown. In: Martinez, F, Laviolette, P (Eds.), Repair, Brokenness, Breakthrough. New York and Oxford: Berghahn.

Martínez, F., 2017. Waste is not the end. For an anthropology of care, maintenance and repair. Social Anthropology 25, 346–350.

Martinez, M., 2014. Squatting for justice: Bringing Life to the city. ROAR Magazine.

Matofska B. (2016) What is the Sharing Economy? Available at: https://www.thepeoplewhoshare.com/blog/what-sharing-economy.

McLaren, D, Agyeman, J, 2015. Sharing Cities: A case for truly smart and sustainable cities. MIT Press, Cambridge MA.

McLaren, DP., 2018. In a broken world: Towards an ethics of repair in the Anthropocene. The Anthropocene Review 5, 136–154.

Mendoza, JMF, Gallego-Schmid, A, Rivera, XCS, et al., 2019. Sustainability assessment of home-made solar cookers for use in developed countries. Science of the Total Environment 648, 184–196.

Middleton, J.Mending, 2014. In: Fletcher, K, Tham, M (Eds.), Routledge Handbook of Sustainability and Fashion. Routledge, London.

Migliore, M, Talamo, C, Paganin, G, 2020. Reuse as a Bridge Between Waste Prevention and the Circular Economy. Springer Tracts in Civil Engineering, pp. 77–101.

Milios, L., 2018. Advancing to a Circular Economy: three essential ingredients for a comprehensive policy mix. Sustainability Science 13, 861–878.

Mugge, R, 2017. A consumer's perspective on the circular economy. In: In: Chapman, J (Ed.), Routledge Handbook of Sustainable Product Design Routledge, London, pp. 374–390.

Nabudere, DW, 2013. From agriculture to agricology: towards a glocal circular economy. Real African Publishers, Johannesburg.

Nakajima, K, Matsumoto, M, Murakami, H, et al., 2019. Development of multi-value circulation based on remanufacturing. Materiaux & Techniques 107.

Niskanen, J, Anshelm, J, McLaren, DP, 2020. Local conflicts and national consensus: The strange case of circular economy in Sweden. Journal of Cleaner Production 261.

Nissen, NF, Schischke, K, Proske, M, et al., 2017. How modularity of electronic functions can lead to longer product lifetimes. Research in Design Series 9 PLATE: Product Lifetimes And The Environment (2017, Delft).

Norris, L., 2019. Urban prototypes: Growing local circular cloth economies. Business History 61, 205–224.

Nussholz, JLK., 2017. Circular Business Models: Defining a Concept and Framing an Emerging Research Field. Sustainability 9.

Peiro, LT, Ardente, F, Mathieux, F, 2017. Design for Disassembly Criteria in EU Product Policies for a More Circular Economy A Method for Analyzing Battery Packs in PC-Tablets and Subnotebooks. Journal of Industrial Ecology 21, 731–741.

Podkalicka, A, Potts, J, 2013. Towards a general theory of thrift. International Journal of Cultural Studies 17, 227–241.

Poppelaars, F, Bakker, C, Van Engelen, J, 2018. Does Access Trump Ownership? Exploring Consumer Acceptance of Access-Based Consumption in the Case of Smartphones. Sustainability 10, 2133.

Pozo Arcos, B, Balkenende, AR, Bakker, CA, et al., 2018. Product design for a circular economy: Functional recovery on focus. Proceedings of International Design Conference. DESIGN, pp. 2727–2738.

Prabhu, J, Jain, S, 2015. Innovation and entrepreneurship in India: Understanding ju-gaad. Asia Pacific Journal of Management 32, 843–868.

Prendeville, S, Hartung, G, Purvis, E, 2016. Makespaces: From redistributed manu-facturing to a circular economy. Smart Innovation, Systems and Technologies 577–588.

Reike, D, Vermeulen, WJV, Witjes, S, 2018. The circular economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. Resources. Conservation and Recycling 135, 246–264.

Riisgaard, H, Mosgaard, M, Zacho, KO, 2016. Local Circles in a Circular Economy - the Case of Smartphone Repair in Denmark. European Journal of Sustainable Development 5, 109–123.

Rosner DK. (2014) Making Citizens, Reassembling Devices: On Gender and the Development of Contemporary Public Sites of Repair in Northern California. Public Culture 26: 51-77.

Rosner, DK, Ames, MG, 2014. Designing for Repair? Infrastructures and Materialities of Breakdown. CSCW '14, Baltimore, Maryland, USA.

Sauerwein, M, Doubrovski, E, Balkenende, R, et al., 2019. Exploring the potential of additive manufacturing for product design in a circular economy. Journal of Cleaner Production 226, 1138–1149.

Savini, F., 2019. The economy that runs on waste: accumulation in the circular city. Journal of Environmental Policy & Planning 21, 675–691.

Schubert, C., 2019. Repair Work as Inquiry and Improvisation: the Curious Case of Medical Practice. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies. Palgrave Macmillan, pp. 31–60.

Schumpeter, J., 1950. Capitalism, Socialism, and Democracy. Harper Collins, New York.

Schwenkel, C., 2015. Spectacular infrastructure and its breakdown in socialist Vietnam. American Ethnologist 42, 520–534.

Sennett, R., 2012. Together: The Rituals, Pleasures and Politics of Cooperation. Allen Lane, London.

Seyfang, G, Smith, A, 2007. Grassroots innovations for sustainable development: Towards a new research and policy agenda. Environmental Politics 16, 584–603.

Shareable, 2018. Sharing Cities: Activating the Urban Commons. Shareable, San Francisco.

Shaw, WS., 2018. Trashion treasure: A longitudinal view of the allure and re-functioning of discarded objects. Environment and Planning D: Society and Space 37, 122–141.

Sihvonen, S, Ritola, T, 2015. Conceptualizing ReX for aggregating end-of-life strategies in product development. In: Kara, S (Ed.), 22nd Cirp Conference on Life Cycle Engineering, pp. 639–644.

Singh, J, Cooper, T, Cole, C, et al., 2019. Evaluating approaches to resource management in consumer product sectors - An overview of global practices. Journal of Cleaner Production 224, 218–237.

Sinha, P, Muthu, SS, Dissanayake, G, 2016. The remanufacturing industry and fashion. Environmental Footprints and Eco-Design of Products and Processes 1–9.

Sormani, P, Bovet, A, Strebel, I, 2019. Introduction: When Things Break Down. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies: Revisiting Breakdown, Relocating Materiality. Palgrave, London, pp. 1–30.

Spring, M, Araujo, L, 2017. Product biographies in servitization and the circular economy. Industrial Marketing Management 60, 126–137.

Stahel, W., 1982. The Product Life Factor. An Inquiry into the Nature of Sustainable Societies: The Role of the Private Sector. NARC.

Stal, HI, Jansson, J, 2017. Sustainable Consumption and Value Propositions: Exploring Product-Service System Practices Among Swedish Fashion Firms. Sustainable Development 25, 546–558.

Steuer, B., 2016. What Institutional Dynamics Guide Waste Electrical and Electronic Equipment Refurbishment and Reuse in Urban China? Recycling 1, 286–310.

Sugiura, M., 2019. The mass consumption of refashioned clothes: Re-dyed kimono in post war Japan. Business History 61, 106–121.

Ta, TX., 2017. A space for secondhand goods: Trading the remnants of material life in Hong Kong. Economic Anthropology 4, 120–131.

Tecchio, P, Ardente, F, Mathieux, F, 2019. Understanding lifetimes and failure modes of defective washing machines and dishwashers. Journal of Cleaner Production 215, 1112–1122.

Tsanakas, JA, van der Heide, A, Radavičius, T, et al., 2020. Towards a circular supply chain for PV modules: Review of today's challenges in PV recycling, refurbishment and re-certification. Progress in Photovoltaics: Research and Applications 28, 454–464.

Türkeli, S, Huang, B, Stasik, A, et al., 2019. Circular Economy as a Glocal Business Activity: Mobile Phone Repair in the Netherlands, Poland and China. Energies 12, 498.

Tyfield, D., 2012. A Cultural Political Economy of Research and Innovation in an Age of Crisis. Minerva 50, 149–167.

Ureta, S., 2014. Normalizing Transantiago: On the challenges (and limits) of repairing infrastructures. Social Studies of Science 44, 368–392.

Valenzuela, F, Böhm, S, 2017. Against wasted politics: A critique of the circular economy. Ephemera: Theory and Politics in Organisation 17, 23–60.

van den Berg, M, Voordijk, H, Adriaanse, A, 2020. Recovering building elements for reuse (or not) – Ethnographic insights into selective demolition practices. Journal of Cleaner Production 256, 120332.

Vanegas, P, Peeters, JR, Cattrysse, D, 2018. Ease of disassembly of products to support circular economy strategies. Resources, Conservation and Recycling 135, 323–334.

Vinsel, L., 2017. Maintenance as Romance: Recuperating Zen and the Art of Motorcycle Maintenance. Continent 6, 87–91.

Watson, M, Shove, E, 2008. Product, Competence, Project and Practice: DIY and the dynamics of craft consumption. Journal of Consumer Culture 8, 69–89.

Webster, K., 2017. The Circular Economy: A Wealth of Flows (2nd Edition). Cowes: Ellen Macarthur Foundation.

Whalen, KA, Milios, L, Nussholz, J, 2018. Bridging the gap: Barriers and potential for scaling reuse practices in the Swedish ICT sector. Resources Conservation and Recycling 135, 123–131.

Wieser, H, Troger, N, 2018. Exploring the inner loops of the circular economy: Replacement, repair, and reuse of mobile phones in Austria. Journal of Cleaner Production 172, 3042–3055.

Williams M, McDonough M and Edge S. (2017) Interdisciplinary circular economy design education through local and regional partnerships. PLATE: Product Lifetimes And The Environment, 9, 432–436.

Yan, JY, Wu, N, 2011. Technology Supporting System of Circular Economy of Mining Cities. 2011 Asia-Pacific Power and Energy Engineering Conference, Wuhan.

Yang, MY, Smart, P, Kumar, M, et al., 2018. Product-service systems business models for circular supply chains. Production Planning & Control 29, 498–508.

Young, M, Rosner, DK, 2019. Repair for the masses? Gender and care work in the fixers' collective. In: Strebel, I, Bovet, A, Sormani, P (Eds.), Repair Work Ethnographies. Palgrave, London, pp. 313–334.

Zwier, J, Blok, V, Lemmens, P, 2015. The Ideal of a Zero-Waste Humanity: Philosophical Reflections on the Demand for a Bio-Based Economy. Journal of Agricultural and Environmental Ethics 28, 353–374.