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Human-Centred Design of Products And Services for the Circular Economy – A Review

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ABSTRACT This paper aims to broaden the circular economy discussion by emphasizing the role of people. The paper combines *core* circular economy literature and user-centred design *seed* literature with illustrative case studies, to consider the positioning of design within a circular economy. The article observes that design is considered predominantly in positivist terms within a field dominated by management, engineering, ecological and environmental science literature. Conceptualizing the designer's

opportunity within the circular economy would benefit from integration of knowledge from the social sciences (sociology of consumption, consumer psychology, cultural studies, *inter alia*). The current orientation overlooks design as a 'radical humanist' paradigm and this has implications for how people are considered (from 'users-as-subjects' to 'people-as-participants') raising ethical questions about design practice within divergent circular economy framings. The article lays a basis for further research and theory-building for a fuller conceptualization of the designer's opportunity within the circular economy.

KEYWORDS: Circular economy, user-centred design, consumers, business-to-consumer, consumption, circular design

Introduction



The 'circular' economy is a conceptual model presenting an alternative to the 'linear' economy (make, use, waste). It imagines how we might keep resources in use for as long as possible by extracting the maximum (use and exchange) value from products and materials at the end of each service life' (WRAP 2017). Two key approaches to achieve this are closing resource loops through recycling (at the end of product life) and slowing cycles of resource use (Bocken et al. 2016; Cooper 2017; Stahel 1984).

Design places human experiences at the core of its practices (Dunne 2011) and this is acknowledged as an important starting point for meaningful innovation (Verganti 2008). Designers are recognized as having the skills to understand people, influence values, attitudes and perceived user wants and desires (Vezzoli and Manzini 2008). Through the construction of symbolic meaning, designers are well positioned to shape culturally dominant value systems (Wahl and Baxter 2008). Addressing a culture of consumption (Jackson 2005), where products are prematurely aged (Crocker 2017) and disposed of, requires changes in both consumer behaviours and culture (Cooper 2017), suggesting there is value in drawing on design skills for the development of solutions for the circular economy. However, up to now, design is considered within the circular economy discussion solely as a means for engineering product life-extension (through durable design, modular upgrades, repair, design for maintenance etc.).

The likely reason for this is due to the circular economy's focus on corporates operating within business-to-business models (Ellen MacArthur Foundation 2017). This corporate context emphasizes innovations in production systems (Ellen MacArthur Foundation 2013) showcasing, for example, case studies of supply-chain innovation and reverse logistics (Bakker et al. 2014; Bocken et al. 2016). Technological approaches (e.g. 'biocycle', 'technocycle') and solutions (e.g. renewable energies, product sensors) that emphasize codified innovation management frameworks on production (cf. Ghisellini, Cialani, and Ulgiati 2015;

Lieder and Rashid 2016). This technocentric framing reflects a sense of technological determinism reminiscent of the early days of ‘ecodesign’, which also focused on (material and energy) resource efficiency with limited reflection on the social. However, within the field of ecodesign (Wever, van Kuijk, and Boks 2008) and the broader field of innovation (von Hippel 1976) the need to consider people is well-established and thus focusing on the duality of human and technological aspects of innovation is necessary.

Though there are few examples of business-to-consumer models, there are many reasons why this sector warrants further exploration, such as the need for innovation to address consumer waste, a changing regulatory landscape, and a need to address societal overconsumption. Yet, the complexity of human behaviour and the globalized nature of consumer goods, means that this is challenging. As such this is an important and under researched area to investigate.

In this paper, we aim to broaden the role of the designer within the circular economy discourse by bringing together insights from the social sciences with design practices centred on people. The paper combines core literature on the circular economy with seed literature from the fields of design and the social sciences, with illustrative business-to-consumer case studies. This work intends to lay a basis for theory-building regarding the role of designers within the circular economy. A number of areas for further research are identified.

Methodology

The scope of this study is limited to the circular economy within a design for product and/or service remit. The research uses a two-step literature review to firstly systematically identify a set of *core* articles that bring the concept of circular economy together with users/consumers. Core literature is defined as literature that forms the conceptual basis of the circular economy field and was gathered systematically. This is complemented by using the concept of ‘seed’ literature (den Hollander, Bakker, and Hultink 2017), and integrating these two approaches towards an analytical synthesis. Seed literature is defined as literature that are considered fundamental to the fields of user-centred design and sociology. Core literature was identified using a process of sourcing articles indexed on Scopus (www.scopus.com) according to the overarching research themes of: circular economy; user-centred design and consumers. The specific search terms utilized for searching on Scopus each are presented in Appendix A.

The total return from this search was reduced by filtering those that fell outside the scope of the research as well as removing duplicates. A second screening step was taken to filter the list further, selecting articles that were deemed to be able to contribute to the aim of the research, that is those that offered substantial insights on the potential of designing products/services for users/consumers in the circular economy. Articles that superficially referred to users/consumers were deemed outside of scope, unless such articles were viewed to be

significant to the field. Articles that focused on manufacturing; building; architecture; engineering; materials science; and process and technologies were excluded from the study. Appendix B shows the fields of the core journal articles identified within the scientific journals listed on Scopus.

Seed literature was identified by checking known seminal works on the topics of user-centred design and design for sustainable behaviour, the work of key authors on Google scholar, and the reference lists of key articles identified. In addition, specific design journals and consumer-studies journals were targeted to identify relevant articles on the topic.

The theoretical insights are supported by a set of illustrative consumer-related case studies drawn from circular economy literature. At present a limited number and range of such case studies exist and as such, though not intended to be exhaustive, the case studies presented are considered to be largely representative of the consumer-related circular business models currently on the market, an assumption which was tested by the authors at PLATE 2017 (Lofthouse and Prendeville 2017).

Illustrative Cases

This section draws on illustrative examples of circular business model concepts and considers each of them from a sociological framing.

From Rational Choice to Values-Based Behaviour

Hewlett Packard's Instant Ink service (HP 2017) uses Wi-Fi technology to anticipate when new printer cartridges are required and posts them to the user for a low-monthly fee (based on number of sheets printed). Through this approach, Hewlett Packard can benefit from economies of scale by using much larger, refillable ink cartridges that are returned to them by pre-paid envelope as part of the service, whilst the customer has an uninterrupted supply of ink at a significantly lower price to traditional cartridges (see Figure 1).

Taking a rational choice perspective (Scott 2000), the analytical consumer may perceive this as a good purchase after they have calculated the costs and benefits of this particular purchase. Some studies have shown that convenience and cost are key purchasing drivers for some groups of users (Botelho et al. 2016; Lofthouse and Bhamra 2006). There is convenience in that cartridges arrive before they are needed, purchasing does not need to be planned and cartridges need replacing less frequently than traditional ones, as the refillable ones are larger. From a cost perspective, the new service proposition costs between £1.99 and £7.99 a month, compared with a cost of around £60 for a new set of cartridges, which may be required as frequently as monthly.

The rational choice model has been heavily criticized as it is understood that humans decision-making is not a 'deliberative cognitive process' and such models do not account for normative, cognitive and



Figure 1.
HP's Instant Ink service.

habitual elements of behaviour (Jackson 2005). An alternative view could take a values-action perspective (e.g. Schwartz's Norm Activation Theory, Stern's Value-Belief-Norm Theory), where morals, norms and beliefs are understood to inform consumer behaviour and attitudes (Jackson 2005). Some people may find the inconvenience of purchasing a new printer and returning the empty cartridges in the prepaid envelope unacceptable, despite the cost savings.

Habits and behaviours as Enablers / Inhibitors

Mud jeans have developed a rental business model where customers can avail of wearing new jeans, without having to own them. The concept presents an offer to rent jeans for five euros per month for 12 months, at which point customers can exchange their old pair for new. Alternatively, one can opt to extend the rental agreement and continue to wear the garment, or end the relationship by returning the jeans to Mud. For those who decide to hold on to the jeans, the company offers a financial incentive for the eventual return of the garment ('Mud Jeans 2017). Customers are also offered free repairs.

Habitual behaviours and past routines play an important role in understanding consumer behaviour in the present and future (Jackson 2005). In this instance, a range of new behaviours are asked of the customer that may confront their established habits or require conscious decision-making and intent if they are to succeed (Ouellette and Wood 1998). Equally, an individual may make impulsive and immediate purchases of other jeans that would compromise any environmental savings achieved through such a rental system and jeopardize the business model. Moreover, considering western norms of owning up to 10 pairs of jeans at any one time, there are a number of challenges to a model which requires such a high-level of commitment to one brand. An individual's propensity for status consumption and their level

Figure 2.
Vitsoe adaptable furniture.



of materialism would also effect the success of this proposition (Lertwannawit and Mandhachitara 2012).

Identity and Lifestyle as Symbolic Representation

Flexible leasing of products, such as pushchairs as investigated by Bugaboo with their Flex Plan pilot study (ResCom 2017), endeavoured to engage its customers through a new offer to update their chosen buggy based on their changing life circumstances through leasing or paying a deposit and a rolling monthly fee (ResCom 2017). Users are enticed to subscribe to the offer to have ‘access’ to a ‘high-end’ stroller without the equivalently high cost. The positioning of the product offer as sustainable alongside the calibre of product design plays into an individual’s positive associations with that particular symbolic meaning. Doing so, the proposition can be framed as a means of cultivating identity through the products symbolic ‘representations’ (Lunt and Livingstone 1992).

Symbolic cultivation and construction of identity through consumption practices is a significant perspective within sociology (Featherstone 2007; Giddens 1984) and is relevant to inform a more nuanced circular economy discourse. ‘Sufficiency’ approaches (Bakker et al. 2014) that are reappropriated within the circular economy discourse can also be considered from this perspective. For example, Vitsoe’s high-end range of adaptable shelving systems integrate principles of modularity based on renowned designer Dieter Rams’ principles for good design (see Figure 2). This product concept is evocative and resonates with a certain aesthetic sensibility towards minimalism.

The Dyad of Satisfaction and Desire

The Rentez-Vous (2017) model that offers a service for short-term rental of high-end clothing to customers who would otherwise be unable to afford them, increases resource intensity of items which would otherwise sit unused. While this approach, which appears to be popular with target customers, is perceived to have the potential to reduce the need for purchases, it also stokes consumer desires for a certain calibre of material goods. Desires reveal cultural codes of ‘distinction’ (Bourdieu 1984). Following Bourdieu, Elliott (1997) outlines the nature of consumption as a negative act in the ‘refusal of other tastes’. That is, what is not consumed, based on distaste, is equally relevant in cultivating identity (Falk 1994) and therein driving consumption. Together, conspicuous consumption and negative desires feed displays of social status predicated on consumption (Jackson 2005).

Alternative approaches, such as ‘Buy Me Once’ (2017) propositions and ‘The 30 Year Collection’ where every garment is built to last a lifetime (Cridland 2017) could be considered to consciously confront consumer pressure by aiming to reduce consumption through a sense of long-term product satisfaction. This satisfying component can also be observed in (circular) business efforts to extend product lifetimes by offering a range of repair services, such as Nudie jeans (2017) and Patagonia (MacKinnon 2015). The durable materials used in the construction of jeans and outdoor clothing means that the product life-extension approach is especially suitable. The rugged material aesthetic is acceptable, even *desirable* to a certain demographic. Thus, this business strategy can be seen as paradoxically offering satisfaction while appealing to the desires of a socially conscious consumer that fits an ‘upper-middle class ‘counter-culture’ profile (Webster 1975) as it indicates a tendency to engage in purchasing behaviour that may not be commonly acceptable (Webster 1975). While popular in the apparel sector, users’ propensity to engage in repair in other sectors, such as consumer electronics is unclear (Lefebvre, Lofthouse, and Wilson 2018).

Sharing as Practice amongst Users

In recent years, there has been a proliferation of sharing and collaborative consumption practices (Belk 2014; Frenken 2017), such as collaboration consumption, (Ritzer and Jurgenson 2010), PSS (Mont 2002), peer-to-peer platforms, access-based consumption (Bardhi and Eckhardt 2012) and collaborative and sharing economy initiatives (Belk 2014). Belk (2014) identifies two commonalities between sharing and collaborative consumption practices: ‘non-ownership models’... reliant ‘on the Internet’.

Sharing examples could be considered from another sociological perspective, social practice theory. Social practice theory is conceived to address the failings of the rational choice model (not all consumers are rational all the time) and the value-action gap (behaviour does not always follow belief) (Blake 1999) as well as accounting for the socially

constructed nature of the 'self' beyond individualism (Jackson 2005). Social practice draws on theories of practice (Bourdieu 1984; Giddens 1984; Schatzki 1997), which are a combination of competences (skills and knowledge), conventions (socially acceptable norms) and material artefacts (artefacts utilized in 'doing' the practice) 'carried' by people (Shove 2010). For instance, sharing practices in city bike schemes might consider whether individuals have the confidence to cycle in the city as well as the financial and technical capabilities to access the Internet, that city cycling is perceived as an acceptable behaviour according to a given individual's contemporaries, alongside considering cycling infrastructure.

The same could be said of toy libraries (Packham 2017), a potential context which could be very suited to sharing services for a circular economy. They reduce the need to buy toys used for a short duration, enable families (and/or childminders) to access a wider range of toys than they might otherwise be able to afford and can be space-saving (Packham 2017). A social practice viewpoint might consider people's competences to engage repeatedly and reliably with a short-term leasing arrangement, whether it is socially acceptable amongst peers to lease and exchange toys, alongside the material infrastructure of a given toy service.

This view has the potential to illuminate why new service approaches may be successful or unsuccessful by revealing difficulties that go beyond the removal of contextual barriers perceived from a social psychology viewpoint (Hargreaves 2011). Practitioners' identities and experience, social and power relations, and the process of socialization that practices might bring about are relevant aspects (Hargreaves 2011) that can affect the potential success of such sharing models.

Complexity of Consumption

Through the review, few studies were identified that consider people or consumers directly while substantial research has been undertaken on consumption within sociology. Considering the illustrative cases discussed allows for reflection on the complexity of consumption. Consumption can be understood in terms of a set of continua from the material to the symbolic; the social to the self; desire to satisfaction; rationality to irrationality; and between creativity and constraint (Elliott 1997).

People are influenced by a multitude of diverse and complex factors including: socialization, living conditions, alternatives on offer, and the cumulative effects of past choices (Vezzoli and Manzini 2008). Consumption is affected by quotidian factors, including habits, behaving in ways that conform or are expected (i.e. 'normative expectations'), shared cultural meanings, and 'material infrastructures', that taken together mean consumption behaviour cannot be understood on individual terms, but rather as a combination of 'recursive processes' that position consumption as an act embedded in social lives (Vezzoli and Manzini 2008). Understanding people's cultures, social situations,

desires, norms, habits, expectations and attitudes to new solutions will be required.

Much of the literature that does consider users does so from an innovation management perspective. Such studies focus on socio-demographic factors (age, income, education and gender) finding that user demographics and economic situations have a substantial impact on responsiveness to circular business models (e.g. Laroche, Bergeron, and Barbaro-forleo 2001). For example, in response to new take-back schemes, individuals who find themselves in precarious economic situations favour monetary incentives, whereas older citizens tend to opt for tax incentives, and men and women are found to behave differently depending on the scenario (Botelho et al. 2016). Yet, as we have seen, from a sociological viewpoint user choices are not rational. Thus, to develop circular business models requires changes in how businesses sell goods (Gregson et al. 2015) informed by much deeper insights and consideration of how people behave in practice (Lofthouse, Tringham, and Bhamra 2017; Tukker 2015).

Furthermore, many of the illustrative cases can be framed as mid-high-end luxury goods that tap into certain lifestyle trends (containing hedonic attributes which are associated with luxury brands) (Zhu et al. 2009) and as such they are limited in scope to a small wealthy portion of society, targeting high-income levels and a certain sense of identity (Babin, Darden, and Griffin 1994). Yet, the concept of luxury is subjective and therein contested in sociology (Lunt and Livingstone 1992). Luxury can be better considered as being relative to necessity where luxury is based on a 'socially defined comfort'. That is to say, consumption practices are socialized (Lunt and Livingstone 1992) and this issue has not been discussed within the circular economy debate.

Understanding users to inform business model success

Many models within the management and strategy literature place users at the centre of the circular business model concept (Bressanelli, Perona, and Sacconi 2017; Osterwalder and Pigneur 2010). The need for consideration of consumer-related factors is acknowledged. This is likely because such business models depend on use-phase interventions (e.g. repair, rental) (Nußholz 2017). Yet the persistent narrative of willing participation is assumed (Bakker et al. 2014). Only limited studies have included user-centred design or human-centred design, to date (Lofthouse and Bhamra 2006; Van Weelden, Mugge, and Bakker 2016). A greater understanding of the nuances of people's behaviour (Tukker 2015) with respect to the types of business models associated with the circular economy is required.

For instance, Lewandowski (2016) and Urbinati, Chiaroni, and Chiesa (2017) emphasize additional components that need to be considered within business models for the circular economy, such as customer irrationality and the 'customer value proposition and interface'. Nußholz (2017) also argues that effective development of business models needs to better explore users' predispositions. Lofthouse,

Trimingham, and Bhamra (2017) report that consumers in their study would not want to pay more for a concentrated product, even if it was stated that it would last 10 times longer. There was instead an expectation refills should be cheaper than the 'original' product and that a price incentive is expected (Lofthouse, Trimingham, and Bhamra 2017). This indicates an inability to recognize the cost savings of the concentrate as part of a circular business model, which in turn means that 'from an environmental perspective... there are limits as to how efficient refillable packaging [systems] can be' (Lofthouse, Trimingham, and Bhamra 2017).

In the current market, consumers have a choice between ownership or more constrained access to goods (i.e. leasing) (Perzanowski and Schultz 2016), typically provided through services. Product-service-systems have long been the promise of sustainability, but increasingly we observe heightened criticism of such servitization models that confront peoples' rights on multiple fronts (e.g. 'rights to repair', 'prohibition of lending' (Perzanowski and Schultz 2016)). Thus, 'ownership is a contested question' and the consequences of non-ownership business models on people and society have yet to be clarified (Perzanowski and Schultz 2016). The rise of do-it-yourself (Bonvoisin, Krishna Galla, and Prendeville 2017; Salvia 2016) and grassroots repair assert people's rights to ownership and repair and in doing so confront servitization business models typified in circular economy discourse.

As we can see from this summary of studies, the sociological perspective is so far absent. This means that users need more consideration in the theoretical conceptualization as well as the practical implementation of circular business models. This literature also overlooks that many such business models have been discussed for some time (Mont 2008; Tukker 2004) and to-date have failed to address over-consumption issues. One-off purchases/rentals, such as sufficiency-based designs, will not lead to societal sufficiency and many artefacts designed for sustainability we know do not achieve sustainability on the market due to issues like rebound effects.

Design considerations to support circular products and services

In this section, we summarize studies on designing for the circular economy that include human-centred design strategies.

Within the circular economy literature a strong emphasis is placed on product and design engineering design approaches (e.g. Bakker et al. 2014; Bocken et al. 2014, 2016; Moreno et al. 2016). In the design literature, design strategies which consider the symbolic meaning of 'person-product' relationships (e.g. through memory attachment and personalization) (Mugge, Schoormans, and Schifferstein 2005) have been developed as ways to overcome the knowledge-behaviour gap identified in pro-environmental consumers. Reported user aspects consider 'emotional / visual' (e.g. surface damage, wear and tear) reasons for product replacement (Bridgens and Lilley 2017) and technical

obsolescence (Cooper 2017). Similarly, Baxter and Childs (2017) reflect that developing understanding of people's relationships with possessions and of object attachment is necessary. In this way, design can be drawn on in a much fuller way, beyond design engineering practices, to better build upon these insights into people's social lives.

Recognizing that circular business models are largely predicated on the design and delivery of new services requires a range of additional considerations by design teams. Designing high-end services that users will take up is critical (Vogtlander et al. 2017), yet so far service design knowledge within this space is under-developed. New service contracts, need to consider the realities of people managing multiple service contracts for everything from pushchairs, to mobile phones, fridges and drills. Roos and Agarwal (2015) pose that designers play a key role in the development of services that can appropriately interface between the 'desired objective' and the 'desired behaviour change' of a given circular business model.

Being required to engage with services requires a wider range of new behaviours from the consumer, many of which are presumption activities, which would have traditionally been carried out by a company employee. This externalization of labour, known as the 'third job' is the work outsourced to the consumer by service providers, all of which puts pressure on the consumer and means they have less disposable time (Toffler 2013). Further, the more the customer is asked to do by way of unpaid work, the more important this sector of the market becomes (Toffler 2013).

Multiple use life cycles are more complex than traditional business models and require 'different configurations' for multiple sets of users (Nußholz 2017). This means that there is a temporal dimension to the use of products that has not needed consideration by designers in the past, ranging from short-term shared use (e.g. multiple users in a sharing community) and short-term multiple use (e.g. products that are needed for a specific period of time) to a long-term (i.e. changing user demographics previously discussed) dimension. den Hollander, Bakker, and Hultink (2017) describe how a hard-wearing pair of boots might need reinforcement to support the owner's feet better as she grows older.

Designers need to consider user interactions and communities of users' experiences with respect to the product and its context. At present, there are many assumptions around how users interact with the product after it has been purchased. In practice, there are many points where designers need to consider the people using the service: at the point of sale, during use and during any further interactions with a provider (e.g. in the Instant Ink example, every time a new cartridge is sent through the post or the service provision is altered).

Products and services that have communities of users of varying profiles (e.g. sharing models, such as the Toy library) need to consider the actual ways in which people use products and the shared practices within a community of users. This can be informed by drawing on social practice theory. For instance, factors such as 'contagion', for

example shared cars which smell of cigarette smoke (Bardhi and Eckhardt 2012), can lead to avoidance and even substitution behaviours brought on by a low-quality user-experience (Baxter, Aurisicchio, and Childs 2017). For designers, this means there is a need to design for equivalence of experiences between users. Product type and context are important indicators for user-centred design aspects in these scenarios, such as how domestic appliances may convey a 'hygienic look' (Bakker et al. 2014) or how designers need to consider trust relating to circular medical designs (Kane, Bakker, and Balkenende 2017).

Furthermore, Atlason, Giacalone, and Parajuly (2017) raise the issue of 'user mobility' where users may move between demographic brackets over the lifetime of a product, for example from 'Student life' to 'Career climbers' to 'Successful suburbs' (CACI CACI Limited 2014). So, where product longevity is the eco-strategy of choice, designers need to create products which respond to shifting demographic profiles across the product/service lifetime.

Design from 'User-as-Subject' to People as Partners

The intention of this integrated literature review is to broaden the role of designers within the circular economy agenda by emphasizing the role of people. In this article, we have chosen to discuss the nexus of design and society according to a human-centred design framing as this promotes an interest in people beyond our roles as users and consumers of commodities. In the design literature, designing for and with people has been considered across a continuum that considers 'users' as subjects towards 'users' as partners (Sanders and Stappers 2008; Steen 2007, 2011).

In the literature, we observe an emphasis towards a 'user-as-subject' framing of innovation, exemplified in the design of market-based lifestyle goods. For example, 'sufficiency' studies have simplistically referred to making 'products that last' by *allowing* users to hold on to them for as long as possible (Bocken et al. 2016). Similarly, Moreno et al. (2016) assume user behaviour issues are internalized and accounted for within a 'palliative' circular design approach focused on production (Moreno et al. 2016). Substantial work on how designers draw on sociology of technology using concepts of 'scripts' embedded in artefacts (Akrich 1997) to shape sustainable behaviour (Wever, van Kuijk, and Boks 2008; Lilley 2009; Wilson, Bhamra, and Lilley 2016) has been undertaken that could have greater representation within this body of work.

At the other end of the spectrum, participatory design takes an entirely different approach absolving power to users where participants co-define their own future use requirements (Björgvinsson, Ehn, and Hillgren 2010; Ehn 2008). Much of this work emphasizes the agency and power relationships as well as the cultural and contextual nature of human experiences (Steen 2011). For example, very little is discussed about how people engage with utility services (water/energy) where these are significant agendas within the circular economy and insightful

studies have been conducted within design, such as on bathing and water consumption (Kuijer 2014) and sustainable energy conservation (Haines, Mitchell, and Mallaband 2010).

While participatory innovation practices can befall the same criticisms as that of the ‘users as subjects’ framing (such as through exploitative open innovation practices) considering *people as partners* in innovation has the potential to broaden the remit of issues and design artefacts under consideration. This might establish questions of environmental and social justice (e.g. fuel poverty). Thus, there is an opportunity to develop understanding on the range of ways that people are conceived to be involved in circular solutions beyond taking the user-as-subject position.

Furthermore, within a user-as-subject framing people are seen as submissive recipients of innovation, reflective of a deterministic sense of how people behave in a society oriented towards positivism (Burrell and Morgan 2005). This deterministic viewpoint on human behaviour is not commensurate with design’s origins as a radical humanist paradigm (Johansson and Woodilla 2011). The social constructivist orientation of radical humanism (Burrell and Morgan 2005) means that design practice is future- and change-oriented where nuance and contextual considerations can enrich how designers think about people in society.

Discussion

Here, we reflect on a number of key themes identified through the analysis of the core and seed literature already discussed. This includes reflections on the complexity of people, their decision-making process and behaviour, how we might move towards more people-centred design approaches and the implications of framings of circular economy narratives on design ethics, perspectives and activity. This is followed by a observations for further research.

Nuance in person-product relationships

This paper raises questions as to whether people will buy-in to circular business offerings as they are currently conceptualized within the literature. Consumer purchasing is difficult to adjust and this affects the potential success of any potential circular business models. Whether or not a given type of circular business model will be successful depends on a multitude of nuanced and often subconscious human behaviours that can be perceived from multiple sociological perspectives.

From a socio-cultural standpoint, considering either the symbolic/semiotic meaning of identity creation and self-expressions through consumption practices (Bauman 2005) or the mediating perspective of materiality taken through a use-as-practice perspective (Shove 2010), would lead to a reconsideration of people beyond subjectification and individualization. From a semiotics viewpoint, consumer goods can be viewed as ‘signifiers’ or ‘sign values’ that attribute meaning, values

and social status to our consumer society (Braudrillard 1981). A social practice perspective would mean that designing for circular business models would consider how relations between skills, knowledge and resources emerge within an evolving and unfolding meaning-making (Shove 2010; Warde 2005). De Certeau's (1984) influential work on the practice of everyday tells us that these practices may shift depending on history, culture and political meaning. A number of studies that take either social practice theory (Jong and Mazé 2010; Kuijer and De Jong 2011) or semiotics theories (Santamaria, Escobar-Tello, and Ross 2016) as a framing to inform sustainable consumption/behaviour can be drawn on to inform a richer design discourse in circular economy contexts.

Crucially, socialization towards higher levels of consumption, the interdependent relationship between purchases and the residual influence of past consumption behaviours all coalesce to inform human behaviour in the present (Douglas and Isherwood 2009). Therefore, the authors suggest that there is a need for a more theoretically informed understanding of how people behave in order to avoid developing naive designs and business models which may not progress beyond pilot schemes, single-line products or products that have poorly informed understanding of human behaviour.

Towards Human-centred Design Solutions

Through the literature and illustrative case studies, we observe that design practice is integrated within the circular economy literature from a positivist viewpoint (i.e. design engineering, design strategies, technical design principles, eco-design). Within this framing of design practice, designers need to consider a number of additional aspects in the development of solutions for a circular economy.

All of the illustrative cases described here can benefit from a broader discussion on the role of design. For example, in the context of high-end durable items, such as the '30 Year Jumper' (Cridland 2017), at the point of sale, designers might think about ways to overcome false economies and invest in higher-quality goods that are still affordable to them. Alternatively, while refillable biros and pens are a useful example of a hybrid business model, many such items remain in people's drawers un-refilled and unused, due to forgetfulness, a lack of time to source the refills or because of the commonplace nature of ordinary pens. In such examples, drawing on theories from the sociology of consumption might be beneficial to increase the likely use of these options.

This is all the more prescient given that recent research has recognized that designers face a number of challenges when it comes to considering sustainable design in the professional practice (Stevenson et al. 2011). Issues around availability of information, a lack of confidence in their ability to address sustainable design issues, limitations set by the client and whether more sustainable approaches make it to market at all, have contributed to a lack of seed change in this area

across the design industry (Lofthouse 2017). The need for additional considerations may add further to these challenges.

Considering ethics within circular economy framings

While some circular economy management studies consider aspects of consumption (De los Ríos and Charnley 2016; Mugge, Jockin, and Bocken 2017; Murray, Skene, and Haynes 2015; Van Weelden, Mugge, and Bakker 2016) this area is currently under-addressed in the literature, and is a considerable challenge in terms of practical application. Currently, many examples are ‘Lifestyle’ products. Hobson and Lynch (2016) state that if we are to realistically take the circular economy as the transformative agenda that it seeks to be, we must address ‘deeply embedded’ societal issues of overconsumption and consumerism. This reflects a number of alternative positions (Frenken 2017; Hobson and Lynch 2016) that question the socio-economic norms, ethics and actors (Hobson and Lynch 2016) whose agendas are upheld within the innovation management emphasis of circular economy literature. This is all the more prescient in an age of significant societal and technological changes that reshape people’s relationships with products, raising important ethical questions that design needs to better consider. Better integration of sociological perspectives, such as those discussed here, can take steps to redress this imbalance.

Contemporary design narratives (e.g. Bakker et al. 2014) reveal how people exchange convenience for huge quantities of information about their daily personal lives. We have to ask what the larger cost of ‘access’ for people actually is. We are living in a time of rapid technological advances that, it is widely accepted, are poorly understood with respect to personal privacy and consumer rights (Toffler 2013). The significance of these issues is underexplored within this body of literature and for a truly human-centred design approach the ethics regarding what is exchanged and how people engage with products and services need to be considered. These issues are more fully addressed in related bodies of literature on sharing economy and would benefit from a fuller discussion within the circular economy debates.

At present, the design for circular economy literature takes a narrow position on its starting point to designing for people, leading to a framing of the circular economy that is severely wanting. A broader conception of people’s lives and day-to-day problems, as well as for whom the circular economy might be conceived, would begin to correct this shortcoming. This would push design practice towards more participatory design approaches and would draw on design’s roots as a humanist and/or interpretivist/structuralist practice (Johansson and Woodilla 2011).

Areas for Further Research

This review article has allowed for the identification of a number of areas of further research to support the development of theory and practice

within design for the circular economy. Key outstanding research questions are identified as follows:

- How and what interdisciplinary perspectives (e.g. semiotics, cultural sociology, consumer psychology) should be drawn on to inform and develop circular design theory?
- What new business approaches emerge when taking a human-centred design approach that are so far unobserved? How can we determine if novel business models are sustainable?
- What is the role of a humanist/interpretive design practice within the circular economy?
- How can service design utilize digital technologies, data and user feedback/responsiveness, in facilitating human-centred approaches to circular economy innovation?
- What can be gleaned from taking a more participatory approach to circular economy innovation?
- What are the ethical questions that need to be drawn out with respect to designing for users in circular economy contexts? In particular, what power imbalances, data and privacy rights, as well as uneven development issues are at play? How can designers reconcile these issues?

However, while there is much work to be done, there is also a clear need to better build on existing knowledge developed from both within and outside of the discipline of sustainable design, incorporating past lessons as well as recognizing that much existing research not framed as circular economy can contribute to this emerging field.

Conclusions

This paper sought to broaden the circular economy discussion by emphasizing the role of the user. Through this review, we have identified a number of areas for further research to initiate a fuller discussion on the designer's opportunity within circular economy research. The article identified that the positioning of design within circular economy innovation is located within the fields of engineering, innovation management, and ecological and environmental science, reflecting a dominant positivist paradigm that leads to the treatment of users as passive subjects of innovation. This is reflected in a range of luxury/lifestyle consumer products being developed that are positioned within mid-high-end markets. The article observes that this positioning of the designer's role overlooks its potential to facilitate innovation with people as participants and therein respond to the circular economy by bringing design's humanist and/or interpretivist/structuralist perspectives to bear on it.

Research on design in the circular economy needs to develop knowledge on designing products and services by considering norms, behaviours, attitudes and the contexts of people's social lives. This

needs to be considered in light of past research on alternative consumption models, recognizing the immense challenges of behaviour change and sustainable consumption.

Broadening the conceptualization of the designer's opportunity within the circular economy would benefit from integration of knowledge from the social sciences (social practices, consumer psychology, cultural studies, *inter alia*) as well as a critical debate on the philosophies behind and ethics of design practice within divergent circular economy framings. The article lays a basis for further research and theory-building.

This paper concludes by arguing that changing the way that the circular economy is framed so that it is more inclusive of people and their behaviours would open up a broader and more nuanced debate on the role of design within a multitude of possible circular economy futures. Expanding the designer's opportunity beyond what we observe as positivist design engineering approaches, would present opportunities to respond to the very real societal issues that we face.

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Biographies

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Sharon Prendeville is a lecturer in design innovation at Loughborough University's new London School. Her research takes a critical design management perspective on new sustainability contexts for design. She is interested in the creation of sustainable futures through innovation in the governance of resources by alternative modes of production and alternative business models.

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Appendix A. Overview on Search Strings and Articles Returned

<i>Search String</i>	<i>No. of Articles Returned</i>	<i>No. of Articles Selected (stage 1)</i>
TITLE-ABS-KEY ('business model innovation' 'circular economy')	13	9
TITLE-ABS-KEY ('business-to-consumer' 'circular economy')	0	0
TITLE-ABS-KEY ('circular business models')	19	17
TITLE-ABS-KEY ('circular design')	141	11
TITLE-ABS-KEY ('circular economy' 'service design')	3	2
TITLE-ABS-KEY ('circular economy' 'user-centred design')	1	1
TITLE-ABS-KEY ('circular product design')	2	2
TITLE-ABS-KEY ('Circular thinking')	15	0
TITLE-ABS-KEY ('customer segmentation' 'circular economy')	0	0
TITLE-ABS-KEY ('customers' 'circular economy')	37	8
TITLE-ABS-KEY ('designers' 'circular economy')	34	10
TITLE-ABS-KEY ('human centred design' 'circular economy')	0	0
TITLE-ABS-KEY ('service design' 'circular business models')	1	1
TITLE-ABS-KEY ('sustainable behaviour' 'circular economy')	0	0
TITLE-ABS-KEY ('users' 'circular economy')	39	15
TITLE-ABS-KEY ('Circular practices')	2	2
TITLE-ABS-KEY ('sustainable behaviour' 'circular economy')	1	1
TITLE-ABS-KEY ('sustainable behaviour' 'circular economy')	0	0
TITLE-ABS-KEY ('sustainable design' 'circular economy')	8	6

Appendix B. Journal Fields hosting core literature on circular economy

<i>Journals</i>	<i>Field</i>
Fashion Practice	Cross disciplinary: economics, earth sciences, social sciences
Sustainability	Ecology and earth sciences
Journal of Industrial Ecology	Ecology and earth sciences
Journal of Cleaner Production	Ecology and earth sciences
Procedia CIRP	Engineering
Journal of Industrial and Production Engineering	Engineering/Operations
International Journal of Sustainable Engineering	Engineering/Operations
Resources Conservation and Recycling	Environmental Sciences/ Engineering
Futures	Interdisciplinary: Economics, Sociology, Management
Business Horizons	Management
Business Strategy and the Environment	Management and ecology
Research Policy	Management and economics
Economy and Society	Sociology and economics
Philosophical Transactions of the Royal Society	Interdisciplinary: Economics, Sociology, Philosophy