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Abstract: To address the current unsustainability of socio-technical-ecological systems, humanity and design should increasingly consider the needs of natural entities. This paper outlines initial considerations for nature-inclusive Collaborative and Participatory Design (C&PD) by critically questioning the approach through the perspective of a bioinclusive ethic, one of the nature-inclusive ethical frameworks. It suggests that bioinclusive C&PD and its sub-approaches would explicitly acknowledge nonhumans as non-designers and would, to a varying extent, involve them in the design processes. They would explicitly outline the benefits of involvement of human and nonhuman non-designers and grant goal-setting and decision-making power to the latter. Bioinclusive participatory design would explicitly acknowledge humans and nonhumans in its core principles and directly or indirectly involve the nonhumans. Bioinclusive collaborative design before use would ensure that nonhumans can impact the goals of the project. Finally, bioinclusive collaborative design-in-use might embrace nonhuman-made adjustments to designs during the use time.

Keywords: Bioinclusive Design, Nature-Inclusive Design, Collaborative Design, Participatory Design, Bioinclusive Ethic

1. Introduction

There is an urgency for society to address the current unsustainability of socio-technical-ecological systems. In 2017, over 15 000 scientists signed a petition encouraging society to take immediate action against current unsustainable practices (Ripple et al., 2017). Among the various causes for the crisis outlined, there is the anthropocentric culture of humanity (e.g. see Ceballos et al., 2015; Ripple et al., 2017; Watts, 2018). Humans tend to focus on their own needs while ignoring, diminishing or denigrating the needs of other species and natural systems (Hajjar Leib, 2011; Kotzé, 2014). The anthropocentric culture has manifested itself strongly also in design.

Design has always focused on satisfaction of human needs and wants, first through technology-driven and then through human-centred practices. Collaborative and Participatory Design (C&PD) emerged in the second half of the 20th century to even further support humans in shaping solutions that satisfy their needs and wants (Simonsen & Robertson, 2012). Through direct participation in design processes, human stakeholders have been "empowered" to create products, services or

systems that satisfy their needs and wants better. Such design processes tend to focus only on the humans and, typically, leave out considerations about the nonhumans. Meanwhile, transitions towards sustainable futures require increased and urgent consideration of the needs of nonhuman living beings and natural systems. Therefore, a more nature-inclusive design discipline should be envisioned.

C&PD could be one of the subfields of design that could evolve to be more inclusive of and considerate towards needs of natural entities and systems. C&PD encourages representation and participation of different perspectives; this characteristic can serve as a good starting point for rethinking the C&PD and the design discipline overall. Several researchers (e.g. see Avila, 2017; Forlano, 2016; Jönsson & Lenskjold, 2014; Mancini, 2011; Thomas, Remy, & Bates, 2017; Westerlaken & Gualeni, 2016) have started questioning and rethinking design as a more nature-inclusive discipline. However, their work does not yet constitute a holistic perspective for nature-inclusive C&PD. Such perspective could arise from a systematic assessment of the C&PD and its reinterpretation through a nature-inclusive lens. This paper outlines initial considerations about the nature-inclusive design by critically analysing the human-centric value base of C&PD through the lens of the bioinclusive ethic, one of the nature-inclusive ethical frameworks. It outlines seven implications for C&PD to become a more bioinclusive discipline. Here, nature-inclusive design refers to a design discipline that incorporates perspectives of various environmental ethics; meanwhile, bioinclusive design and bioinclusive C&PD only incorporates perspectives of the bioinclusive ethic.

2. Methodology

To develop an understanding of bioinclusive C&PD, a two-part, systematic integrative literature review was conducted. The first part aimed to develop an understanding of the bioinclusive ethic and its characteristics. The second part aimed to build an understanding of C&PD, its main approaches and review the existing examples of bioinclusive and nature-inclusive thinking and doing in C&PD. The review was structured around a systematic literature review process (Booth, Sutton, & Papaioannou, 2016; Grant & Booth, 2009). First, a total of 345 resources were found using 39 search terms, expert suggestions, and bibliographic and citation searches. Then, appraisal strategies were developed to guide the selection of resources to be reviewed. Among the resources compiled, 121 of them were selected to be reviewed in detail. The selected resources were reviewed qualitatively. Further details of the systematic review can be found in Veselova (2018).

The key findings of this systematic review were integrated to develop partial insights: each key insight about C&PD was questioned through each of the key insights about the bioinclusive ethic. The final implications were developed by merging the partial insights. Additionally, each implication was further explained through examples of nature-inclusive projects described in C&PD publications.

3. Collaborative & Participatory Design

Design processes typically include two types of participants – designers and non-designers. Designers are accountable for the design process and relevant approaches to be employed in a particular project (Bødker, Kensing, & Simonsen, 2011). Predominantly, designers have been formally trained in designing. The non-designers are all other stakeholders of the process, e.g. commissioners, experts who can contribute relevant theoretical or practical knowledge and the ultimate users of the outcomes (Bødker et al., 2011; Simonsen & Robertson, 2012; Zhang & Dong, 2016). Increasingly, the stakeholders of the processes have been assigned more active design roles, and their title has been

shifting to, e.g., co-designers. Nevertheless, this paper deliberately uses the term non-designer to refer to all stakeholders relevant to the process without formal training regardless of the level of their involvement in the act of designing across the spectrum of degrees of participation. Design researchers and participatory development researchers (e.g. see Harder, Burford, & Hoover, 2013; Hyysalo & Johnson, 2015; Lee, 2008; Zhang & Dong, 2016) would arrange the spectrum and name its levels in differing ways. However, the variety can be summarized in a six-level spectrum (Figure 1).
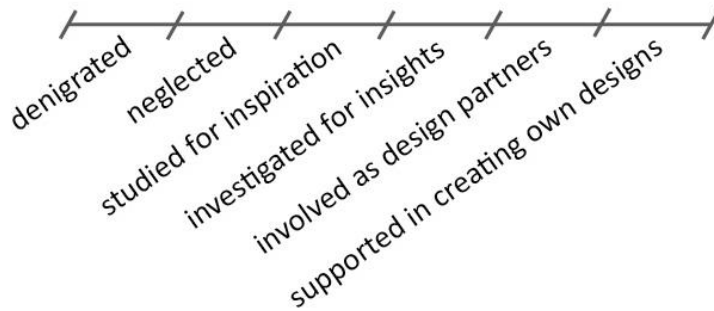

Figure 1. Spectrum of non-designer involvement in design processes.

On this spectrum, C&PD corresponds to the 'non-designers involved as design partners' level. At this level, non-designers are actively involved in the design process as partners (Lee, 2008; Sanders & Stappers, 2008; Zhang & Dong, 2016). In C&PD, designers are typically seen as experts of the design process (Taffe, 2015) while non-designers are seen as experts of their own lives (Simonsen & Robertson, 2012) who can contribute perspectives and knowledge from various domains and levels of expertise (Mattelmäki, Brandt, & Vaajakallio, 2011). Though these basic principles are similar, the overall C&PD framework is flexible with regards to focus of the processes, e.g. research or design focus (Sanders & Stappers, 2008; Steen, 2013), actors that lead and set goals for the process, e.g. designers or non-designers as leaders (Lee, 2008; Sanders & Stappers, 2008; Steen, 2013). C&PD is also flexible with three parameters of participation: (1) depth: the extent to which non-designers can make decisions in the process, (2) breadth: the number and variety of the stakeholders involved and (3) scope: the stages of the process non-designers are involved in (Harder et al., 2013).

There are four main reasons for non-designer involvement in C&PD: political, pragmatic, innovativeness-related and commercial. The political reason, sometimes also referred to as the moral underpinning, highlights that people should be able to affect design decisions that influence their lives (Bannon & Ehn, 2012; Carroll & Rosson, 2007; Kujala, 2003; Simonsen & Robertson, 2012; Vines, Clarke, Wright, McCarthy, & Olivier, 2013). The pragmatic reason accentuates that participation of non-designers increases the quality, applicability and usability of the designs (Bradwell & Marr, 2008; Carroll & Rosson, 2007; Hyysalo & Johnson, 2015; Kristensson & Magnusson, 2010; Lundström, Savolainen, & Kostiainen, 2016; Steen, 2011). The innovativeness-related reason highlights that participation of non-designers increases the amount of and innovativeness of ideas and design outcomes (Kristensson, Magnusson, & Matthing, 2002; Mitchell, Ross, May, Sims, & Parker, 2016). Finally, the commercial reason emphasizes that participation of non-designers, especially of the future customers, strengthens the brand, builds customer loyalty and, ultimately, increases competitiveness and revenue of the organization (Kristensson et al., 2002; Sanders & Stappers, 2008; Steen, Manschot, & De Koning, 2011; Vargo & Lusch, 2004). The flexibility of project parameters and differing reasons for non-designer involvement have resulted in development of a vast array of C&PD approaches.

This vast array has created confusion about the meaning of the terms and classification of the approaches and the sub-approaches. There seems to be a lack of standard terminology and framework of approaches for non-designer participation (Taffe, 2015). The terms participation, participatory design, co-design, co-creation, and collaborative design carry multiple meanings (Harder et al., 2013; Lenskjold, Olander, & Halse, 2015; Sanders & Stappers, 2008). Moreover, C&PD researchers organize their understanding of the subfield into dissimilar frameworks (e.g. see Hyysalo & Johnson, 2015; Sanders & Stappers, 2008; Steen, 2011). Therefore, the authors devised their own classification of approaches within the field according to two parameters: (1) design time or use time (Fischer, Nakakoji, & Ye, 2009) of the participation and (2) reason underlying non-designer participation.

The authors organized sub-approaches of C&PD into three groups: participatory design (PD), collaborative design before use (CoDBU), and collaborative design-in-use (CoDIU). The PD category includes those sub-approaches that focus on the political reason of non-designer participation (Bannon & Ehn, 2012; Carroll & Rosson, 2007; Hyysalo & Johnson, 2015; Kujala, 2003; Simonsen & Robertson, 2012; Vines et al., 2013) during design time (Ehn, 2008). This group includes the classical Scandinavian PD and contemporary PD. The CoDBU category includes those sub-approaches that involve non-designers due to pragmatic, innovativeness-related or commercial reasons (Bannon & Ehn, 2012; Steen, 2011; Teli, Di Fiore, & D'Andrea, 2017) during the design time (Giaccardi & Fischer, 2008; Steen et al., 2011). This category includes approaches that are typically called co-design, co-creation, collaborative design, co-creative design and cooperative design (Botero & Hyysalo, 2013; Halskov & Hansen, 2015; Mattelmäki et al., 2011; Mattelmäki & Sleeswijk Visser, 2011; Sanders & Stappers, 2008). The CoDIU category encompasses those sub-approaches that involve non-designers during the use time, after the solution has been taken into use (Botero & Hyysalo, 2013; Giaccardi & Fischer, 2008; Hyysalo & Johnson, 2015) regardless of the reason for participation. The category includes meta-design (Botero & Hyysalo, 2013; Ehn, 2008; Fischer, Giaccardi, Ye, Sutcliffe, & Mehandjiev, 2004; Fischer et al., 2009), lead-user approach (Churchill, von Hippel, & Sonnack, 2009; Hyysalo et al., 2014; Kristensson & Magnusson, 2010; Steen, 2011; Von Hippel, 2005) and living labs approach (Almirall & Wareham, 2011; Garcia Robles, Hirvikoski, Schuurman, & Stokes, 2016; Hyysalo & Hakkarainen, 2014; Kanstrup, 2017; Mulder & Stappers, 2009). These three approach groups, along with the reasons of participation, parameters of participation, non-designer involvement spectrum and pre-requisites for being a non-designer can be questioned through the perspectives of the bioinclusive ethic.

4. The Bioinclusive Ethic

The bioinclusive ethic is an ethical framework outlined by environmental philosopher Freya Mathews (2011). The ethic expands the arena of moral considerations from including only humans to also including the nonhumans, both individual organisms and natural systems (Mathews, 2011). "Even if it is conceded that our moral reasoning starts within the human circle, this circle needs to be expanded to include the interests of the members of the larger life system" (Mathews, 2011, pp. 365–366). The bioinclusive ethic strives to reshape the current dualistic worldview, which posits humans as detached from and superior to nature, into an inclusive one, which would see humans and nature as parts of one joint whole (Mathews, 2011). Such positions are similar to the ideas of deep ecology (Drengson, 2005; Naess & Sessions, 1984). Nevertheless, Mathews (2011) stresses that bioinclusive ethic, in contrast to biocentrism and, e.g., deep ecology, does not strive to strip away the human culture, self-meaning and self-intentionality nor to place an ecological but culture-less, primitive, nature-dependent human into nature (Mathews, 2011). Instead, it focuses on creating an

appealing, novel, larger worldview that encompasses both, the cultural human and nature (Mathews, 2011). This worldview would be based on the deeper notions that the ethic carries.

The bioinclusive ethic has three interrelated principles. First, it advocates for a non-dualistic perception of nature and a more equal moral standing to humans and other natural entities (Mathews, 2006, 2008, 2011). In the current dualistic view, nature is defined as something detached from, autonomous of and inferior to humans (Mathews, 2011; Palmer, McShane, & Sandler, 2014). The ethic suggests a more inclusive definition in which belonging to nature is defined through conativity, attributed both to humans and nonhuman natural entities, and assigns moral standing to all elements of nature (Mathews, 2008, 2011). In the context of the bioinclusive ethic and this paper, the terms nonhuman and nonhuman natural entity refer to the widest possible range of natural entities, including but not limited to individual animals, plants, organisms, ecosystems and natural systems. Second, the ethic advocates that nature and its parts should not only be viewed as materials and resources but also as living entities with self-meaning (Mathews, 2006, 2008). The ethic criticizes the instrumental, materialistic perception of nature currently prominent in Western sciences and societies (Mathews, 2006, 2008). As a replacement, it suggests a post-materialistic view of nature in which nature is interpreted as a system of living beings with self-intelligence and the ability to experience the world around themselves in particular, peculiar ways (Mathews, 2006). Third, the ethic urges humanity to shift from domination over nature to a synergetic relationship with it (Mathews, 2006, 2010, 2011). In domination, nature is only a material, an instrument to satisfy human needs and desires; meanwhile, in synergy, the natural entities and systems would shape and guide the goals and actions of humanity (Mathews, 2006, 2010, 2011). The ethic suggests that the synergetic relationship is the most sensitive to the needs of natural systems and, thus, could be viewed as the relationship between humans and nature with the highest potential for yielding to sustainability (Mathews, 2011). These three principles – a more equal moral standing, non-materialistic view of nature and a synergetic relationship between humans and nature - served as the key perspectives through which to critically analyse C&PD.

5. Seven Implications of Bioinclusive Ethic on C&PD

C&PD is a vast, diverse, human-centred approach to design, and many of its aspects could be questioned through the perspective of the bioinclusive ethic. This paper focuses on seven key aspects that could serve as starting points for a discussion about a more bioinclusive and nature-inclusive C&PD:

1. The conception of non-designers,
2. The six-level spectrum of non-designer participation,
3. The goal-setting and decision-making roles in the processes,
4. The reasons for non-designer participation,
5. The grounding principles of participatory design,
6. The grounding principles of collaborative design before use,
7. The grounding principles of collaborative design-in-use.

The following section presents seven potential implications that stem from application of the principles of the bioinclusive ethic on these seven aspects of C&PD.

5.1 Implication 1: Bioinclusive concept of non-designer

The first implication indicates that a more bioinclusive C&PD would need to recognize nonhumans as potential designers and non-designers. It is hard to imagine a nonhuman trained in designing;

therefore, the authors do not claim that nonhumans could be designers. However, the current definition of the non-designers does not prescribe any specific skills or training that the stakeholder should have. This absence of pre-requirements allows C&PD to view nonhumans as potential non-designers of the process. Moreover, the bioinclusive ethic suggests that: (1) nonhumans might possess certain knowledge, understanding and perspectives that might be vital to the design processes and outcomes; (2) if goals of nonhumans should shape human goals and needs, then these natural entities should be involved as participants in the design processes. Therefore, a bioinclusive C&PD research and practice would explicitly recognise nonhumans as non-designers.

Several authors within C&PD have already been questioning the human-exclusive definition of non-designer. Thomas et al. (2017, Chapter 3) have proposed that the definition of a stakeholder to include "an object, person, animal, ecosystem or organisation having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations". This paper uses the term non-designer to describe the stakeholder. Schweikardt (2009) has urged designers to recognize humans, other living beings and the Earth as indisputable stakeholders of design processes. Meanwhile, Forlano (2016) argued for de-centring the human as the only focus of design processes. Moreover, some design researchers and practitioners, especially in the Animal Computer Interaction (ACI) domain, acknowledge animals and plants as legitimate non-designers of the process. They tend to view nonhumans as potential contributors (Aspling, Wang, & Juhlin, 2016), as the future users (Driessen, Alfrink, Copier, Lagerweij, & Peer, 2014; Wirman & Jørgensen, 2015), as direct participants of design experiments (Jönsson, 2014), as less powerful stakeholders of design processes whose rights need to be defended (Mancini, 2011), or as co-designers (Westerlaken & Gualeni, 2016).

5.2 Implication 2: Bioinclusive concept of non-designer participation spectrum

If the definition of non-designer would be expanded to include both humans and nonhumans, the spectrum of non-designer involvement in design processes would need to represent both types of non-designers. To accentuate the inclusion of nonhuman perspectives, the authors choose to showcase the involvement of humans and nonhumans on two separate spectrums. These two spectrums could be combined as a matrix consisting of two perpendicular axes: X axis representing involvement of nonhumans and Y axis represents involvement of humans (Figure 2). The bioinclusive matrix of involvement suggests that the traditional C&PD, which involves human non-designers as design partners, would be categorised into six types: (1) collaborating with humans and denigrating non-humans; (2) collaborating with humans and neglecting non-humans; (3) collaborating with humans and studying non-humans for inspiration; (4) collaborating with humans and investigating non-humans for insights; (5) collaborating with humans and non-humans; (6) collaborating with humans and supporting design done by non-humans. Design by non-humans here refers to instances when natural entities create a situation or context that is desirable for them which resemble instances when non-professional human designers create solutions for themselves.

The bioinclusive perspectives seem to align better with the last three categories. On one hand, the bioinclusive ethic suggests that nonhumans have particular, peculiar experiences of the world and themselves. They could be viewed as experts of their lives who can provide invaluable, unique perspectives, interpretations, knowledge and ideas to the design processes. Therefore, their perspectives would need to be studied for inspiration, investigated for insights, and they could be involved as design partners or supported in their own design initiatives. On the other hand, the bioinclusive ethic suggests that nonhumans should have the ability to shape the goals, desires and designs of humans via direct interaction (Mathews, 2010, 2011), yet this does not define whether the

encounters should happen between the nonhumans and one, several, many or all humans. The nonhumans should not only inspire the humans but should directly interact with at least one human to shape the goals of the design process. They could also directly interact with several or many human stakeholders involved in the process. Therefore, a bioinclusive C&PD might collaborate with human non-designers while investigating nonhuman non-designers for insights, involving them as design partners or supporting the design work done by nonhuman non-designers.
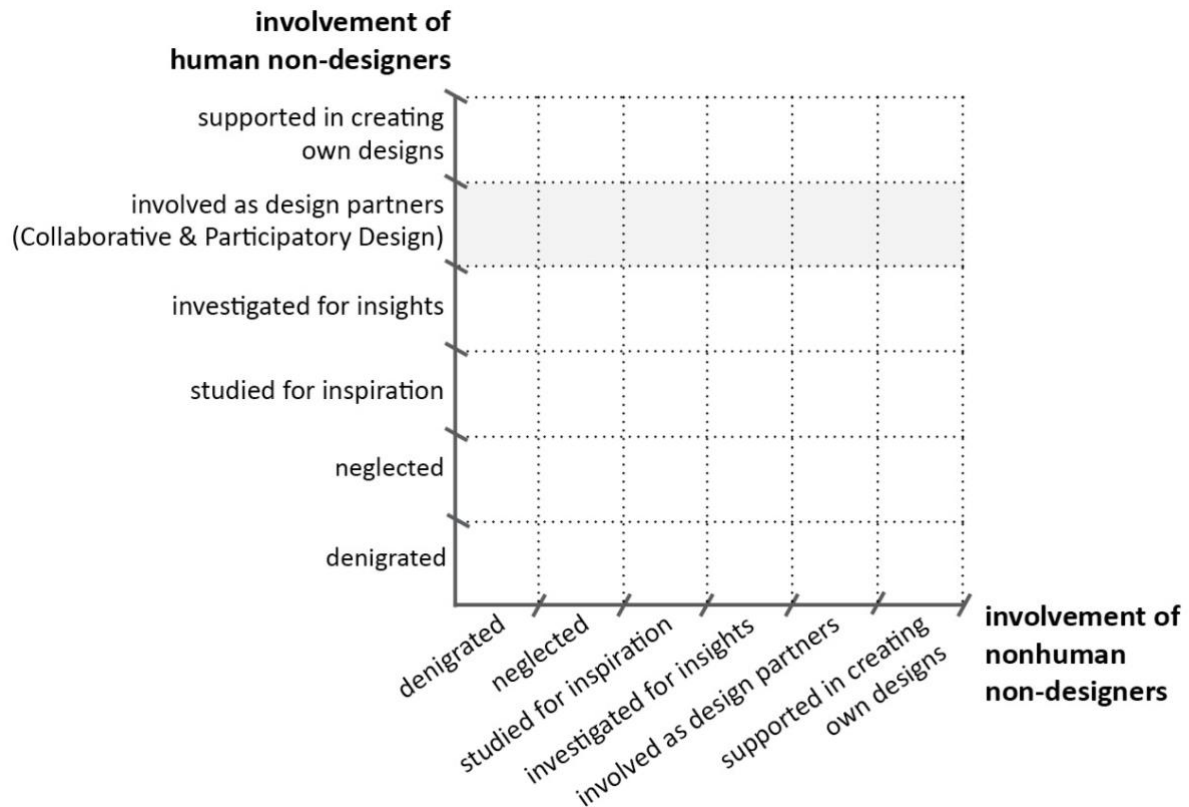

Figure 2.   Matrix of human and nonhuman non-designer involvement in design processes.

Several researchers in the C&PD community have already questioned the potential extent of nonhuman non-designer involvement. One category of researchers recognizes nonhumans as non-designers and the need to involve this type of non-designers in some way, yet they also highlight that these non-designers might never be equally involved (Ritvo & Allison, 2014) or be ethically equal to human participants (Westerlaken & Gualeni, 2016). A second category of researchers tend to recognize nonhuman non-designers and investigate them in their natural habitat without involving them as direct participants or partners (e.g. see Avila, 2017; Bastian, 2016; Bos, Koerkamp, Gosselink, & Bokma, 2009; Isokawa et al., 2016; Wirman & Jørgensen, 2015). Yet a third category of researchers strive to involve nonhumans, most commonly mammals, as active design partners or co-designers (e.g. see Jørgensen & Wirman, 2016; Mankoff, Dey, Mankoff, & Mankoff, 2005; Westerlaken & Gualeni, 2014, 2016).

5.3 Implication 3: Bioinclusive concept of goal-setting and decision-making

As discussed above, the bioinclusive perspective suggests that nonhumans should be able to guide the goals of humanity. In addition, through a synergetic relationship, nonhumans should be able to impact the goals of humans to realign them to the goals of natural systems (Mathews, 2011). Thus,

natural entities should also guide the goals of design processes. Traditionally, the goals of the C&PD processes have been set by human designers, human non-designers or both. The bioinclusive notions suggest that goals should be shaped also by nonhuman non-designers. Therefore, these goals could be shaped by nonhumans together with designers, human non-designers or by all three parties together. However, the goals of the process might not be achieved without making design decisions that contribute to achieving these goals. The decisions along the design process should also be made in relation to the perspectives of the nonhumans and their goals. Nonhuman non-designers should have at least some decision-making or decision-shaping power. Thus, a bioinclusive C&PD would grant goal-setting and decision-making power to the nonhuman non-designers.

Such considerations have especially been prominent in ACI, which views animals as direct stakeholders and participants of the design process. Grillaert and Camenzind (2016) questioned whether animal participants are actually able to set the goals of the process, e.g., whether a dog actually would prefer to play a video game with the owner developed with ACI methods rather than going on a hike (Grillaert & Camenzind, 2016). Westerlaken and Gualeni (2016) have highlighted that, predominantly, only humans seem to have decision-making power in ACI processes. In their project, they tried to break this paradigm by acknowledging and respecting behaviour of one dog participant which indicated that the dog did not want to take part in the activities (Westerlaken & Gualeni, 2016). In another project, Jørgensen and Wirman (2016) also strived to acknowledge and respect potential desires and decisions of orangutan participants.

5.4 Implication 4: Bioinclusive reasons for non-designer participation

Recognition of nonhumans as non-designers would reshape the reasons of non-designer involvement. The initial attempt at outlining bioinclusive reasons might simply acknowledge both types of non-designers, side by side, as follows:

- Political/moral reason: both human and non-human non-designers should be able to partake in and affect decision-making that will affect their future.
- Pragmatic reason: participation of both human and non-human non-designers could assist designers in developing solutions that better satisfy the needs of *all* stakeholders of design processes. This could also be viewed as the sustainability reason for participation, as the design outcomes would be more aligned with the needs of natural systems.
- Innovativeness-related reason: involvement of both, human and nonhuman, non-designers might increase the number and innovativeness of the ideas, concepts and design solutions because nonhumans are able to provide perspectives unimaginable to humans.
- Commercial reason: involvement of both, human and non-human, non-designers could strengthen brands and create new commercial opportunities.

Thus, a bioinclusive C&PD could explicitly outline reasons for participation that represent the benefits of involvement of not only human but also nonhuman non-designers.

So far, C&PD researchers have predominantly pondered upon the pragmatic reasons of nonhuman involvement, and three of them have directly linked it to sustainability. Thomas et al. (2017) link the sole focus on humans in human-centred design to environmental degradation and suggest that, to decrease this impact, the circle of consideration should be expanded to include nonhumans. Schweikardt (2009) highlighted the large, negative impact that design decisions have on the Earth and urged the design community to include considerations about "animals and the Earth" to mitigate these impacts. Mancini (2013, p. 2235) indicated that "through designing-with other species, ACI

could help us reassess what sustainability is about and reconsider our place within a shared, fragile ecosystem". Moreover, ACI has highlighted the political or moral reasons for involving animals in the design process, as it views animals as "equally deserving of consideration, respect, and care according to their needs" (Mancini, 2011, p. 72). Meanwhile, as yet, there seem to be no explicit consideration about more nature-inclusive innovativeness-related or commercial reasons.

5.5 Implication 5: Bioinclusive Participatory Design

The bioinclusive perspectives suggest that nonhumans, which currently are viewed as inferior to humans and are excluded from nearly all design processes, are equal to humans and should guide the goals of humanity. These notions strongly relate to PD. Currently, PD represents those sub-approaches that strive to give people voice and decision-making power in design processes. It is based on five core principles: (1) designing for real people; (2) 'genuine' participation of non-designers which includes sufficient access to resources and decision-making power; (3) mutual learning among all participants; (4) use of action-based tools and methods that boost participation, engagement, communication and mutual learning; and (5) commitment to understanding practices of people (Kensing & Greenbaum, 2012; Simonsen & Robertson, 2012). These core principles would need to evolve, and the principles of bioinclusive PD might be as follows:

1. Designing with real humans and nonhumans for real humans and nonhumans;
2. 'Genuine', active participation of human and nonhuman non-designers and sufficient resources and decision-making power for both;
3. Mutual learning among all human and non-human participants;
4. Use of appropriate, action-based tools and methods through which human and non-human participants can express and understand each other's perspectives, needs, desires and challenges;
5. Equal commitment to understanding practices of humans and nonhumans.

Such bioinclusive PD could be envisioned in theory or as a speculation. Nevertheless, it can be challenging to implement in practice due to underlying differences between humans and nonhumans. Nonhumans are likely to have particular perspectives and experiences of the world that are unimaginable for humans or other nonhumans. Each type of participants could be communicating in a manner that is not understandable for others. These communication challenges between humans and nonhumans and among several nonhumans are a substantial challenge for bioinclusive PD. It might be impossible for PD designers to initiate, justify and facilitate fully bioinclusive projects. Nevertheless, it would be possible to make the processes more bioinclusive without fully fulfilling the bioinclusive PD core principles outlined above. As discussed above, nonhumans could be involved in bioinclusive processes in three ways: through investigation for insights, involvement as design partners and support of their design initiatives. It is possible to imagine PD processes in which nonhumans are not involved as direct participants but are investigated and represented by human participants. Such processes would also be bioinclusive, and the core principles for such bioinclusive PD processes would be different. Definition of such principles lies beyond the scope of this paper. Nevertheless, a bioinclusive PD would explicitly include both humans and nonhumans in its core principles and would directly involve human non-designers while directly or indirectly involving the nonhuman non-designers.

Several projects seem to have started initial considerations of a more nature-inclusive PD. Frawley and Dyson (2014) strived to have a PD process that included birds, but the birds were not direct participants of the process and their perspectives were represented by humans. Mankoff et al. (2005) and Westerlaken and Gualeni (2016) state that they have tried to conduct PD processes with

dogs and Jørgensen & Wirman (2016) with orangutans. Several of these projects recognize that the human-nonhuman communication challenges are critical for nature-inclusive PD processes (Jørgensen & Wirman, 2016; Mankoff et al., 2005; Westerlaken & Gualeni, 2016). Two of them use play as a way to overcome this challenge (Jørgensen & Wirman, 2016; Westerlaken & Gualeni, 2016).

5.6 Implication 6: Bioinclusive Collaborative Design Before Use

In traditional CoDBU the humans, who are placed at the centre of the design process shape the process and outcomes (Bradwell & Marr, 2008; Degnegaard, 2014; Mattelmäki et al., 2011). In bioinclusive CoDBU, both the humans and the nonhumans would be placed at the centre of the design process. This way nonhumans would be able to shape the process and outcomes of the design project in a way that better aligns them to the needs of natural systems and entities. CoDBU is a very flexible category of C&PD sub-approaches in relation to scope and intensity of non-designer involvement (Hoyer, Chandy, Dorotic, Krafft, & Singh, 2010). The bioinclusive CoDBU would also remain (or become even more) flexible. It would be flexible to the extent of involvement of nonhumans: either as objects for investigation, design partners and stand-alone designers. Nevertheless, the bioinclusive CoDBU might need to involve nonhumans or their perspectives in the goal-setting phase. Such processes might also need to ensure that the nonhumans have enough leverage and decision-making power to really shape the design process and outcomes. Thus, a bioinclusive CoDBU would place humans and nonhumans at the centre of the design process, involve nonhumans to a differing extent, but would ensure that nonhumans can impact the goals of the project.

Some designers have already started placing nonhumans at the centre of the design process. Several projects have attempted to involve nonhumans as co-designers at different phases of the process, yet it seems that nonhumans had little impact on the goals of these processes. Nonhumans were only involved in testing the solutions envisioned by humans to increase the human ability to interact with their pets (Cheok et al., 2011; Lee et al., 2006; Westerlaken & Gualeni, 2014) or to improve the animal experience of completing a human-assigned task (Mancini, Harris, Aengenheister, & Guest, 2015). Meanwhile, Resner (2001) and now also ACI projects seem to explicitly argue for and place animals at the centre of their processes (Mancini, 2011, 2013). However, some researchers (e.g. see Grillaert & Camenzind, 2016) challenge if animal needs or human desires are indeed at the core of ACI processes.

5.7 Implication 7: Bioinclusive Collaborative Design-in-Use

The bioinclusive perspective would reshape CoDIU which encompasses the approaches enabling non-designers to reshape and readjust design solutions that are already in use, such as living labs, meta-design and the lead user approach. Bioinclusive CoDIU might also allow nonhumans to reshape the design solutions as during use. On one hand, this could be challenging to implement. It could be hard to define what is use – a mere interaction or deliberate use, and it might be impossible for designers to enable or encourage nonhumans to adjust the solution. On the other hand, nonhumans might be already directly and indirectly shaping all or some of the design solutions implemented in the world. For instance, nonhumans almost always strive to adjust solutions implemented by the landscape architects; meanwhile, dogs can rearrange the interior of a home, readjust their dog beds or chew up their toys. In such cases, the perception about the action of the nonhumans might play a key role: is the entity damaging the human design or is it adjusting it to better satisfy its own needs? The bioinclusive CoDIU might need to create and foster a very open, accepting mindset among the designers and human non-designers. The human stakeholders of the process, especially the designers, might need to view nonhuman-made changes to the design as adjustments and cases of

design-in-use. The acceptance of the adjustments might also question the traditional human-nonhuman power dynamics and foster a more equal stance between the two. Therefore, the bioinclusive CoDIU might embrace nonhumans as non-designer who can and are welcome to make adjustments to design solutions during the use time.

There are likely at least two cases of bioinclusive CoDIU thinking within C&PD. In the first case, Wirman and Jørgensen (2015) studied engagement of orangutans with a design object, which they refer to as prototype, that was placed in the natural habitat of captive orangutans. Over an extended period of time, the researchers studied behaviours, reactions but also adjustments made by orangutans to the solution prototype. In the second case, researchers at the More-than-Human lab (Galloway, 2017) have created an open-ended long-term process to study interrelations of human-made design solutions with nonhumans.

6. Discussion

The seven implications for bioinclusive C&PD outlined above are initial considerations about the possibilities of a more nature-inclusive C&PD. These implications draft an ideal case of bioinclusive C&PD. However, implementing bioinclusive perspectives in C&PD practice is likely to require variations and reinterpretations of the idealized bioinclusive approach. Moreover, the implications represent perspectives of only one environmental ethical framework and, thus, provide a limited insight into nature-inclusive, not solely bioinclusive, C&PD. Future research on the topic should focus on further elaborating the fundamental notions of nature-inclusive design from the perspective of varied environmental ethics. Moreover, it must outline the reality of implementing bioinclusive and nature-inclusive perspectives on C&PD in design processes and cases.

The development of the implications was impacted by the seven-months long timeframe allocated to the project which limited the scope and depth of the project. Thus, the implications do not cover many aspects of C&PD, including methods, tools, areas of application and ethical and power-related discussions within the approach. Additionally, the implications were developed by questioning each of the seven key insights about C&PD individually and might not fully reflect the existing interrelations and connections between the different notions of bioinclusive C&PD. Therefore, future research should investigate impact of the bioinclusive perspective in relation to various, if not all, aspects of C&PD and should elaborate on the potential interrelations and interconnections of the implications.

7. Conclusions

This paper aimed to outline initial considerations for a nature-inclusive C&PD by critically questioning the approach through the perspective of the bioinclusive ethical framework and outlining a bioinclusive C&PD. The bioinclusive ethic expands the circle of moral considerations from including only humans to also including nonhuman natural entities and, while doing so, strives to assign them a more equal moral standing. The ethic urges humans to view natural entities not only as materials but also as entities with self-meaning and particular experiences of the world. It also urges humans to build a synergetic relationship with natural entities, through which the nonhumans could impact the goals and means of the humans.

In this paper, the principles of a bioinclusive ethic were used to critically reflect on the seven key aspects of traditional collaborative and participatory design. Overall, C&PD is a flexible and vast design approach that involves human non-designers as partners in the design processes and grants them with varying extents of goal-setting and decision-making power. The bioinclusive perspective challenges the assumption that only humans should be acknowledged as potential non-designers. It also suggests that the nonhuman non-designers should be granted appropriate levels of goal-setting and decision-making power to enable them to shift and shape goals and outcomes of the design processes. Recognition of nonhumans as non-designers would have an impact on the theory of C&PD. It might lead to a shift from a linear spectrum of non-designer involvement to a matrix of involvement that represents humans and nonhumans on separate axes. The bioinclusive C&PD, while involving humans as design partners, might need to involve nonhumans by investigating them for insights, involving them as design partners or by supporting design by nonhumans. The bioinclusive perspectives might also reshape the political, pragmatic, innovation-related and commercial underpinnings for non-designer involvement in the processes.

The bioinclusive perspective also questions the three groups of sub-approaches of C&PD. Bioinclusive participatory design would explicitly include nonhumans in their core principles and involve them in the process in direct or indirect ways. Bioinclusive collaborative design before use would place not only humans but also nonhumans at the core of the design processes. The approaches and projects would involve nonhumans in different ways and to a varying extent, but would ensure that nonhumans are able to impact the goals of the design project. Finally, the bioinclusive collaborative design-in-use approaches would develop an inclusive mindset and embrace the adjustment that nonhumans create for the design solutions released into the real world. These seven initial implications that the bioinclusive perspectives have on C&PD are a starting point for development of a more nature-inclusive C&PD and design field overall. A more nature-inclusive design might recognize the needs of the natural systems and entities better, thus contributing to sustainability initiatives.

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