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Interdisciplinarity and Collaboration – A Study Focusing on Experienced Biodesign Practitioners

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ABSTRACT

Biodesign is an emerging area in the design field that addresses ecological concerns by working with or learning from organic processes found in living systems. Therefore, biodesign leans on knowledge acquired from other fields, especially sciences. A direct interdisciplinary collaboration between scientists and designers happens very often in biodesign. This paper describes the findings of interviews exploring how biodesigners collaborate with scientists in their activities. The authors conducted semi-structured interviews with ten experienced biodesigners from Europe and South America. After collected, the information of the different interviewees was synthetized and compared, and a thematic analysis was made. The paper identifies and reflects on the designers' methods to collaboration. It also shows the impact of such partnerships, their relevance to the design field and the specific contribution design brings to science. In addition to the expected impact of science in the design field, the study indicated the influence that designers are achieving inside scientific contexts as co-workers or leaders of biodesign projects.

Keywords: Biodesign, Science, Collaboration, Interdisciplinary, Innovation

INTRODUCTION

The selection of resources and processes with low environmental impact combined with highly efficient results is essential in the current panorama of design for sustainability. Therefore, an emerging area of design is being distinguished, as it tries to integrate living organisms as part of design processes: biodesign. "It goes beyond mimicry to integration, dissolving boundaries between the natural and built environments and synthesizing new hybrid typologies" (Myers, 2018, pp. 8–9). The contribution of biodesign can impact biotechnology and bioeconomy, and as such it can "challenge modern industrial, social, and economic paradigms" (Ginsberg & Chieza, 2018).

It is key here to differentiate the term biodesign that refers to "bio-informed design strategies as a driver for sustainable innovation" (Collet, 2019) from the same term, "biodesign" when used to identify both the area related to innovations in biomedicine - projects that combine natural and artificial elements, and the processes in the field of synthetic biology, even though all the three of them conform science and design collaborations that have the ability to create "possible futures different to those dictated by our planet's naturally evolved present"(Ginsberg & Chieza, 2018) .

As a sign of officialization of the field, the first so-called "Master in Biodesign" was recently launched, in 2019, by Central Saint Martins at the University of the Arts London (Collet, 2019). This also signifies that the pioneers of biodesign were not fully educated as such, and had to try, adapt and create new ways of working.

In their practice, most biodesigners need to reach and work with different disciplines outside of design, usually related to the scientific fields. However, scientists and designers have different ways of approaching their questions and facing problems. The natural sciences are based on logic, a rigorous and objective method, often developed inside laboratories. Design, on the other hand, is hermeneutical, makes use of dialogue and of interpretive processes, opening up to experience in specific contexts (Coyne & Snodgrass, 1997).

Studies and books related to biodesign acknowledge the value of the collaborations among scientists and designers, mentioning some of the challenges present in this interaction and even offering practical tips for collaboration in this field (Kääriäinen & Tervinen, 2017) (Kääriäinen et al., 2020) (Myers, 2018). Chris Rust has produced relevant literature on the subject of collaboration between designers and scientists, as well as Carlos Peralta, who presents empirical evidences of his conclusions. However, no systematic study has been conducted more recently to reveal how this relationship takes place specifically in the evolving interdisciplinary area of biodesign, showing the potential, the role and the benefits of science in the design field, and vice-versa. The aim of this paper is to understand how the partnerships happen through the lenses of biodesigners, as usually it is the designer who first looks for the assistance of scientists in biodesign projects. Besides reflecting on the practices of this emergent field, this knowledge will facilitate the contacts of new designers to biodesign, and also provide background information to scientists that would like to benefit from approaching design.

METHODS

A non-interventionist and qualitative methodology was utilized. The investigation started with mapping initiatives that involved biodesign directly, and which included interdisciplinary collaborations. As we chose to emphasize the diversity of approaches in the field, the selected professionals work in European and South American countries, contexts that are familiar to the authors of the study. The research was done by conducting in-depth semi-structured interviews with ten biodesigners, who show a variety of ways of working in different institutions and through their practices, as Table 1 indicates.

A curious observation is that almost all interviewees are women. All practitioners selected for the study have graduated in the design field - as this is not always the case of biodesigners, and all of them have at least four years of experience, which reflects a good acquaintance of biodesign, given this is a recent area that started to receive attention around 2012

Table 1. Interviewee's profiles.

	Country	Years of experience	Institution / kind of practice	Areas of science with which collaborated
1	Argentina	4	academia / independent project[1]	engineering chemistry, material science, biology,
2	Brazil	6	academia	material science, biology, engineering
3	Ecuador	4	academia	biology, engineering
4	Chile	4	independent project	biology, biochemistry
5	Colombia	5	academia / company	biology, engineering
6	Finland	10	academia	chemistry, engineering
7	Italy / The Netherlands	10	independent project / company / academia	biology, material science
8	UK	5	company	material science
9	UK / Estonia	4	independent project	biology, material science
10	UK / Italy	4	company	chemistry, material science

(Karana et al., 2020). Table 1 also indicates the scientific disciplines with which the interviewees mostly collaborated with.

The interviews were undertaken in English language via Zoom platform during August and September 2021, and their duration ranged from 45 to 90 minutes. The authors interviewed all the practitioners using a topic guide to structure the inquiry, while keeping the conversation open-ended and paying close attention to emergent topics during the discussions. The topic guide prepared by the authors covered questions about how the interviewees approached scientists, how a discussion on a project typically began and how works developed, the main impact of the projects and the specific contribution of the areas involved.

Following the interviews, a thematic analysis was pursued making use of the systematic process articulated by Braun and Clarke (2006). This method shows clear phases on how to give order to and discern patterns in the reports of interviewees. In the next section, based on the interviews' answers, we first provide the reasons for the collaborations to exist and describe the occasions when designers met scientists. Then, we focus on the contribution science brings to design and design delivers to science. The results are discussed in the remainder of the paper.

[1]"Independent project" refers to laboratories, workshop practices, consultancy and exploratory projects that are not conducted inside the academia but also don't constitute a company. According to interviewees, these practices normally subsist on grants and commissions.

THE START OF A COLLABORATION

Rekonen (2017) mentions that the starting point of interdisciplinary collaboration is “information asymmetry, which means that team members have distinct, unshared information” (Rekonen, 2017, p. 93). This implies that there is a gap in knowledge that can only be fulfilled by reaching out or exchanging ideas with professionals with a different background, and that is the case of design-science collaborations.

According to this study, the demand for partnerships in biodesign happens in different ways, and comes out more frequently from the designer. The designers are the main initiators either because designers start a new project based on their own subjects of interest and want to explore it in novel ways – for example themes such as “waste”, “death”, or “material alternatives”; or because designers are propelled by their clients, for example “to search for a vegan alternative” (i9)[2] or for scaling up a solution.

However, the association of scientists and designers also happens as a fruit of coincidence, such as “participating in the same conference” (i6), or by the decision of an upper-level supervisor or dean who requests a collective effort, for different reasons. Both of those cases were reported within academic contexts in Europe and South America, and in those situations designers and scientists started the project together. This shared motivation results in a more balanced relationship, one that makes a difference in the development of the projects, as will be explicit later on.

In this study, cases in which established scientists demanded a designer to join a project were mentioned only by those biodesigners with longer practice after years working together with the same scientists. “Scientists are not looking for designers” (i1). Nevertheless, in South American contexts we could notice cases in which young scientists became partners of designers’ initiatives, having joined the designer’s work at a phase when it was already organized and visible to external audiences. That points to a difference in the approaches of old and young scientists’ generations, who might be getting more exposed to new education practices, as Ito (2016) states: “working in spaces that simply do not fit into any existing academic discipline – a specific field of study with its own particular words, frameworks, and methods” (Ito, 2016).

Before reaching out for a scientist, most designers revealed having studied scientific topics by themselves. They did it in a variety of ways: reading online websites and specialist papers, attending conferences, making low-tech experiments in kitchen-like labs, refining their skills via residencies in existing biodesign labs, producing prototypes and documentation about the work done, and whatever else was at their reach. As a consequence of their own effort, designers start to get familiar to scientific language and get more intimate to certain procedures. The need for an expert comes when designers want to achieve certain results that depend on variables that are not visible to their eyes, for example: “I wanted to inform properties of a material in order to create from a biological agent” (i7) or “I needed a material that should be thin, strong and flexible” (i9).

[2] Interviewees are identified by the numbers given in table 1.

Most designers already know who are the scientists they would like to ask for help, as an outcome of designers' own exploratory phase. The challenge is, then, to have access to the expert scientist. "It is very hard to find people. One in a hundred will reply" (i10), "they don't take you seriously, some were quite disrespectful" (i7) and "they are very busy" (i4) were common complaints among designers in the quest of scientists. Nevertheless, many designers didn't had any pains, those being either the ones who joined scientists from the start of the projects, the ones who had scientists within their own personal relationships, or designers that work inside academic contexts. Even though few designers consider the Academia a closed environment to collaborate with and prefer to avoid it, most interviewees view the connection to Academia as an indispensable facilitator of partnerships designer-scientist that boost their projects.

Universities and Faculties are, then, important hubs for biodesigners, especially when they already work there. "To partner with someone inside Academia, being an academic, is easier than to someone out in the market" (i2). Yet, the access to academics does not mean there's a match for biodesign projects: "In Academia it is easy to find people that could collaborate, but not everybody is open for that" (i3). It is also noticeable in the declarations of the interviewees that they find fundamental to their projects to nourish a network of peers from other fields who share a similar perspective or have common objectives: "Connections are really important: professors, companies, accelerators" (i8). "To collaborate you need a good chemistry, you have to build the relationship, you can't force it" (i1).

DESIGN-SCIENCE CONTRIBUTIONS

Vuorinen & Solala mention that science aims to organize knowledge in order to understand complex systems and phenomena, in an attempt to make possible to predict their effects (Kääriäinen et al., 2020, p. 24). Scientific protocols, even though seemingly strict and sometimes conservative, are the means to pursue deep knowledge on subjects, they are a "consistent way of working" (i5) that teaches designers important lessons when dealing with living organisms, as they understand the "correspondence between things" (i1) and "what happens behind" (i4) – and therefore can repeat procedures.

Scientific rigor and language also give credibility to designers. Some designers mention learning the importance of backing their results with data, which is highly appreciated not only by scientists but also by larger audiences, as the work is "not only sensorial, experiential" but based on "facts" (i4). This was also reported in the work of Peralta: "case studies demonstrated that scientists are able to carry out rigorous testing of product concepts, providing the designers and investors with valuable test data" (Driver et al., 2011).

Scientists' equipment and technologies were also mentioned as tools that help designers find out many things about the projects that wouldn't be possible in other ways (i8). Finally, many designers expressed the amazement with their findings in collaborations with scientists: "the magic of chemist" (i10), "they create true wonderings" (i9), "they help make things real, faster, better" (i3), "they gave me tools to create change" (i5).

When asked about what is the contribution of designers to the scientific field, we received some expected answers, such as "providing an application for the scientific knowledge" by connecting it to markets (i10), or assisting with communication (i6, i9) and dissemination of research (i7) – all answers that Driver, Peralta & Moultrie (2011) have already shown in their research. However, designers also mentioned, for example, adding to the research outcomes "sensory qualities, craft" for a material solution (i8), or helping "understand the whole" (i4), as scientists usually isolate elements in their studies.

Looking in the other direction, according to the interviewees, science specially benefits from the intuitive and exploratory approach of designers: "we don't work with status quo, we don't know what happens at the end" (i5), "we can work with everything" (i3), a spontaneous attitude that can "place the creative process inside science" (i2) and lead to discoveries and innovations.

As practical contributions to society, half of the interviewees have launched new companies or startups as a consequence of the collaboration with scientists – they are developing and selling products or materials that fit into circular economy principles. A heavy influence to academia was mentioned by at least four designers, in which laboratories, courses and research groups were created because of the potential revealed by the partnership. In one case, the University launched a Master on bio-inspired innovation aimed at biologists, where design tools and approaches form the basis of the curriculum of scientists.

Chemists Tapani & Solala state that in working with interdisciplinary groups of students they have found "that design students can also make scientifically important observations by experimenting on something that scientists do not consider interesting" (Kääriäinen et al., 2020, p. 24). This is a sign that a number of scientists, today, acknowledge the importance of designers not as "service providers" (Driver et al., 2011) or in "subsidiary roles" (Rust 2004, p. 84), as it used to be the case years ago, but as co-workers that might happen to lead the projects.

DISCUSSION AND CONCLUSION

Our study brings to light important questions about the roles of designers and scientists in the context of interdisciplinary collaborations in biodesign projects and hopes to help strategies that foster these partnerships. Driver, Peralta & Moultrie (2011) suggested a role for designers in scientific research as co-researchers with a background in design. Ten years later, we notice that, as they advised, designers nowadays "present themselves in this new role, so that their relationship with scientists is different from the start of the project" (Driver et al., 2011).

The most important findings of our study relate to prominent positions that designers have in biodesign projects which were initiated by themselves, ideas that came out of their own design vision but that involve science and need its support to be further developed. This kind of project require a lot of time and effort from the designer's side: studying, reaching out scientists, exposing their ideas, failing several times. Biodesigners, as this study shows, are exemplary in developing mechanisms to absorb scientific approaches and integrate their disciplinary methods to that field, and as a consequence they are impacting society by creating new products, materials, courses, companies. Rust, who was an early enthusiast of this collaboration seem to have predicted it: *If an energetic and able designer can find any role at all in a research environment, they can quickly develop that role by creating and deploying artifacts that affect the work in hand, and demonstrate the designer's ability to make a difference* (Rust, 2004, p. 85).

The practices thereby embody the clash of views that happens when designers face the reality of working with professionals from a totally different background, at the same time that they highlight the value that grows from the encounter of diversity.

The study also indicates the essential role of education in facilitating interdisciplinary collaboration, suggesting that design and science students who were stimulated to work with peers from different backgrounds during their foundational years are more likely to be open to partnerships, influenced by their previous experiences.

Academic contexts are key for biodesign as they already contain a structure that enables its practice, such as spaces (labs, meeting areas), possibilities of financial support (grants, funds) and the network of researchers with a variety of areas of knowledge. This research showed that Universities were protagonists in fostering cases of equalized relationships between designers and scientists, benefiting the development of biodesign projects. In the same way, specific biodesign courses that are being created recently can nurture balanced collaborations and diminish obstacles that might hold back advancements in the field.

Limitations and Suggestions for Future Studies

This study was limited to interviews with design professionals from Europe and South America. As biodesign is a joint field, it would also benefit from a more in-depth analysis of the scientists' perspectives. That said, the practices pursued by these biodesigners may not be representative of those used in other geographical areas. In probing such differences, future studies could be directed towards uncovering design-science collaborations in other territories.

The results of our study benefitted from the openness of the designers in discussing their work during the interviews. However, the confidential nature of some projects regarding IPR and patents makes accessing specific moments of the collaboration a concern in devising future studies. We can suggest that in expanding on our findings scholars conduct observations or ethnographies in order to gain a more direct knowledge about the relationship between designers and scientists.

Finally, it is interesting to highlight that almost all the biodesign professionals that were interviewed in this study are women. Studies that relate gender and professional approaches can also contribute to a better understanding of biodesign practices.

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