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Playful prototyping in speculative design practices

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Abstract: Prototyping is a fundamental part of the design process. The iterative assemblage and manipulation of shapes, textures, colors, and volumes generate reflections not only about formal qualities but also about possible affordances, functionalities, and meanings. Prototypical artifacts emerge from the negotiation between the informed rational thinking coming from research, the mechanical behavior of the material, the human body ergonomics and dexterity, and the serendipitous discoveries happening in the process. Analyzing the creative dynamics happening during prototyping, it is possible to observe similarities between model-making and play. Such dynamics of reflection in action have the creative potential to foster speculative inquiry. The aim of this contribution is to present, through a case study workshop, playful prototyping as a speculative design methodology: a playful approach that can generate extreme, thought-provoking, and radical outputs in the form of diegetic prototypes of speculative design and design fiction.

Keywords: Prototyping; Speculative Design; Playful Design; Research through Design

1. Introduction: Playfulness in design prototyping

Research has investigated how play and creativity relate to children's cognitive development (Cecil et al., 1985; Hughes, 1999) and how designing playful interaction can incentivize physical activity and social interactions among children (Bekker et al., 2010). Fewer studies have discussed adult playfulness in relation to education (Holflod, 2023), creative tasks, and how to address its integration into designers' education (Lloudon et al., 2012). In fact, it appears that when considering the range of activities that relate to adult play, greater emphasis has been given to gamification (Deterding et al., 2011; Jagoda, 2013) and application of games in learning and training (Sawyer, 2002; Sawyer & Smith, 2008). Games have been presented as an effective means of persuasion (Bogost, 2007; Flanagan, 2009/2013) and complex problem-solving. The proceduralist approach argues that games, and video games in particular, are effective in building meanings, driving transformations, and fostering the emergence of creative solutions thanks to the algorithmic structure of rules they are built upon. It has been contested that such an understanding of games pretends to predict players' behaviors,

giving too much emphasis on the role of designers without considering the actual moment of play and the importance of players' interactions (Sicart, 2011). Following a play-centric approach, Ludic Design has been proposed as an alternative attitude to address design issues (Gaver, 2002; Morrison et al., 2007). Instead of pursuing persuasion and aiming toward problem solutions through play mechanics, a ludic approach offers an alternative attitude to design that is more open to questions and doubts, encouraging cooperation and participation through playfulness. In accordance with such approach, this contribution focuses on prototyping as a process in design research that embeds and enables a playful attitude that can foster critical reflection and creativity.

Playfulness constitutes an attitude rather than an activity: whereas an activity is defined by a defined chain of operations that lead to a certain output, an attitude is a "psychological, physical, and emotional perspective we take on activities, people, and objects" (Sicart, 2014, p. 22). It is, however, necessary to acknowledge the differences between adults and children's playfulness and its expression in relation to different personality constructs (Van Vleet & Feeney, 2015). This contribution presents a case study with qualitative analysis that does not delve into the characterization of the participants' personalities, thus potentially limiting the interpretation of the outcomes. Therefore, the case study is presented as a preliminary application of the theoretical framework that is used to situate prototyping as a playful attitude in anticipatory and speculative design practice.

In this contribution, it is argued that the playful material attitude that emerges in the iterative process of assembling and manipulating shapes, textures, colors, and volumes can allow reasoning not only about formal qualities but can also foster critical reflection of the potential functionalities and meanings materialized by the prototyped artifact. The ambiguity of the prototype opens to interpretations, confrontation, and problem discovery. Prototypical artifacts emerge from the negotiation between the informed rational thinking coming from research, the mechanical behavior of the material, the human body ergonomics and dexterity, and the serendipitous discoveries happening in the process. This attitude appears to be particularly relevant for design research that addresses anticipation since they often deal with undefined complex scenarios in which problems and design goals are not clearly defined (Celaschi, 2015; Celi & Formia, 2015). To investigate how play and prototyping intersect to generate ideas in anticipatory and speculative settings further, a design workshop in which international students of two product design degrees participated will be presented as a case study.

2. Design and prototypes

Across the different areas of design, prototyping is a fundamental part of the creative process. Scholars and practitioners have defined prototypes addressing their use both in design practice (Camburn et al., 2017; Lichter et al., 1994; Otto & Wood, 2001) and in research (Wensveen & Matthews, 2014). In design practice, prototypes are largely used to explore ideas and evaluate decisions in multidisciplinary design teams. Prototypes can be described

from the perspective of their scope in presenting specific design features of complex systems: the artifact's *role* in the user's life, the *look and feel* of the final product, the technical *implementation* through which the artifact will actually work (Houde & Hill, 1997). In design research, prototypes can function as the means through which research is conducted (Wensveen & Matthews, 2014): prototype can function as experimental components; as a means of inquiry, like technology probes (Hutchinson et al., 2003) or "provotypes" (Mogensen, 1992); as research archetype that physically exemplify research concept. However, shifting the focus from the prototype artifact to the process of making the prototype, Matthews and Wensveen argue that prototyping itself can constitute the method of inquiry in design research. The use of prototypes as epistemological instruments of knowledge construction in design practice is characteristic of the research *through* design approach (Stappers & Giaccardi, 2017). Documenting the construction process and the decisions made allows for critical reflection driven by the experience of making rather than the final outcome. A methodology that builds on the critical analysis of the process is the Method for Design Materialization (MDM) proposed by Khaled and Barr as a methodological evidence-based approach in video game design (Khaled & Barr, 2023). When committing a change in the source code, instead of the brief description of what has been modified (that is the common practice of a software engineering approach), in MDM, the change is largely discussed, and considerations are made by the developer to foster design reflection on the work. In this way, starting from small changes, the designer is encouraged to deepen the reasoning on the impact that minor changes could have on the broader meaning of the project. Contextual reflection on the committed design choices directly connects theory and practice. The prototypes become the materialization of the design hypothesis.

Prototypes play a major role in anticipatory and speculative design. Advancements in technology need to be developed within their social context and prototyping has become the driver of innovation (Schrage, 2000). In speculative design, the materiality of the artifacts is the means that encourages a critical reflection that challenges presumptions and preconceptions about the future (Dunne & Raby, 2013). In science fiction prototyping (Johnson, 2011), prototypes suggest how the artifacts will actually work and live in the imagined future. In design fiction (Bleecker, 2009; Sterling, 2013), in conjunction with other worldbuilding elements, prototypes are used to develop narratives around future scenarios in which speculative artifacts are the materialization of the transformation happening in culture, value, and technologies. Such prototypical artifacts are often called diegetic prototypes: "cinematic depictions of future technologies" that exist in the fictional world (Kirby, 2010). Games as fictional artifacts in a narrative world can evoke speculation about alternative futures (Gualeni & Fassone, 2022).

One of the main goals of speculative and critical approaches to design is to include more and diverse perspectives into the discourse about the design of the future. For this reason, participatory and co-design practices are particularly relevant in future-oriented design research. Making emerges as the characteristic method for doing design research and is pivotal in participatory design (Sanders & Stappers, 2014). To support co-design, prototypes can

be used to collect data and information in the form of cultural probes (Gaver et al., 1999), to facilitate collaborative activities as generative toolkits (Sanders, 1999). Playfulness has an important role in facilitating collaboration and engagement. Through physical interaction with artifacts, like probes and prototypes, designers can activate playful dynamics that can foster creativity.

In design fiction and anticipatory practices, prototypes are most often presented in their final form, and less emphasis is given to the prototyping process as a speculative moment itself. Also, such prototypes are often displayed as exhibition artifacts with which it is not possible to interact. Both these aspects prevented consideration of and solicited by materiality and physical interaction. For this reason, the contribution's aim is to consider how speculation unfolds often in behind-the-scenes phases of prototyping and how it develops in creativity.

3. Prototyping as play, prototypes as technologies of play

The contemporary product-service system is largely based on computing. Technological solutions brought into everyday life the values of the workspace from which it developed, defining the standards and the parameters of daily activities according to criteria of optimization and efficiency (Gaver, 2002). The mediation of human experience through digitized and gamified interfaces constantly redefines the distinction between playful and working time. The real world itself appears as a gamespace that resembles "an imperfect form of the computer game" in which the nuances of the analog have been violently replaced by binary decisions and output of the digital (Wark, 2007). However, humans are playful creatures (Huizinga, 1938), and Gaver suggests that designing for *homo ludens* means evading the assumption that the scope of technology is only that of providing effective solutions to defined problems. Hence, a design methodology that produces artifacts that encourage exploration and embrace curiosity should incorporate more subjective and open forms of inquiry, together with strategies of appropriation and re-functionalization, and should pursue pleasure and engagement instead of performance and clarity (Gaver, 2002). Such methodology proposes a radical approach to design that questions the established assumptions of efficiency on which human-computer interactions are based upon. Such assumptions are based on the systems that reduce human psycho-physical behaviors to computable and predictable models. Subverting the perspective from which designers observe phenomena and propose solutions, this methodology proposes an alternative way to critically encourage creativity. The playful design is ambiguous, open to interpretation, and shifts the focus from the designer's intention to the possibilities that emerge from the user's understanding of the artifact (Sicart, 2014).

As discussed in the previous section, prototypes can serve different design needs, and hence, they can be understood according to different categories. However, if we consider that playfulness may emerge during the making of the prototype, how do we situate the resulting artifacts in relation to other technologies of play? What are the characteristics of such playfulness since it emerges in the context of design practice? How does it apply in the

context of speculative design and anticipation? This paragraph frames the theoretical concepts used to define the connection between play and prototyping and situate prototypes in relation to toys, games, video games, and other technologies related to the experience of play.

Research has investigated the benefits of a playful approach to design and how it be activated by introducing technologies of play, such as games, video games and toys in the design practice. For example, the co-creation of playful objects has proved to encourage the emergence of a shared space of collaboration and dialogue (Holflod, 2023) with positive impacts on participatory and collaborative design processes. According to Jagoda, games can be observed as experimental artifacts both in formalist terms, as they represent a simplified model of reality in which experimentation takes place, or, from an alternative player-centric perspective, as processes or occasions for play in which experimentation can go over the predesigned affordances of a simulation (Jagoda, 2020). In fact, whereas gamification and simulation approaches set their experiments in models of the real world, games, as an "alternative form of experimental art-science" can serve as an alternative method for problem-making, rather than a problem-solving instrument (Jagoda, 2020, p. 142). Drawing from Jagoda's definition of the experimental qualities of games, prototyping could be seen as an experimental process that intertwines conceptual and technical reasoning with manual skills and sensorial-driven dexterity in an explorative practice that embeds and encourages a playful attitude.

Another concept that is functional to define the duality of prototypes as the technology of play and as artifacts for speculative inquiry is that of plaything. Adopting a materialistic ontology approach, Sicart understands the technologies of play (such as games, video games, and playgrounds) as epistemological structures of knowledge formation and as cultural constructs rather than ontological categories (Sicart, 2023). According to Sicart, such things become playthings in the moment their materiality is activated when we play with them. Following this conceptualization, it could be argued that prototypes are playthings that came into existence as knowledge construction tools through the process of prototyping. They inform the material practice of shaping forms and, as discussed later in the paragraph, encourage the exploration of possible affordances.

Prototyping offers a space to evaluate and, above all, challenge design ideas. The play has been considered in relation to its capability to encourage divergent thinking and in relations to prototyping (Loudon & Deininger, 2011). Within rules and constraints designers develop creative solutions often relying on alternative ways to approach design problems. In speculative design, rules are not those set by current technologies or by actual market and production constraints. In anticipatory practices, designers need to develop their own set of rules, and the boundary definition is part of the design process itself. During prototyping, the physical qualities of the material enable or limit the capability to represent forms and shapes. Mechanical properties can become the trigger of design strategies, and serendipitous discoveries can occur through physical interaction with the material and by observing of the shapes gradually taking form.

It is possible to observe that the making of prototypes shares commonalities with play. Since childhood, building is a form of play that allows the development of sense-perceptual abilities and dexterity. Crafted objects become tools, characters, and fictional artifacts. During play, things acquire new meanings through contextualization and appropriation (Sicart, 2014). Objects become props that encourage the emergence of play, even though their physical qualities do not necessarily correspond to those of the represented artifact. Similarly, initial prototypes are rarely built with the same material as the final product. Cheap and easy-to-work materials allow for fast iterations of design ideas. In this phase, designers make their evaluation projecting the look and feel of the final material and finishes on the prototype. Without a preliminary introduction, when these kinds of prototypes are shown to people outside the design team, they may cause misunderstandings and confusion. Depending on the audience, prototypes require to be contextualized by a description of the design choices and consideration. Observers need to be introduced to the design world, the scenario where the prototype lives with its rules and constraints. Also, the prototype should provoke reactions and questions in the observers, inviting them to consider radical solutions. Prototypes live, like toys, in an ecology in which they perform a specific function and represent defined cultural values.

Toys, prototypes, and diegetic prototypes enable us to tell stories through objects that can help to envision alternative versions of the present reality or to speculate about possible future scenarios. Toys and prototypes define gateways between the fictional/speculative world and the actual one. To properly and effectively function as a tool for critical reflection on both future (speculative futures) and contemporary technologies (alternative presents), speculative design needs to balance the limits of its inquiry to be sufficiently speculative, but not end up in unrelatable or implausible proposals (Auger, 2013). Drawing from Auger's proposed methodology for speculative design, prototypes and toys can function as "perceptual bridges" between the familiar everyday reality of the player/designer, and the reflection proposed by the speculation by soliciting reaction in the human mind. Critically engaging with play and toys is a design attitude. Playfully approaching design problems is a critical attitude to design.

4. Playing speculation through prototyping: A case study

In order to investigate the interplay between playful approaches to design and prototyping, a group of fifteen students from the second year of the master's degree in Product Design from the University of Bologna and the National University of Colombia were invited to participate in a workshop. The workshop, titled "Prototyping Artifacts for Future Food Rituals", aimed to investigate how artifacts will mediate the relationship between food and the human body in the future. The workshop was designed to experiment at the intersection of speculative design, game design, and prototyping, alternating between game mechanics and manual work to stimulate creativity.

4.1 Workshop structure

Due to time constraints, the total duration of the workshop was 3 hours. The workshop was divided into two parts of respectively 2 and 1 hour.

In the first part of the workshop, the students were given two sets of cards. From each set, students were asked to pick one card: the first contained a hint about a future food-related topic (such as the growing interest for entomophagy in Western countries for human consumption, ethical issues about animal-based food products, food and water scarcity); the second contained one of the five human senses. Using clay, students were challenged to prototype an artifact that both addressed that topic and had a relation to the picked sense. All students had to work individually but they had the opportunity to engage with the tutors or to search for information about their own design topic online. To emphasize the physical relation to the human body, the prototype had to be realized on a one-to-one scale. The object could be designed without limits regarding its use: it could be made for eating, cooking, harvesting, storing, or every other activity involving human interaction with food.

In the second part of the workshop, each student presented the prototype to the rest of the class, declaring only the topic that served as a prompt. The other students were invited to ask question and make guesses about the possible use of the artifact.

Two main reasons have motivated the use of clay during the workshop. The first reason is of diegetic nature: clay has mediated human relationship with food since prehistoric times and, at the same time, it is the base material for today's advanced technical applications. This suggestion guided the choice to use clay not only as a prototyping medium but also as the final construction material of the object. The second one is connected to the material's workability: the students, except for one single case, were not familiar with clay working. This presented a challenge, but also an opportunity to engage with the mechanical behavior of the material. Since it was expected that most student would not have familiarity with clay working, it became interesting to observe how their sensibility and the dexterity acquired handling other mediums could transfer into an unfamiliar setting.

Since the workshop had to be completed in a relatively short timeframe, the topic was chosen to both be familiar but also to provide a certain degree of challenge. Food cultures are rich and diverse. They provide discussion topics across different nationalities and ages. Also, food is deeply connected to the human body and to the environment. The many connections that can be articulated from this topic, offered the students enough freedom to diverge and interpret the picked design theme. In fact, the first card had the scope to offer a starting element to trigger ideas and was not designed to provide a mandatory design challenge. After the workshop, students were invited to answer some questions about the experience.

4.2 Outcomes and discussion

All students produced an artifact within the timeframe (Figure 1). The majority of the students, after some initial tinkering with the material, started working on the first concept directly using clay. A few preferred to draw sketch ideas on paper. From the questionnaire, it

emerges that, despite being a novel experience, working with clay was a positive experience. A student described the prototyping activity as relaxing, while others appreciated working with a malleable material and being able to work both by adding and subtracting material.

Figure 1 Students' prototypes

Another aspect that emerged as challenging was the constraint to work on the prototype on a one-to-one scale. Considering the real scale of the object while defining its use allowed for direct connection not only with the physical body but also with the surrounding environment in which the object had to be used. One example is the project inspired by the topic of entomophagy and the sense of hearing. In this project, the student adopted the technique of coil building to shape an artificial habitat for home harvesting insects for consumption purposes. The structure was designed for channeling sound and noises coming from the artificial nest (Figure 2).

Figure 2 Artificial nest for home insect farming by Raissa Tič, Master student in Advanced Design at the University of Bologna.

The playful approach, fostered by the card-based mechanics and by the way topics were presented, allowed students to freely explore ideas. The speculative setting allowed students to develop concepts without being constrained by problems of feasibility or cultural biases. One example is the prototype developed by a student, which started from the topic of mushroom-based products and the sense of sight. The artifact was inspired by a particular pair of glasses used by the ancient indigenous population of the Artic. Traditionally used to protect sight in the extremely bright condition of Artic environments, such glasses are characterized by a thin slit through which hunters could see and focus their sight. The project is set in a future scenario in which the consumption of mushrooms with psychoactive effects is socially accepted and functional to improve focus and creativity. The designed pair of glasses functions both as a tool for serving the mushrooms, evoking a form of ritualistic consumption, and also as a visual aid to channel the sight and support focusing.

In the second part of the workshop, students showed their artifacts to the rest of the group. The scope of this phase was to trigger serendipitous ideas coming from misinterpreting the intended use. The most interesting aspect that actually emerged was the group discussion about the speculative scenario in which the artifact would have been used. This allowed students to further develop and articulate their initial concept. In the case of the artificial nest for insect farming, it was suggested that, since the object was made with clay, it was suitable for baking and, subsequently, for serving. Such consideration broadened the debate about the ethical implications of eating living creatures regardless of their species but also the way artifacts and food processing alter our attitude towards what we eat.

The discussion has also contributed to broadening the boundaries of the speculation. Some projects explored solutions to the proposed scenarios following technological solution that seemed plausible to achieve with current or not too futuristic technologies. Others were more open to embracing a more metaphoric and poetic attitude. For example, a student prototyped a bottle cap and a straw in which a porous ceramic structure hosts microbial organisms that depurate water. On the same topic of water scarcity and adaptation, another student designed a set of jewels that allowed nomadic on-body micro-cultivation. The shape of the jewel facilitates plants watering with the user's tears. The two projects solicited a discussion on the way other living beings, even if invisible to our eyes, such as the yeast in the process of fermentation, are crucial in food technology and how ecosystemic transformation could impact and alter this symbiotic coexistence. On the other hand, the idea that the human body can nurture other living beings overturning the anthropocentric exploitative perspective has developed in a discussion on design practice and industrial systems in the post-Anthropocene.

From a material and formal point of view, some projects have embraced clay's physical characteristics and workability to shape a solid structure. One example is the coil-building technique used to prototype the artificial nest. Other projects challenged the mechanical proprieties of the material to seek formal qualities and ergonomic characteristics that could suggest specific affordances and gestures during the use. A representative example of this latter approach is the case of the flower-shaped jewels for on-body harvesting, which presented

thin clay petals that were curved to facilitate the collection of tear droplets. It was possible to observe collaborative dynamics between the students who helped each other in trying to understand which tools to use and how to manipulate the medium to achieve a determinate shape. The overall atmosphere of the workshop favored a playful experimentation environment where transformation could be observed in the collaborative attitude engaged by the need to understand how to work with clay. The failed attempts, the clumsy shapes, and the resulting laughter defined a safe space of experimentation in which tacit knowledge were constantly achieved and passed on. It can be argued that the most transformative aspect of this workshop experience was mediated by playfulness and resulted in the collaborative exploration of the medium's malleability.

5. Conclusions

In this contribution, prototyping and prototypes have been situated in the context of playful design and speculation. A design workshop has been presented in order to explore how playful dynamics can intertwine with the prototype process. The workshop aimed to investigate how game mechanics and physical manipulation during prototyping invite a playful attitude in speculative design.

Qualitative outcomes showed that the materiality of the prototypes, emphasized by the adoption of particularly tactile and plastic material like clay, solicited in-action reflection on the relationship between the human body, the artificial artifacts, and the environment. From the questionaries, it emerges how of a novel prototyping medium under time constraints can present a challenging yet intriguing experience. It has been observed that the discussion that happened in the second part of the workshop helped the working group to elaborate on the ideas that drafted during the prototyping phase and encouraged them to explore more extreme perspectives. The guessing game about the prototype function was both an ice-breaking mode of engagement and a form speculation enabled by the artifact. A second prototyping iteration would have provided further insight into the transformative dynamics activated during the workshop.

Possible ways of utilizing the prototype were not only described verbally but were also demonstrated through mimicking gestures, suggesting the need to investigate the affordance of physical prototypes. For example, further experimentation could investigate how using prototypes in a fictional setting could engage students in playful and speculative co-design dramatization.

Based on this initial discussion, further investigation will explore how a playful attitude could intervein and bring value even in more advanced stages of the design process. More experimentation will also be developed to consider how digital prototyping and models can be integrated into play-driven design approaches to innovation and anticipation.

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