ELICITATION, PRIORITISATION, OBSERVATION: A RESEARCH MODEL TO INFORM THE EARLY DESIGN PHASES WITH CHILD-CENTRED PERSPECTIVES

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ABSTRACT

ELICITATION, PRIORITISATION, OBSERVATION: A RESEARCH MODEL TO INFORM THE EARLY DESIGN PHASES WITH CHILD-CENTRED PERSPECTIVES

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As children have become active users of diverse range of products and systems, the study of the experiences of child-users has become a specialised field of research, especially in the field of child-computer interaction. This has led to the recognition of children as a special user group with needs and interests different than that of adults. Incorporating child-driven perspectives into early design space is vital to inform the development of design concepts which can deliver meaningful interactions. However, children still dominantly inform the design process as testers, and the research methods usually follow human-computer interaction tradition with a strong focus on the design process itself, and the role of children in it.

The goal of this dissertation is to steer away the focus of inquiry into the methods of the involvement of children in design, towards a comprehensive understanding of product related expectations, priorities and needs of children to inform and enrich the design space with child-driven perspectives in a way that is meaningful and useful for design activities. For this purpose, a review of the literature on the key dimensions of user-product experience, as well as the informational requirements of design have

informed an evolving methodological exploration of eliciting design-relevant information from child-users in three different field studies. The output of this work is *Elicitation, Prioritisation and Observation* as a research model which integrates both conceptual and contextual inquiry of the child-user space, and two novel techniques corresponding to these inquiries, respectively *Construct Elicitation and Prioritisation,* and *Shared Discovery*.

Keywords: design for children, construct elicitation techniques, user research, early design phase

ÖZ

TANIMLAMA, ÖNCELİKLENDİRME, GÖZLEMLEME: ERKEN TASARIM AŞAMALARINI ÇOCUK ODAKLI PERSPEKTİFLERLE BİLGİLENDİREN BİR ARAŞTIRMA MODELİ

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Çocukların çok çeşitli ürünlerin aktif kullanıcıları olmaya başlamalarıyla birlikte, özellikle çocuk-bilgisayar etkileşimi alanında çocuk kullanıcıların ürün ve sistemlerle olan deneyimlerinin araştırılması başlı başına bir çalışma alanı haline gelmiştir. Bununla doğrultulu olarak çocuklar, yetişkinlerden farklı, kendine has ihtiyaç ve ilgilere sahip özel bir kullanıcı grubu olarak tanınmaya başlanmıştır. Çocuk merkezli perspektiflerin tasarımın erken aşamalarına dâhil edilmesi, anlamlı etkileşimler doğurabilmesi açısından oldukça önemli bir husustur. Ancak çocuklar tasarım sürecine hâlâ baskın olarak tasarlanan çözümlerin test edicisi olarak dâhil edilmekte ve araştırma yöntemlerinde genellikle ürün tasarlama ve geliştirme sürecini ve bu süreçte çocukların rolünü merkeze alan insan-bilgisayar etkileşimi geleneğinin izlediği görülmektedir.

Bu doktora tezinin amacı, araştırmanın odağını çocukların tasarım sürecine dâhiliyetinin yöntemlerinden uzaklaştırıp çocukların ürünlerle ilgili beklentileri,

öncelikleri ve ihtiyaçlarına yönelik kapsamlı bir kavrayışa doğru yönlendirmek ve böylece tasarım alanını, tasarım etkinlikleri için anlamlı ve kullanışlı bir biçimde çocuk merkezli perspektiflerle zenginleştirmektir. Bu amaçla, ürün-kullanıcı deneyiminin aslî boyutları ve kullanıcı bilgisinin tasarım süreci açısından içerdiği gerekliliklere dair yapılan yazın taraması, çocuklardan tasarıma ilişkin bilgi edinilmesi yönünde üç farklı alan çalışmasıyla evrilen, bir yöntemsel arayışı yönlendirmiştir. Bu çalışmanın çıktıları; *Tanımlama, Önceliklendirme ve Gözlemleme* olarak adlandırılan, çocuk kullanıcıların deneyimlerinin kavramsal ve bağlamsal boyutlarını bütünleştiren bir araştırma modeliyle, bu boyutlara karşılık gelen *Yapı Tanımlama ve Önceliklendirme* ve *Ortak Keşif* adlı iki yeni araştırma tekniğidir.

Anahtar Kelimeler: çocuklar için tasarım, yapı elde etme teknikleri, kullanıcı araştıması, erken tasarım aşamaları

To a better future

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CHAPTER 1

INTRODUCTION

1.1 Problem Background

Children of today, especially in the developed world, are born and raised in a technologically-rich social and physical environment. From their homes to classrooms, they not only witness, but also are actively involved in various uses of educational or entertainment products. The purposeful interactions of children with their environment are immersed and enriched with mobile technologies, interactive toys, and various leisure and learning applications. Together with this has come the recognition of children as a user group with unique needs, motivations and interests. Not only that children have started to be seen as a growing market for technological products, the societies have also started to raise concerns in terms of developing technologies that would support the wellbeing and development of the youngest among us, which has led to the design of interactive technologies for children becoming a separate field of research (Markopoulos, Read, Hoÿsniemi, & MacFarlane, 2008).

The growing interest in designing for child-users has called forth immense discussions and methodological contributions on how to design for and with children. Methods of involvement range from usability testing (see, for instance: Hanna, Risden, & Alexander, 1997; Read, 2008) to participatory design methods (Fails et al., 2012; Guha et al., 2005). The research field, which is often described as *child-computer interaction* (CCI) or *interaction design and children* (IDC)[1], borrows methods of research from a

[1] These terms also refer to two significant research and publication venues specialised in the design of children's technology, namely *International Journal of Child-Computer Interaction*, and the *ACM Conference on Interaction Design and Children.*

number of other fields including education, psychology, computing, and so on, making it difficult to draw a general picture of the landscape of research (Markopoulos et al., 2008). Naturally, there is no wonder as to why there has been a significant interest towards building a research agenda on the methods of children's involvement in the process of the design of products and systems for their use.

In their analysis of the 20 years of CHI papers presented between 1994 to 2013, Liu et al. (2014) find out that in the first half of that duration the research community was significantly interested in design techniques and participatory methods in designing educational applications for children. A comparison to the second half of the 20 years shows that methodological issues have reached a saturation point, and are replaced with the design of learning or gaming applications as well as particular interaction modalities as the top issues of interest. Nonetheless, examining or comparing methods still remain to be a central issue in interaction design and children community (Yarosh, Radu, Hunter, & Rosenbaum, 2011).

Developing products and systems for children can be more challenging than that of designing for adult-users. This is due to the potential mismatch between how children experience products and make sense of this experience, and how adult-designers conceptualise children as users. One source that has been helpful for the designers of children's technologies is age-based developmental characterisations (for examples of design guides based on developmental characteristics, see Bruckman, Bandlow, & Forte, 2007; Hourcade, 2007). Although being a useful start for designers who are novices in the field, the intergenerational differences between adults and children do not only stem from the developmental issues, but also from the fact that unlike adult-users, most children were born into an environment equipped with technologies that seem novel to most adults. For this reason, the differences in the interaction are not only *biological*, but also to some extent, *cultural* as well. The study of "childhood as a culture" and "children as a distinct social group" is well received in the new sociology of childhood, which acknowledge the unique knowledge of children that comes simply from the experience of being a child (Mayall, 2000). Taken from this lens, the developmentalist approach remains to present over-generalising assumptions

about child-users' abilities and interests, which fail to notice both the unique perspectives of children, and the differences among them.

The most notable line of methodological work seems to have been done towards direct involvement of children in the design activities, which started to become significant as of late 1990s (Druin, 1999; Scaife & Rogers, 1999). Designing technologies *with* children was perhaps more popularised after the proposal of a framework by Druin (2002) and her colleagues, which conceptualises the different roles children can take (user, tester, informant, and design partner) in the technology design, and the resulting contribution of this involvement. *Cooperative inquiry* (Druin, 1999; Guha, Druin, & Fails, 2013; Yip et al., 2013) is perhaps one of the most influential methodological approaches in the field. Essentially being a participatory method, cooperative inquiry aims sustained involvement of children as design partners in intergenerational design teams via different techniques throughout the design process. This method to some extent builds upon *contextual inquiry*, which is a participatory human-computer interaction (HCI) method developed for designing workplace technologies with users.

Early involvement of children in design has gained considerable attention in the past years, with a significant interest in methods of inquiry (Read & Markopoulos, 2013). Participatory design (PD), especially co-design techniques, have been a central point of interest in this regard. In fact, quite progressive applications of participatory methods are perhaps seen in the field of child-computer interaction, enabling long-term intergenerational and multidisciplinary collaborations with child-users and experts through such frameworks as *learner-centred design* (Good & Robertson, 2006), *bonded design* (Large, Nesset, Beheshti, & Bowler, 2006), *informant design* (Scaife & Rogers, 1999) and so on. It appears that involving children as much as possible has become a norm, and evidence to empowerment of child-users by giving them voice in the design process (a detailed investigation on this can be found in Chapter 2).

Despite the strong emphasis on the contribution of children for the development of child-friendly products and systems, the challenges posed with the dominant participatory practices with children has not gone unnoticed. For instance, Iversen,

Halskov, & Leong (2010) criticise the contemporary PD practices with children for being too much focused on the level and methods of participation, and overlooking the original premise of Scandinavian PD, which is to incorporate user values into designed products and systems. It is true that the aforementioned methods are quite product-centred, meaning that they focus on developing the technology in question together with children, with no specific focus or significant attempt to understand the underlying reasons to children's creations during co-design activities. Such a strong focus on the material or structural aspects of the product can fall short of investigating what this technology means for its users in practice, and they even become irrelevant when designing ubiquitous technologies with perhaps no visible product at all (Smith, Iversen, Hjermitslev, & Lynggaard, 2013). These two perspectives have been decoupled by Van Mechelen et al. (2017) as *descriptive perspective* and *knowledge perspective*. The former, the authors suggest, is typically suitable only after there is a well-defined design problem, whereas the knowledge perspective is useful in the early, fuzzy stages of design, when children's contributions can help take major design directions.

The significance of consulting the future users in the fuzzy front-end is apparent, as it gives the users the opportunity to reflect on their design-relevant perspectives and knowledge, which can lead to the design of products and systems that appeal and are more meaningful in their lives. Even though it is invaluable for designers to step into users' world through participatory methods, long-term collaborations can pose feasibility problems in an industrial setting due to division of labour in the organisation of the firm (van Veggel, 2005). When this is the case, it is vital to not only elicit, but also effectively communicate to design teams what really matters for the users in a way to support the requirements of the design activities (Töre Yargın & Erbuğ, 2012).

Another limitation identified can be related to the fact that the design of products and systems to support specific learning goals is a significant domain of research (Liu et al., 2014; Yarosh et al., 2011). The strong focus on learning may require prioritisation of educational goals over vitalising what really matters for children through an inquiry into the sort of meaning the products in question should facilitate in children's lives. Transferring methods of inquiry from HCI, which traditionally focused on the

workplace technologies, can be seen natural as learning is somewhat the equivalent of "work" for children.

Although it is true that many products and systems designed for children tend to achieve certain learning goals, children are not simply *learners*. The attribution of such predefined character for child-users may prevent us from understanding differing expectations and interests of children, which can be an invaluable input to inform and expand the early design phases with diverse child-centred perspectives. A comprehensive understanding of children's multi-faceted experiences will help designers to challenge their own beliefs and judgements about child-users, hence inspiring the design of products that will facilitate experiences which are meaningful for children's lives.

1.2 Aim and Research Questions

The aim of this dissertation is to develop a research model for exploring the product experience of children in the fuzzy front-end, in order to inform and expand the early design space by unravelling how children make sense of their interactions with products. In this regard, the focus is on devising a roadmap for the holistic inquiry of children's experience with the product in question, which will help designers to have a comprehensive understanding about not only how children engage with products, but also how they give meaning to this engagement.

In this direction, this dissertation aims to answer the following question: *how can we obtain a holistic capture of children's product experience to inform and inspire early design process through a child-centred lens?* To address this issue, the following sub-questions become forefront:

1. What are the state-of-the-art methodological approaches to user research with children?
2. What are the critical dimensions affecting children's product experiences, and to what extent do contemporary early stage methods correspond to them?
3. In which ways can we elicit and integrate the various factors affecting children's product experience to present a holistic capture of the user space to inform the design process?

1.3 Significance and Contributions of the Study

This study contributes to the relevant literature by offering a research model for a comprehensive investigation of children's user space in order to expand the early design space with child-centred possibilities. The following sources have been influential in development of the model:

- Literature on the contemporary landscape of user research with children in order to be able to describe dominant trends and gaps,
- Models of user experience for a holistic portrayal of the user space, and how it is relevant in terms of designing products and systems for children,
- An interpretative review of the meaning-driven research to transfer theoretical and applicable knowledge into the field of user research with children, for the purpose of inquiring design-relevant child-centred perspectives,
- The accumulative knowledge and experience gained from field works based on the implementation of the aforementioned theoretical knowledge.

In this regard, the contributions of this dissertation take place in the following issues:

1. *A comprehensive review of the state-of-the-art user research practices with children, especially in the early design phase*: A critical review of the methods of children's involvement and the resulting impact in design, which contributes to the existing discussions and body of knowledge on representing children in the design space.
2. *Experiential approach to the inquiry for a holistic understanding of the children's user space:* Shifting the focus of inquiry from children's role in the design process to the comprehension of the factors affecting overall product experience.
3. *A research model to capture and make sense of children's experience from their perspective:* Moving from the experiential approach, development of a research model consisting of methodological guides and recommendations for researchers and practitioners to help understand and reflect children's perspectives in product design, hence leading to expansion of the child-user space into design space.

4. *A strategy to support expansion of the design space:* Recommending data-driven strategies to elicit and represent the diversity of children to support expansion of the design space with meaningful possibilities.
5. *Practical recommendations on translating user information into design-relevant knowledge:* Detailed practical strategies related to data gathering, analysis and representation in order to meet the requirements of the designers and design activities without losing the richness of the user information.

1.4 Structure of the Thesis

The structure of the thesis is presented in Figure 1. Chapter 2 outlines a critical analysis of the state-of-the-art methodological approaches to user research with children. First, literature review is presented on the role of children in design process, early involvement of children, participatory methods, and methods to explore children's space. Then, a systematic review of contemporary user research trends with children is presented, and predesign research practices in particular are investigated.

Driven from user experience literature, Chapter 3 starts with an exploration of the critical dimensions affecting children's product experiences, and continues with a frame of the informational needs of designers, i.e. what they need to know about the user's space for empathy with the user and guidance in design activities. The chapter concludes with a comparison of to what extent contemporary research practices outlined in Chapter 2 meet the methodological requirements posed by these dimensions.

Chapter 4 begins with the methodological gap in the inquiry as pointed out at the end of Chapter 3, and suggests psychology of personal constructs as the point of departure to fill this gap. Following the theoretical background and methods of inquiry, this chapter also presents two explorative field studies, namely *open-ended* and *structured construct elicitation* techniques, which investigate their potential to scrutinise the concerns and expectations of child-users.

The main study presented in Chapter 5 aims to elicit the dimensions of children's product experience to present a holistic capture of the user space. The study investigates photography experience of children, and consists of a two-step

methodology to integrate both conceptual and contextual factors affecting the user experience. The methodology, findings and design implications are discussed in detail.

Based on the theoretical frame, and insights gained from the fieldwork, Chapter 6 introduces *Elicitation, Prioritisation, Observation (EPO)* as a unified research model to explore and integrate children's product experience in the early design phases. Also, two research techniques, namely *Comparative Elicitation and Prioritisation Technique (CEPT)* and *Shared Discovery Technique* are presented to be utilised within the EPO framework. Chapter 7 reflects on the research questions, discusses the impact and limitations of the study, as well as directions for future research.

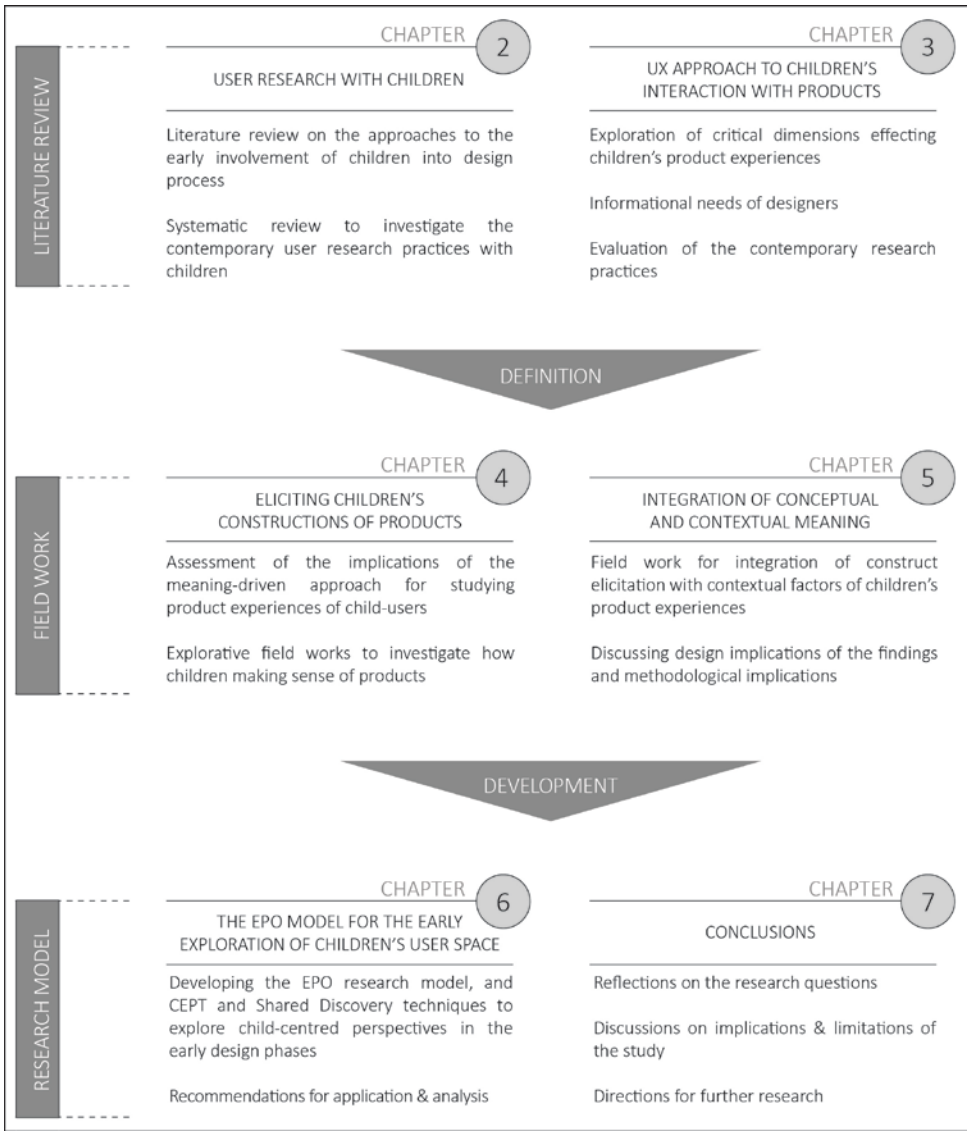

Figure 1. Structure of the thesis

CHAPTER 2

USER RESEARCH WITH CHILDREN

The majority of the work on design research with children comes from child-computer interaction and interaction design fields. With the immersion of technology into children's daily lives, especially in the Western world, research focusing on tailoring the technological products according to the dynamic and diverse developmental and learning needs of children has gained impetus. Technology design for children has become an independent field of research, with maturing discussions on the methods of children's involvement in research and design. This chapter begins with changing perspectives in research with children, followed by an overview of the developmental concerns raised in the field. After, the role of children in design process, and methodological approaches to early involvement of children will be presented. Finally, the methodology and results of a systematic literature survey will be presented to outline state-of-the-art design and research practices for and with children.

2.1 Changing Perspectives in Research with Children

Recent work on design research with children concentrates on how to maximize participation of children, and overcome the challenges in doing so. In order to better address these methodological issues, it is best to first focus on the changing perspectives on children and childhood. There has been a significant shift from research *on* children to *with* children, positioning young people as subjects and participants rather than objects of research (Corsaro, 2005; Mayall, 2000). In this section, I will focus on the changes in the social representations on children and childhood, and how this paradigm shift is reflected on methodological issues in conducting research with children.

The idea of "childhood" as a concept started to emerge during the sixteenth century in the Western world. According to influential French historian Philippe Ariés (1962), this is the *coddling era*, when the image of child started to be seen in paintings and written documents as a 'sweet' and 'innocent' being. This image was soon replaced with the modernist view, which represents children as 'immature', wannabe adults, who need to be disciplined and prepared for adulthood. This paradigm shift, according to Ariés, is a reflection of a more general cultural change, resulting in separations of class, race, age, and formation of ideal types and conventional models under modernist world view. Early twentieth century is marked by behaviourist approaches to children and childhood. Experiments on babies and children were conducted to show how certain behaviours are not innate but learned through sustained experiences with the environment. Taking John Locke's concept of *tabula rasa*, behaviourist approach sees child as a "blank vessel" to be filled by responsible adults with required skills, knowledge and experiences (Bruce, 2011). The emphasis on transmission of culture to children by adults positions children as passive recipients, who are incomplete and need to be nurtured to adulthood. This view of children as passive recipients has been reflected on research practices on children and childhood. Traditional research is adult-centred, exploring the children's lives through adult caretakers' and professionals' accounts, such as parents, teachers, and psychologists, since the child is seen as incompetent, doubtful and untrustworthy in understanding and articulating views about their own lives (Christensen & Prout, 2002).

This traditional view that positions children as passive recipients has been challenged by a rather child-centred perspective, which advocates that although different than adults, children possess genuine social and cognitive skills, with their own subjectivity (Christensen & James, 2000b; Christensen & Prout, 2002). This perspective about childhood is influenced by Kantian understanding of people as active learners depending on personal experiences, and Piaget is the most influential figure of this school with his stage-like cognitive development theory (Bruce, 2011). Although this constructivist approach acknowledges children as active initiators of their own understandings through their physical and social interactions, rather than being simply recipients, developmentalism is still criticised to "diminish the status of the immature child when measured against adult standards of thinking and reasoning" (Woodhead

& Faulkner, 2000). Although the developmentalist approach recognizes the subjectivity of children, it is based on presuppositions and generalizations about characteristics of children at a certain age (Christensen & Prout, 2002). Research practices based on constructivist approach, which has been popularized since the 1970s, is based on revealing the subjectivity of children instead of relying on adult accounts. Hence, children have become the central subjects of the research, with a special consideration of their developmental characteristics in data gathering phase (Christensen & James, 2000a). As a reflection to this; novel, game-like, child-friendly methods are thought to be more appropriate for children (Alderson, 2000).

A more recent approach to children and childhood studies, namely "the new childhood", acknowledges children as active social actors, who have impact on and are affected by the society (O'Kane, 2000). The main objection of this approach to previous portrayals of childhood is evident in its emphasis on the social construction of childhood, which generalizes children as immature and not reliable informants of their own lives. The main argument is to take children as a distinct social group, and childhood as a culture, the unique knowledge of whom comes from the experience of "being a child" (Mayall, 2000). This novel perspective positions children as a disadvantaged group, similar to minorities, and criticizes the mainstream stereotyping, polarizing and abstracted representations of children (Lahman, 2008). Portraying children as competent social actors requires acknowledging what children *can do*, instead of what they *cannot*. This is not to ignore particular biological and cognitive differences of children from adults; but to shift the focus of inquiry from what these differences are, to why they exist in the first place (Punch, 2002). This means rigorous questioning of adult representations on children, and how these constructions are reflected on our expectations of research outcomes.

One central issue of this approach is to explore, understand and deal with the politics of research with children. Generational power issues, disadvantaged position and othering of children in research with adults, and ways of minimizing these problems have been frequently mentioned in recent works of the scholars (Alderson, 2000; Lahman, 2008; Mayall, 2000; Punch, 2002). These works intend to carefully highlight how power imbalance that already exists between the researcher and the researched is

amplified when investigating the lives of children – a social group who has always been stereotyped and marginalized, and subjected to adult power in every domain of social life, such as family, schools, and public space. This way of positioning children as "competent yet vulnerable" (Lahman, 2008) actors of social life is also reflected in research practices. First of all, it is suggested that acknowledgement of children as competent actors and informants of their own lives requires questioning our ongoing assumptions and characterizations about what children can and cannot do during research. It is suggested that we don't have to utilize special methods specifically devised for research with children. This not necessarily means the refusal of biological differences of children from adults. Instead, it is to shift the focus of the research to more general issues which are common to research in general, such as research questions and aims, social and cultural context, and so on (Christensen & James, 2000b). The significance of this research approach comes from its intention to minimize the inequalities between young people and the researcher, give special emphasis on the expertise of children on their own lives and how to understand it, questioning the adult function of expectations about children, and acknowledge the diversity among them. The latter is especially important in recognizing possible differences between children not only based on age, but also gender, class, culture, interests, and alike factors, which are already taken into consideration when conducting research with adult participants.

According to Prout (2000), instead of seeking for special child-friendly methods, we should concentrate on the application of these methods considering the particularities of the studied people, which is a general concern in every research. Alderson (2000), on the other hand, defends that making research tools and procedures more game-like and child-friendly does not necessarily guarantee maximum participation of children, and that the level of participation depends on the level of presenting or withdrawal of information regarding the research from children, how much power children have over the research procedure, and so forth. According to Punch (2002), issues related to research with children are mainly based on adult constructions of children, as follows:

- *Not imposing the researcher's own perceptions* is a concern which is equally important in every qualitative research. The difficulty in research with

children, however, comes from the adult conceptions of children being incompetent in articulating what they experience, and the challenge of getting into the child's world.

- *Validity and reliability* is an assumption also based on adult conceptions on children which presumes that they tend to lie or have difficulty in differentiating between real life and fantasy. This is, however, mainly a trust issue between the researcher and the research subject, which also exists in research with adults.
- *Clarity of language*, which seems to be a very valid concern, is also not only rooted in children's incompetency in speaking "adult language", but also adults' inability to understand the subjective vocabulary that children might use to express themselves.
- *Research context and settings*, a frequently mentioned determinant of the quality of data gathered during research with children, is also significant mainly because almost every space, including home, school and other public spaces, is an "adult space" which reproduces the power imbalance between the child and the researcher.
- *Building rapport*, which is also an important concern of all types of qualitative research, is a challenge because of children's potential lack of experience in building an equal and trustworthy relationship with adults due to power imbalance.
- *Analysis*, the power of which is almost always in the hands of the researcher, is more problematic when conducting research with children due to adult researcher's tendency to over-interpret the data based on his/her own and social perceptions and understandings about children.
- *Using appropriate research methods* is a central concern for every research. However, when it comes to research with children, there is a tendency to devise fun and child-friendly methods due to over emphasizing the developmental characteristics of children such as attention span, limited use of vocabulary, and the difficulty of building a rapport. Although these concerns are not utterly irrelevant, it might not be the case for every single child, and it doesn't mean

that methods, which have been applied with adult participants, are completely useless.

Based on the changing perspectives in sociology of childhood, it is possible to conclude that the main challenge in conducting research with children derives from adult (in this case, user researcher) preconceptions about the capabilities of children, as well as how they do, will and are supposed to interact with their environments. Hence, before concentrating on the methodological issues, it is important to acknowledge children as a diverse social group, who, until recently, were long been ignored and unheard of in design research. This is not to ignore the possible biological differences of children from adults, but to change the centre of attention towards questioning how well our research practices enable the effective participation of a disadvantaged group. This alternative construction of childhood has also been reflected on design research as involving children in the design process as effectively as possible. Recognition of children as active and competent agents having subjective interests and attitudes, and a rigorous exploration of their lives, will lead to novel designs enabling more meaningful experiences.

2.2 Awareness of Developmental Characteristics in Designing for and with Children

The ways children differ from adults in terms of their interactions with technology has always been a focus of interest in design research and practice for and with children. Although developmental characteristics are not the focus or the central foundation of this dissertation, it is worth to mention such an awareness, since it has not only had an impact in the field, but also is an important resource to appreciate the diversity of children. It is accepted that children show differing needs due to their developmental characteristics, which should be acknowledged and addressed by designers. A few of these guidelines and frameworks will be mentioned in this section, some focusing on design recommendations based on developmental characteristics, while others are interested in how these factors affect the involvement of children in the design process.

Bruckman, Bandlow & Forte (2007) frame their work on HCI with children around the changing developmental characteristics of children with age, and how these

cognitive and physical qualities relate to children's experience with technology. Drawing from Piaget's developmental stages, and acknowledging the diversity of children showing different developmental characteristics, they suggest tactical guidelines for designers. They identify fine motor dexterity, speech, reading, background knowledge, and interaction style as showing different characteristics in children than in adults. Based on these characteristics, they suggest both hardware and software interaction guides for designers working for children. Similarly, Hourcade (2007) depends on the developmental theories of Piaget, Montessori, Vygotsky, Gardner and alike theoreticians to define certain characteristics that frame the ground for designers. As interaction-defining characteristics, he refers to fine motor skills of children such as manipulation and reaching movements that guide physical interaction, as well as cognitive skills including perception, memory, problem solving, language and symbolic representation characteristics of children, which mostly affect both hardware and software interaction.

Moving from intellectual and skills development literature, Gelderblom & Kotzé (2009) come up with design lessons for designers of children's technology. They claim that a comprehensive and practice-based framework fuelled from child development literature, although not an enough source alone to come up with developmentally appropriate designs, can effectively reduce the amount of the usability testing needed, hence would be time and cost-effective. Suggesting that existing frameworks lack differentiating the recommendations based on diverse age groups, and that they provide high-order, conceptual advice, their framework focuses on children five to eight years old, and provides a rather hands-on guideline for designers. Their review on Piaget and Vygotsky's theories of cognitive development, development of special skills, and children's technology use patterns result in a broad categorisation of recommendations with practical suggestions (Gelderblom & Kotzé, 2008).

Apart from the aforementioned and alike design guidelines of design for children, developmental characteristics have also been a concern in doing research and designing *with* children. For instance, in their guidelines of usability testing with children, Hanna, Risden & Alexander (1997) suggest separate recommendations for preschool, elementary school and middle school children. Differently than the

previously mentioned work, their guidelines are not based on theory, but rather their personal experience in usability testing with children. Hence, the recommendations they give are mostly related to practical issues such as children's attention span, verbal expression, and communicating with adults. Another example of developmentally appropriate recommendations involve participatory methods. Reflecting on the age-appropriateness of the tools and techniques employed in participatory design practices with children is common. Driven partly from developmental theories, but mostly from experiences from practice, these recommendations mostly touch upon the practical aspects of involving children in design practices. For instance, Jones et al. (2003) share the difficulties they face when prototyping with children, while Knudtzon et al. (2003) reflect on different levels of engagement of children in different ages during the activities conducted in intergenerational design teams. Gielen (2008) provides practical recommendations based on experiences of generative design sessions with children, for better engagement of participants in the sessions, and improve the quality of the session outputs. On another work, Van Mechelen et al. (2014) focus on the challenging group dynamics in co-design activities with children.

Along with these practice-driven and rather unstructured recommendations and guidelines, Sluis-Thiescheffer et al. (2011) present a comprehensive and structured framework for early involvement of children based on their developmental skills. Building on a previous work (Sluis-Thiescheffer et al., 2007), they take the theory of Multiple Intelligences (MI) of Howard Gardner as the basis of their framework. They stress the importance of a focus on the suitability of the methods to children's skills and the expected design outcome, rather than the common practice, which focuses on the level of participant engagement and the expected inspiration for design. To identify the suitability of the methods, their framework utilises the theory of Multiple Intelligences (MI) as the basis for the required skills for the implementation of the 28 different design methods, such as storytelling, brainstorming, interviews, prototyping, etc. Based on a cluster study with designers, they match these methods with different intelligence types as identified in MI.

Considering the fact that developmental characteristics of children has been an influential factor affecting the design practices, some studies were presented in this

section to convey the general trends. It is possible to increase the number of the studies that exemplify how developmental psychology informs the process of design for and with children. Nevertheless, the general categorisation will suggest that developmental characteristics of children inform the field at two levels. First level is the decisions taken during the design of the products for children's use by focusing on how the developmental characteristics will potentially affect the ways in which children engage with the products to-be-designed. Second level is related to the ways children are included in the design process, either in the form of experiences gathered from practices or theoretically informed recommendations on how children's developmental characteristics affect their engagement in design activities.

2.3 The Role of Children in the Design Process

Perhaps the most influential work on children's involvement in design is presented by Druin (2002). As is the case in majority of the interaction design practice for children, her work is mainly focused on the design of educational technologies, which is naturally reflected on her framework and terminology. Her influential framework on the potential roles children can take in the design of technology describes four role categories based on the way adult researchers relate to children, how children relate to the developed technology (phase of the design process), and the researchers' goals for children's inclusion. According to this, Druin defines four roles for children: user, tester, informant, and design partner (Figure 2).

When children are given the role of *users*, their relationship to adult researchers and the designed technology is rather distant. Children are involved after the design process is completed, typically their interaction with the existing and released products is observed and tested by the researchers. The resulting knowledge can inform the future designs by testing a certain concept, or developing educational theories by studying the impact of the immediate technologies on children's learning. Naturally, children in the user role are passive, and have none to limited indirect control over the research and design process.

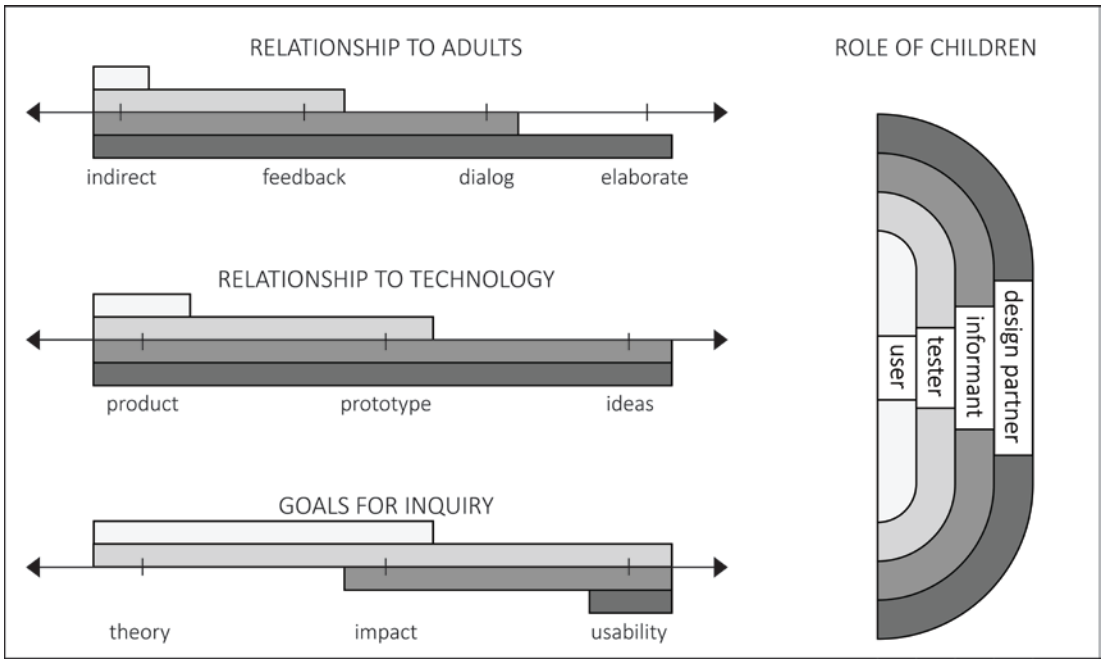

Figure 2. The role of children in technology design (adapted from Druin, 2002)

In the *tester* role, children are included in the later phases of the design process to provide feedback on prototypes or products for improvements before they are released. Hence, children are given a more active part in the design process compared to the user role, since they can influence the future design iterations, and a closer relationship is constructed with the researchers as children may provide feedback and suggestions. This way, children can inform the researchers theorising educational concepts, inquiring the impact of the technology in question, as well as improving usability.

As *informants*, children can play a rather direct role compared to user and tester. *Informant design* as a participative rather than reactive method of inviting children to the design process, was first introduced by Scaife & Rogers (1999). In principle, they point out to the opportunity of including children, along with other stakeholders, to inform the design process at various stages. For instance, in the early phases, children might be observed in natural context while using existing technology. In the following stages, they can be invited to design and/or test low fidelity prototypes. Later in the design process, they may give feedback on prototypes for further iteration. Hence both children's relationship to researchers and the technology, and goals for their inclusion might be diverse. Druin (2002) suggests informant design to be most useful when the

research goal is to explore the impact of the technology, and ensure better usability. From distant observations of interaction with products to direct feedback on prototypes, and direct dialog that brings forth their ideas to design scene, children's relationship to adults and technology may vary.

The final, and the most active and inclusive role defined by Druin is *design partner*. As design partners, children become equal members of design teams throughout the project duration, sometimes for several months or even years. Evolved and inspired from methods applied with adult users such as contextual inquiry, cooperative design and participatory design, Druin and her colleagues suggest the use of varied methods throughout the design process such as *cooperative inquiry*, where the intergenerational design team cooperatively inquire the existing technology usage patterns of children and reflect on it; or the use of *participatory design* techniques to develop low-tech prototypes. Since children cannot be expected to possess professional designer skills or master in professional design tools, generative brainstorming tools and techniques, such as *bags of stuff* and *mixing ideas* (Fails, Guha, & Druin, 2012) are developed to ensure the participation of children. The strength of involving young users as design partners lies under the ideal of empowering children by giving them an equal voice in the decisions taken during the design process. The relationship of children to the designed technology and the adult members of the team are minimally mediated, only at the expense of limited goals for inquiry, since the focus is strongly on collaborating to develop the technology in question. Druin suggests that partnering with children is most useful for usability of the new technology.

Druin's framework is further elaborated on by (Barendregt, Bekker, Börjesson, Eriksson, & Torgersson, 2016) to describe the nature of children's involvement in the design process. They designed the *role definition matrix* to overcome the challenges of defining the role children take in design. Their model take the stage of the design process, and activity in relation to designers, as basis of the definition of the role children might take. The sample shown in Table 1, for instance, refer to children as informants, distantly observed in the early phases of the design phase, in order to come up with design requirements.

Table 1. The role definition matrix (adapted from Barendregt et al., 2016)

Activity in relation to designer	**Design phase**		
	Requirements	**Design**	**Evaluation**
Elaboration			
Dialogue			
Feedback			
Indirect	X		

The roles defined by Druin are hierarchical in nature, design partner being the most inclusive. The level of involvement naturally touch upon the issue of the phase in which children are included. Children in informant and design partner roles imply that children are invited to contribute to design beginning from the very early phases. Although early inclusion of children is expected to enable children to bring their perceptions and values into the design space (Sluis-Thiescheffer et al., 2007), a later criticism to current participatory design practices with children was brought by Iversen, Halskov & Leong (2010). They point out the fact that most discussion focus on the methods and degree of participation, which overshadows the most important and the original premise of the participatory design approach: incorporating users' values into design solutions. Nevertheless, Druin and her colleagues' work had invaluable impact on the field by challenging the assumptions on children's so-called limitations to contribute design, and paved the way to various participatory techniques, while children's involvement has almost become a norm, and the field is now mature enough to discuss various aspects of children's participation in design.

2.4 Methodological Approaches to Early Involvement of Children

As children and their contribution have become a central factor in the design of products for their use, numerous approaches, methods and techniques have been developed in less than two decades. Ranging from eliciting design requirements to usability testing, children are consulted in different phases of the design process based on the research goals. Since the focus of this dissertation is the early involvement, the methods inviting children to the fuzzy front end of the design process will be reviewed in this section. One common point of all these methods is that, although some share common ground or are informed by design research with adults; they all define their

target group as children. Some of these methods focus solely on the phase from pre-design to design requirements, while others put forward a rather holistic approach to ensure the sustained participation of children throughout the product development process. Based on this division, the methodological frameworks for long-span involvement of children, and the ones focusing on the early exploration of children's space, will be presented separately.

2.4.1 Frameworks for Long-Span Involvement of Children

Methodological approaches inviting the long-span involvement aims sustained participation of children, along with other stakeholders, in the product development process. Hence, these frameworks are most suitable when the inquiry is directed towards development of a specific product or system. Throughout the development process, children can take multiple roles at different or all phases of design.

2.4.1.1 Cooperative Inquiry

The idea of giving space for children as design partners was first suggested by Druin (1999). In her innovative work, which was developed throughout years of project experience, she suggests *cooperative inquiry* as a methodological framework for enabling maximised and sustained participation of children in the design process. Built on and evolved from the methods of research with adults, such as multidisciplinary research partnership with users, fieldwork and participatory design, cooperative inquiry suggests collaboration of adult experts with diverse disciplinary backgrounds and children as experts of their own experiences through intergenerational design teams. Intergenerational design teams utilise techniques such as contextual inquiry and iterative prototyping for both exploring the usage context of children, and developing solutions together. Aiming to remove the unbalanced power relationship between adults and children, the members of these teams work with the premise of equal partnership in decision-making process. Some of the techniques utilised in cooperative inquiry are briefly explained below:

Contextual inquiry (Druin, 2002) is a technique where both adult and child team members observe child users interacting with existing technology to detect activity

patterns which are difficult to verbally articulate, but easier to observe in concrete interactions. These activities are documented by the team through observation notes accompanied with drawings and videos for later collaborative analysis.

Sticky noting (Guha et al., 2013) technique is utilised either for critical evaluation of an existing technology, or early prototyping of a new technology. In evaluating, all the team members first use the technology in question. After, as the name insinuates, the technique makes use of sticky notes for the team to note down their likes, dislikes and suggested changes for the product. These notes are gathered on a wall to be thematically grouped, so that categories and sub-categories emerge. The outcomes of the sticky noting sessions help draw directions for future iterations on the technology.

Bags of stuff (Guha et al., 2013) is a low-tech prototyping technique. The team is provided with bags full of various art supplies such as markers, scissors, clay, glue, and so on. These materials are used for prototyping ideas on a big sheet of paper spread on the floor, which was found more engaging for children than working on small sheets on a table.

Mixing ideas (Guha et al., 2004; Guha et al., 2005) is another low-tech prototyping technique, which was specifically developed for design teams partnering younger children (4-6 years old). The technique consists of physically cutting individually generated ideas to merge into “one big idea”. This way, it aims to foster the engagement of young children as team members in merging the generated ideas by eliminating the discouragement that may arise from problems of ownership and “letting go” of individual ideas.

Layered elaboration (Walsh et al., 2010) is another design iteration technique developed with similar concerns to mixing ideas. It allows iterations on the original design idea by drawing elaborations the previous idea on each time adding a transparent layer of sheet. This way, neither the original nor the following ideas are lost; hence, the ownership among the design participants is increased.

2.4.1.2 Informant Design

Informant design is a method that welcomes the input of children throughout the design process. Unlike cooperative inquiry, informant design questions the feasibility and desirability of involving children as design partners. Instead of permanent members of the design team, informant design casts the role of "native informants" (Scaife & Rogers, 1999) to children. This way, the instances and level of involvement of children are framed by designers, as children are one of the many stakeholders to inform the design process, along with teachers, psychologists, developers, and other potential partners (Scaife et al., 1997). This does not necessarily mean undermining or diminishing the contribution of children in design, but rather amplifies their qualities as "field experts" (Mazzone, Read, & Beale, 2008) who can inform and steer the direction of the design decisions with their authentic knowledge, which is unlikely to be guessed by designers.

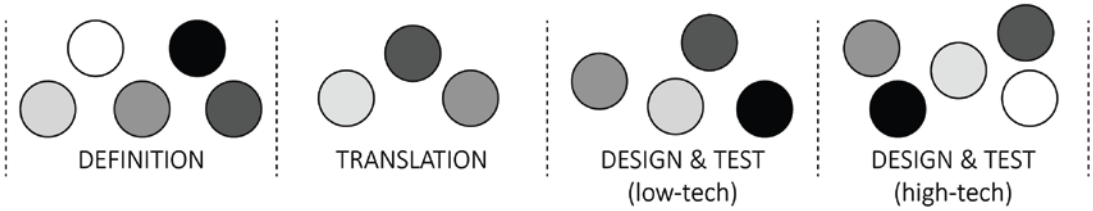

Figure 3. A hypothetical distribution of stakeholders in the process of informant design. Each colour represents a different stakeholder, black circle being children (simplified from case study presented in Scaife et al., 1997)

Informant design functions as a framework, which employs various methods with different stakeholders, at different phases of the design process. Hence, the framework proposes a dynamic structure, which is adaptable to different research and design contexts. For example, in a case study presented in Scaife et al. (1997), children were involved in the design of an interactive environment to promote learning ecological concepts. Children were invited to contribute with their domain knowledge at three different instances, namely definition of the domain and problems, designing and testing of low-tech prototypes, and evaluation of high-tech prototypes (Figure 3). At the first step, contextual interviews were conducted with children to understand the difficulties in meeting the learning goals specified by teachers. Next time children

were consulted was during the design and testing of low-tech prototypes in the format of games and scenarios to provide insights into design and confirmation of the assumptions posed by the relevant experts during translation phase. Finally, children were asked to evaluate the high-tech prototypes to ensure the project goals are achieved.

2.4.1.3 Bonded Design

Bonded design is a collaborative method for designing with children, which the developers position in between informant design and cooperative inquiry based on the level of involvement of children (Large & Nesset, 2009). Although bonded design shares the premise for maximum inclusion of children in decision-making process as in cooperative inquiry, it presents a rather focused and compact procedure to be completed in a few weeks. Additionally, as suggested in informant design, it also has drawbacks about the challenges of building a symmetrical relationship between adults and children. Based on these concerns, the format of bonded design is intergenerational design teams, to which adults contribute with their familiarity to the relevant technology and the design process, while children's input is invaluable as they are the experts in thinking and seeing the world as kids. Hence, bonded design suggests a mutual learning process for both parties (Large et al., 2006)

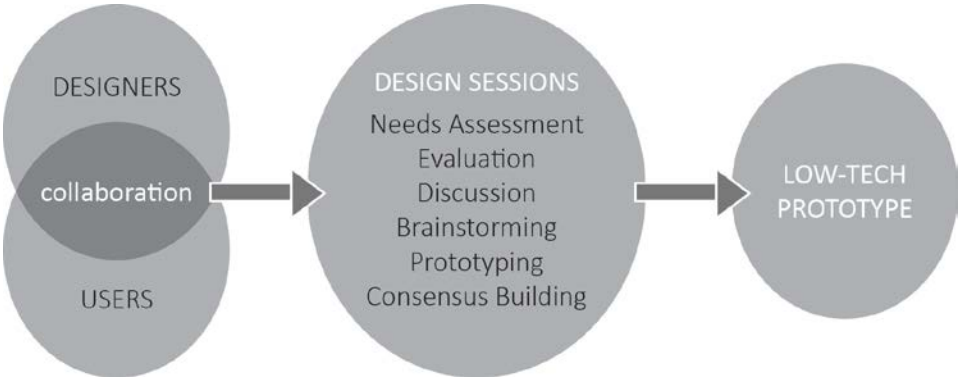

Figure 4. Bonded design model (adapted from Large & Nesset, 2009)

Bonded design proposes several collaborative techniques, which results in the development of a low-tech prototype (Figure 4). The session starts with *needs assessment*, which will later constitute the basis of the remaining design activities. The

assessment of needs might take the form of questionnaires, which is administered to a larger population than the children involved in the design team. It is followed by the critical *evaluation* of the existing relevant technology, which can be spread throughout the sessions to inform the design process. The insights are then shared in *discussion* phase to shape the ideas, which are elaborated in *brainstorming* and *prototyping* sessions. Brainstorming activities might include verbal expression of ideas, or hands-on techniques such as drawings. These ideas are then transferred into low-tech prototypes utilising paper, clay and materials alike. This pool of ideas are then subjected to another discussion for *consensus building*, so that the team focuses on a single solution, which will be finalised with a *low-tech prototype*.

2.4.2 Exploring Children's User Space in the Early Design Phases

The methods of early involvement of children can be less structured and less directed than long-span participation. These generative research methods tend to be more explorative, and not necessarily focused on a specific product or system. In fact, such exploration requires a step back from the design process in the fuzzy front-end to gain insights into children's living context.

It is possible to suggest that these methods cast either *informant* or *design partner* role to children based on Druin's framework, although they not necessarily aim at a long-term collaboration as in the previously mentioned methodological frameworks. Methods classified in this part aim to explore children's experience space through a hands-on approach to inform the design space in the fuzzy front end. Generative methods, such as *make tools* kits, have been gaining popularity as a means to bridge user research and design phases, by allowing users project their experiences, needs and dreams through user-generated artefacts (Sanders, 2002). Focusing on what people *make*, rather than what they *say* and *do*, these methods provide a holistic understanding into design process by inviting users to contribute to the early phases of the design process with their experience-based knowledge. Likewise, designers can take part in the information-gathering phase, hence have a better grasp of user needs and expectations (Hanington, 2007; Stappers & Sanders, 2005).

Although the methods included in this section focus on the early exploration of the user space, in the following phases of the design process, they may be complemented with other methods which are more directed at the design and refinement of the product. Even though being at the early part of an iterative design process, generative methods here refer to the early encounter of the designers with young users. This encounter can help designers gain an emphatic understanding of the child-user perspectives, hence provide insight and inspiration into design solutions (Kaasinen, Väätäjä, Karvonen, & Lu, 2014). Figure 5. The fuzzy front-end of the design process shows where the fuzzy front end stands in a hypothetical iterative design process.

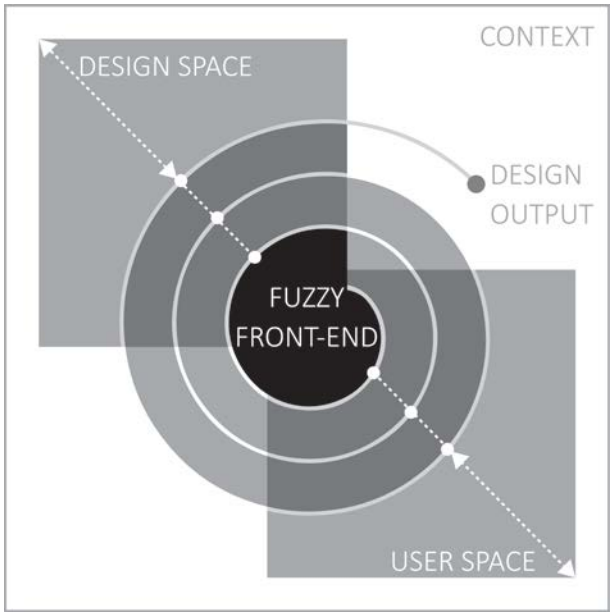

Figure 5. The fuzzy front-end of the design process

There are various generative methods to facilitate stepping into users' shoes. Especially with children, generative tools and techniques are perceived to come even handier than it does with adult users. Non-verbal, such as pictorial ways of communication, are suggested to be suitable methods to utilise in research with children. Use of props and tools while interviewing children is very common for eliciting children's construing about their worlds. Psychologists have been using several tools and techniques during their interviews with children, which relieve them from the stress of narrative expressions, focus on the investigated event, and help the retrieval of the experiences in a more confident and structured way (Bohannan et al.,

2004). Mediums, which are already in use in clinical psychology such as drawing, sticker task, body maps, pictures, toys and so forth, have been inspirational for designers to develop design-oriented research tools and techniques to ease the communication with children. In this section, a selection of methods and techniques will be presented to exemplify how generative methods are in use for the early exploration of the children's space.

2.4.2.1 Contextmapping

Contextmapping is proposed as a method to elicit the tacit needs and dreams of users to synthesize with the information on the ways products are experienced in the natural context, in order to inform future designs (Sleeswijk Visser, Stappers, Van der Lugt, & Sanders, 2005). As the name suggests, it consists of mapping of the factors affecting the context of use with the information collected through user interviews, observations, cultural probes, generative techniques, and so on (Sleeswijk Visser, 2009). Gielen (2008) reports on three contextmapping studies with children. In the project on 'fears', children were asked to project the sources and the geography of their fears through cultural probes and generative sessions. After filling out sensitization booklets with drawings at home, generative sessions were conducted with techniques such as mappings, timelines and writing letters. All the collected materials were then complemented with verbal explanations of children. In another project on outdoor play, it was aimed to identify the aspects of play which children find valuable. The generative sessions included a character collage with provided various body parts, and evaluation of different outdoor activities by using sticker faces on depicted drawings. The author warns, however, about the possibility of the use of sticker faces resulting in misleading conclusions on designer's end, hence in need of further elaboration. The third and last contextmapping activity reported by the author was part of a co-design project on water play. To explore the daily experiences of children and their associations on the type of play in question, participants were first given a culture probe package consisting of diaries, cameras and collage materials to be used at home. In the session following, children were invited to a brainstorming activity complemented with drawings and collages.

As seen in these three examples, contextmapping method may consist of the combination of various tools and techniques. Gielen (2008) suggests contextmapping method to be most useful in the exploratory phase of design to provide designers inspiration, and empathy with children. Hence, he differentiates contextmapping from other forms of participatory methods with children in the sense that it aims to gain insights about themes and daily contexts of children free of pre-defined product categories in mind. This exploratory nature gives the flexibility to make use of diverse tools and techniques within contextmapping studies based on what is being explored.

In a study with children using prosthetic legs, Hussain (2010) employed generative methods to capture their daily experiences. These methods include *write/draw task*, *role playing*, and *photo voice*. With write/draw tasks, she encouraged children to express their wants, hopes, fears, positive and negative experiences, and so on. Photo voice, which is similar to write/draw task, aimed to function as a proxy into children's lives as they give meaning to it, focusing on their daily activities, and the effect of the prosthetic leg use during these daily practices. In role-playing, she asked children to act out how they wanted to be treated by others. In another study with the same user group, Hussain & Sanders (2012) introduced to the children a two dimensional set of paper dolls, clothes and prosthetic legs to encourage them express their views on self-image and aesthetic concerns. Each method aims to gain a better understanding about how this special condition affects their life experience through their own eyes by unravelling their tacit knowledge and needs, which are otherwise difficult to express explicitly. Although not labelled as contextmapping *per se* by the authors, these studies also reflect the aims and the techniques embodied in contextmapping.

2.4.1.2 Design Ethnography

The use of ethnographic methods in design research are proven to provide rich and valuable insights about the real life user context, which expands the relatively narrow personal perspectives of designers (Salvador, Bell, & Anderson, 1999). Design ethnography stands on a cultural approach to investigating the experience of users in its relevant context –the patterns of everyday life-, and expands the possibilities of the design space with rich user information and inspiration. Gaining such a deep

understanding about the users, when utilised in the early phases of design, has the potential to inform relevant and innovative design solutions (Sleeswijk Visser, 2009). Design ethnography is nourished from information coming from multiple sources through multiple methods, such as interviews, photo diaries, observations, and so on (Salvador et al., 1999). Gaver, Dunne, & Pacenti (1999) suggest *cultural probes* as design-driven tools to promote empathy with the users by inviting them to respond to a set of probes designed to gain insights about their daily lives, which is particularly useful when working with an unfamiliar user group. Although the content of the cultural probes packages may vary, some examples are diaries, maps, and disposables cameras with instructions for the users to capture certain instances of their lives that might be relevant to the subject of exploration (Gaver et al., 2004).

Use of cultural probes and alike ethnographic tools and techniques is not uncommon to early exploration of children's space. Iversen & Nielsen (2003) utilised *digital cultural probes* to provide insights for the design of an interactive learning platform. Children were provided with mobile phones to use camera and dictaphone functions for spontaneously capturing and sharing fractions of their relevant experiences, which would otherwise be impossible to observe for the designers. The authors stressed the value of the information gathered from children with the use of digital technologies, spontaneously and flexibly free of time and space restrictions, as it provides rich cultural materials about the informal practices of children when combined with in-depth interviews. Wyeth & Diercke (2006) designed a pack with diverse, open-ended cultural probes focusing on the educational environment to explore children's natural interests within the given context. Their probes span a spectrum from simply reflecting on current practices to making activities, which caters as a bridge between gaining insights from the problem area to projecting into the solution area. The probe pack includes journals, collages, subject ratings, and design of hypothetical artefacts. The authors draw attention to the lack of motivation in completion of some of the activities, such as journal and collage, due to being time consuming and less engaging for children. Moving from this drawback, Riekhoff & Markopoulos (2008) designed a cultural probe pack to explore the emotional experience of sibling rivalry in the daily life context. In the single case they worked on, the participant was an illiterate 4-year-old boy, which required collaboration of the parent to some extent in filling the diary

and sticker tasks. They discuss that playful and automated ways of collecting information would be more engaging for young children.

Iivari et al., 2014 employed video diary method to gain insights into daily technology use of children. Although the aim is similar to the use of cultural probes in general, collecting information with this less-structured digital medium helped them to explore other aspects, such as narrative, self-representation and identity as presented by children themselves. Technology usage practices of children was also investigated by Jorgenson & Sullivan (2009) using participatory photo interviews. This stems from the approach to involve children as research participants by giving them the voice to bring forth issues they care about through photography, which is later used to be elaborated on during interviews.

Design ethnography shares a common ground with contextmapping, and generative methods in general, in so much that the boundaries between might be blurred. They both derive from social sciences, aim to gain an in-depth understanding about daily patterns of users at the fuzzy front end without a specific focus on a product, and make use of similar techniques such as maps, diaries and photography. For example, photo voice method (Hussain, 2010) presented in previous subsection can also be categorised under design ethnography. Likewise, the work reported by Gielen (2008) involves cultural probe packages as a part of the methodology. The line between contextmapping and design ethnography might be drawn in the extent of the methods. Contextmapping presents a hand-on approach to the exploration by inviting the users to generate “things” or “performances”, whereas design ethnography not necessarily require such generation on user’s end.

2.4.1.3 Low-tech Prototyping

Low-tech prototyping is a co-design technique employed in many participatory frameworks, such as cooperative inquiry, informant design, bonded design, and generative design research. In this section, low-tech prototyping is taken as a stand-alone method. The difference is in the extent and the focus of the inquiry. Although it seems that as the method aims to generate a product, the focus of the prototyping activities included in this section is to elicit user perceptions by reflecting them through

the built artefact. Thus, users are invited to bring their expertise on their own experiences into the design space in a rather "designerly" way. For example, *velcro modelling* is suggested by Sanders & William (2003) as a tool to encourage people to express their ideas through making 3D, low-tech models provided by a toolkit consisting of diverse abstract shapes on which Velcro is attached for fastening. A similar method utilising low-tech 3D prototyping is *experience reflection modelling* (Turhan, Doğan, & Korkut, 2011). ERM aims to help potential users to express their experiences, needs and ideas regarding the product in question in an active and participatory process. It is a generative session combining different techniques such as 3D modelling with a toolkit consisting of various abstract geometries, interviewing, and video recording for further analysis.

Vaajakallio, Lee & Mattelmäki (2009) utilised a 3D *make tools* kit for the co-design of a "learning buddy", an interactive device to assist collaboration and learning in team work in the classroom. Their toolkit was comprised of blocks of varying shapes made of cardboard, as well as buttons with diverse symbols. The authors found the toolkit an engaging and useful start for ideation, although reporting on challenges of group collaboration among children, an issue which is extensively addressed by Van Mechelen (2016). A similar method was conducted by Baek & Lee (2008) for building an information architecture in participatory workshops with children. Two toolkits, namely *info tree* and *info block*, were used during these workshops to allow children to re-design the information architectures with the provided content of an existing website. Info tree toolkit takes its name from the analogy of a tree, consisting of abstract parts to represent a trunk, branches and fruits to structure the hierarchy of the information. Info blocks toolkit, as the name suggests, is comprised of blocks in different colours, on which children can manually write tags, and fasten to each other hierarchically on a surface with the aid of Velcro attached on them. The authors report that the outcomes helped them to better understand how the cognitive structures of children differ from those of adults, based on the qualities of the designed artefacts.

A more comprehensive approach, *CoDeT procedure* is offered by Van Mechelen (2016) as a toolkit for co-design activities with children in the fuzzy front end of design to define the problem space, ideally before there is a well-defined design brief. The

toolkit focuses specifically on the design teams consisting dominantly of children with adult facilitator(s), unlike cooperative inquiry and bonded design, which suggest intergenerational design teams formed with a relatively balanced number of child and adult members. CoDeT procedure aims to tackle with the issues of scaffolding design thinking, and dynamics of working as a group among young co-designers. Bearing similarities with other generative methods, the procedure places the scaffolding collaboration and elements of group dynamics within a suggested outline of a co-design session procedure (Figure 6). The procedure starts with an *introduction* of the researchers themselves and the goals of the project to the group. *Sensitizing* activities aim to boost children's curiosity about the topic and the upcoming steps, by encouraging them to think and reflect on the design issue in question. Sensitizing might include hands-on activities such as keeping diaries, making observations and interviews relevant to the design challenge. *Scaffolding collaboration* consists of broad practical suggestions to promote group work within co-design teams through stimulating positive interdependence among members. These include various techniques for improving collaboration through a shared goal, depending on the varying skills and contributions of different team members, and sharing a team identity to motivate working together to achieve the shared goals.

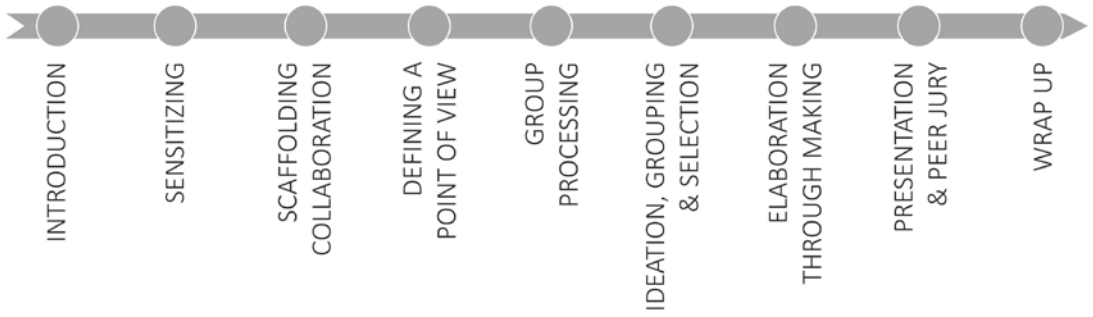

Figure 6. The steps of the CoDeT procedure (adapted from Van Mechelen, 2016)

The first step of the actual designing phase is narrowing down the design space by *defining a point of view*, or a problem statement, based on their experiences from sensitization phase and group discussions. The problem statement and the design criteria addressing this problem then are asked to be visualised through drawing or collage. *Group processing* is suggested as a discussion and recording technique for the

team to critique and reflect on the nature of the activities they conducted, and their performance in relation to the process of achieving their goals to decide on the process of the remaining activities. *Ideation, grouping and selection*, as the name suggests, consists of expanding the design space through ideating as many solutions as possible, ideally through brainstorming techniques, then re-converging by grouping and selecting the relevant ideas based on the criteria defined in point of view phase. The selected ideas are then synthesized and matured in *elaboration through making* phase via low-tech prototyping techniques. The generated designs are discussed with other co-design teams in *presentation and peer jury*, the feedback of which might serve as an opportunity for further iteration for the developer team. And finally, in the *wrap up* phase, children are briefed about how their contributions will be utilised, and children reflect on their experiences of working in a design team.

Although co-designing with children is a widely studied topic, the contribution of Van Mechelen's work is that it proves to be an extensive framework for design researchers to improve the efficiency of co-design sessions with children. The framework is complemented with a detailed list of challenging group dynamics that affect the co-design process and output (Van Mechelen et al., 2014), and GLID (Grounding, Listing, Interpreting, Distilling) as a structured analysis method to identify children's values via visual, textual and verbal outcomes of the co-design sessions (Van Mechelen, 2016).

2.4.1.4 Comicboarding

Another generative method, *comicboarding* is proposed by Morajevi et al. (2007) to improve engagement and productivity of the brainstorming sessions with children. They predicate on the idea that conventional brainstorming techniques and participatory workshops might have challenging issues based on the cultural and personal differences among children, such as the level of shyness, comfort and the level of collaboration experience. As a solution, they suggest comicboarding as a brainstorming method in a semi-structured setting, which aims to increase participation of children, and help scaffolding ideas more comfortably with less skills required on children's end. The method makes use of story completion through comic

strips as a familiar context to encourage children to participate. To provide more structure, some panels and dialogues are given ready-made to children, and they are asked to fill in the blanks by verbally suggesting ideas while an artist simultaneously draws them on the strip.

In a case study, the authors compare comicboarding with conventional *storyboarding* on a blank slate, and *magicboarding*, which shares the same basic principles with comicboarding but adds the "magic" element by removing the artist to another room, while the ideas "magically" appear on a screen as the artist draws them on a digital drawing tablet out of the child's sight. Their study, although not generalizable, demonstrates that comicboarding results in more ideas generated by children.

Drawing inspiration from comicboarding, Mitchell (2011) devises a methodology making use of comic strips to elicit ideas from children about an electricity metering device to reduce consumption at home. Although recognising the significance of the comicboarding method, the author refers to the fact that a professional artist may not always be affordable for the design team. Hence, he proposes that children do the drawing themselves. A filled out comic board is given to children, with a blank end frame, where they are asked to fill by drawing a design solution. He suggests that this method results in many generated ideas affordably and in a very short time.

It is important to note that, in both reported studies, the use of comic boards were not utilised at the initial fuzzy stage of design. As also suggested by Morajevi et al. (2007), this method is rather useful at a stage where design teams have already made some design decisions, but still exploring some details or elaboration. There is a trade-off between providing an existing narrative through filled comic frames to structure and ease the scaffolding of ideas, and simply giving a blank slate to let the children be free to develop a different concept. This is one issue that differentiates comicboarding from the contextmapping techniques, setting a rather open-ended stage for children.

2.4.1.5 KidReporter

KidReporter[2] is a newspaper making method, which was utilised by (Bekker, Beusmans, Keyson, & Lloyd, 2003) for gathering design requirements of an interactive educational game to teach children about the animals in a zoo context. The aim was to get grasp of what children find interesting, as well as the language and vocabulary they use to present the information. It is aimed to be a child-friendly method that would motivate kids and stimulate their engagement with the conducted activities, and at the same time be suitable to their communication skills. Children were asked to bring information about animals, navigation in the zoo, and their interests in games, which was later fused by designers in a newspaper format. Children worked in teams to collect information through taking photos, peer-interviewing, and writing articles. The procedure was complemented with a standardised questionnaire.

The novelty of the KidReporter method is that it helps children to engage in the design process as inquirers of the context of use, in a similar way with *contextual inquiry*, a technique proposed under cooperative inquiry (see section 2.4.1.1). Although this similarity was also mentioned by the authors, they differentiate their method in the sense that it is not focused on a specific product as it does in cooperative inquiry activities. Instead, the information provided by children gave an idea about what kind of animals, and animal-related topics the children are interested in, which was used to form design requirements of the educational game.

2.4.1.6 BRIDGE and Fictional Inquiry

Fictional inquiry is a participatory workshop technique developed as a part of BRIDGE method. Based on the premise that children are able and competent experts on their own experiences, the method takes a socio-cultural activity approach to participatory design, which suggests practice-based techniques to unfold meaningful patterns of activities among children (Iversen & Brodersen, 2008). BRIDGE method

[2] The method was first proposed in Rijnen & Schreuder (2000), and later modified by Bekker et al (2003). The first study is only available in Dutch, hence could not be included here: Rijnen, J.A.M. & Schreuder, E.T. (2000). *Geef ze de ruimte! Kinderparticipatie in de buitenschoolse opvang, NIZW*, Utrecht.

employs two existing techniques, namely *video prototyping* and *technological immersion*, while suggesting *fictional inquiry* as a novel technique.

Fictional inquiry aims to "temporarily change or bypass existing socio-cultural structures in a given practice", by introducing the potential users a shared narrative space, a fictional social and physical context, in which they can playfully pretend to act to focus on future possibilities, rather than reflection on the current problem space (Dindler & Iversen, 2007). Fictional inquiry, then, owes its novelty to the playful interaction of users with each other and the provided materials, in order to set the stage for generation of novel design concepts.

One well-known example for fictional inquiry technique in child-computer interaction community is *Mission from Mars* (MfM), which was utilised to gather design requirements from children for the design of an electronic school bag (Dindler, Eriksson, Iversen, Lykke-Olesen, & Ludvigsen, 2005). In this workshop, the set narrative was that the Martians had visited the earth, and the plot was their curiosity about the schools of the Earth. This way, children were invited to think about, and reflect on their daily school routines by fictionally communicating with someone who allegedly has no idea about it. Hence, the users are encouraged to answer in detail even the "silly" questions. The aim was to learn more about the social usage context, existing usage systems of a physical bag, and the potential users' opinions and attitudes on personalisation, customisation, order and sorting. The resulting information was used as a starting point to design the electronic counterpart of the physical school bag.

The MfM procedure was later utilised in another project for designing mobile outdoor games for children (Verhaegh, Soute, Kessels, & Markopoulos, 2006). Since outdoor play is less tangible to be able to verbally express than a school bag, the workshop procedure was modified by adding a collage-making activity. To inform the curious Martian who was bored of work about their fun games and the way they are played, children were asked to take pictures of their favourite games on the playground to create collages, which they later used to explain to the Martian. This information was then used by the design team as an input to come up with the themes and design of various outdoor game concepts.

These two examples of MfM present an example of unravelling the existing experiences through role-playing in a shared narrative space. In another example, *The King of Atlantis* (Iversen & Dindler, 2008), the focus is on evoking the potential users to generate ideas for future experiences in a marine centre. Unlike MfM, The King of Atlantis was a case of collaboration with a family with children, instead of teams consisting of only kids. The family was briefed with the narrative that the marine centre was built on the city of Atlantis, the king of which personally asks them to help the city by designing "fantastic experiences" with the aid of 'the box of magic tools'. These tools were used as probes to evoke the creativity of the participants. With the aid of the probes, the family came up with several future concepts (Dindler & Iversen, 2007).

2.5 State-of-the-art User Research Practices with Children

The literature review on methodological approaches to early user research with children show an apparent bias towards participatory design methods and techniques. In order to present a more comprehensive landscape of design and research practices with children, this section presents a systematic review of the recent child-user studies. The review aims to investigate the user research trends in relation to design practice based on an analysis framework which is expected to be useful in examining state-of-the art user research practices with children.

For the review, full paper proceedings of the Interaction Design and Children (IDC) conference was selected. IDC was assessed to be suitable for a number of reasons. First of all, IDC, which has been annually held since 2002, is the only academic event fully focused on designing for children. As stated in the call for paper for 2010 conference, IDC aims:

> […] to better understand children's needs, and how to design for them, by presenting and discussing the most innovative research in the field of interaction design for children, by exhibiting the most recent developments in design and design methodologies, and by gathering the leading minds in the field of interaction design for children.

Apart from its special focus on user research and designing for children, IDC has also a meticulous paper selection process. Between 2006 and 2015, the average paper acceptance rate is 23%, while overall acceptance rate is 31% (ACM Digital Library statistics). It is also important to note that most authors of the works on methodological approaches presented in the previous section are also frequent contributors of the IDC conference[3]. For these reasons, IDC was assessed to be a suitable venue for a state-of-the-art and on-point methodological investigation.

In order to improve the readability, the development of the analysis framework, methodology of the systematic review and the findings are presented in Appendix A. Here, key highlights from the findings, and a focused review of the early methods will be presented respectively.

2.5.1 Key Findings of the Systematic Review

Since the focus of this dissertation is user-research methods with children conducted in early design phases, only the key findings of the review will be briefly summarized, and then the second round of analysis of the papers applying user research in the pre-design phase will be presented in detail.

The key findings of the systematic review provide insights into the contemporary user research practices with children, which can be summarized as follows:

- The results demonstrated that children are still dominantly involved in the later phases of the design process as passive testers of the prototypes developed by the design teams, for the purpose of measuring the impact of the product or system, or usability improvement.
- The domain of the design outcome strongly focus on the educational context, which aims to provide a learning outcome for children through the designed product or system.
- Children are mostly involved in the design process with their observable means of participation. The research methods consulting the explicit knowledge of children, which can be done in the form of asking direct questions with the

[3] IDC is often referred to be a “community” of researchers sharing similar research interests.

expectation of direct, self-report answers, are rarely used. When done, these methods are usually seen to be standardised tests and questionnaires, some of which aiming to measure the educational impact of the designed system.

- Finally, the scope of the research outcome it mostly case-specific, with the focus of the generated data being either causal/procedural or descriptive in order to provide direct input for the convergence of the design requirements and engineering the product in question, rather than exploring and expanding the design space with child-centred perspectives.

2.5.2 Early User Research Trends with Children

The findings of the systematic review present an overview of the state-of-the-art user research with children. However, a closer look at the methodological trends in the pre-design phase can provide a more focused understanding within the scope of this thesis. For this purpose, the total 33 papers reported user research in the pre-design phase were extracted from the dataset, and subjected to a second round of analysis. Some papers reported multiple pre-design techniques. A total of 46 methods were identified.

The analysis procedure involved coding the methods used in each study, and the focus of inquiry for each paper, matched with the appropriate method. The frequency of the use of each method is presented in Table 2. The list of foci of inquiry and descriptions can be seen in Table 3. The full list of the 33 reviewed papers and the corresponding coding table can be found in Appendix B.

As the results show, the most common method in the early design phase is *observation* (n=18). There is a strong affinity towards field observations in the natural context, which is mostly school environment. Few number of contrived settings include lab environments, or a setting within the school, which do not focus on the context of use but rather product interaction for a short period of time.

Table 2. Methods used in early user research

Observation		18
	Field/natural	14
	Lab / Contrived	4
Co-design		14
	Lo-fi prototyping	7
	Cooperative inquiry	3
	Generative methods	2
	Ecological inquiry	1
	Collaborative workshops	1
Interview		8
	Not specified	3
	Focus group	2
	Drawing-telling	1
	Semi-structured	1
	UX laddering	1
Survey		4
	Standardised	2
	Open-ended	1
	Fun toolkit	1
Archive analysis (Child-generated YouTube videos)		1
Artefact analysis (Children's constructions with interactive materials)		1
TOTAL		**46**

Observation is followed by participatory design methods. *Co-design* techniques (n=14) are another common methodological approach in early design research with children. Half of these studies make use of lo-fi prototyping with children, with techniques ranging from drawing, paper prototyping, and generation of avatars or narratives. Long-term collaborations via cooperative inquiry, ecological inquiry and collaborative workshops is also common. The use of generative methods to explore the user space is another way of inquiry.

Different types of *interviews* (n=8) were used in different studies, the details of some not specified. Specialised interview techniques include focus group, drawing and telling, and UX laddering (see Chapter 4 for detailed information about laddering

technique). Although not so common in the early design phase, the use of attitudinal *surveys* (n=4) is also seen in few studies.

One study utilised *archive analysis* by analysing child-generated public videos on YouTube. Another study reported on *artefact analysis* of the items children constructed using interactive materials provided by the researchers.

Table 3. Foci of inquiry in early design phase

Focus	Description	Gathering methods
Product	Direct contribution of children to taking design decisions and the development of the product in question	Co-design (cooperative inquiry, lo-fi prototyping, collaborative workshop)
Context	The factors affecting or will potentially affect the product use in the natural use context	Observation (field/natural), generative methods (contextmapping)
Practice	The ways the product is being or will potentially be used in the real life situation, or one-to-one product interaction	Observation (field or lab), interview, survey, archive analysis, artefact analysis, co-design (ecological inquiry, collaborative workshops, lo-fi prototyping)
Attitude	Children's product or experience related judgements, likes, preferences and expectations	Interview, survey

The focus of inquiry refers to the content and direction of the research. Four types of foci were identified, as described in Table 3. There are some methodological trends in this direction as well. For instance, *product-focused* research methodologies typically make use of co-design methods in order to design concepts or identify key directions for content or interaction together with children.

When the focus is the *context of use*, typical method of inquiry is field observations in the natural use context (i.e. classroom). Workshops and activities using generative methods can also provide contextual information to some extent in self-report format, whereas observations cast a more passive role to the users.

Practice-focused inquiry concentrates on the ways products are used, mostly –but not necessarily- in real-life conditions. In that case, observations or self-report methods such as interviews and surveys shed light to product use practices. However, the definition of the practice can be extended to non-product related everyday practices as

well. For example, few studies make observations in classrooms to explore teaching and learning practices with and/or without the use of a specific system or product in order to define design requirements or points of intervention. Also, some participatory methods aim to explore and transfer or embed user practices to the design of products and systems.

Finally, *attitude-focused* research aims to elicit children's judgements, preferences and expectations regarding the product or system. Attitudes of children are naturally explored through self-report methods, such as interviews and surveys. Some of these methods are qualitative, whereas others are quantitative.

2.6 Chapter Conclusions

In this chapter, the landscape of early user research practices with children was investigated. The literature review outlined the major directions in the research trends. When working with and designing for children, developmental characteristics and curriculum requirements provide an awareness and guidance for designers. Such guidance can be useful especially for designers working with a specific age group for the first time. However, relying much on such predefined requirements increase the risk of over-generalising the sample with adult-designer assumptions as well as overlooking the child-centred perspectives.

Children can take many roles in the design process, contributing at different levels. Recent efforts in methodological explorations tend to focus on extensive involvement of children in the design process, with the hope that such involvement will lead to the design of products and systems desired and well-accepted by children. The literature review on the methodological approaches to early involvement of children is dominated by participatory design methods. Participatory framework is extensive and dispersed, embodying several methods and techniques to support participation of children. Some of these methods aim sustained participation of child-users throughout the product development process for the purpose of directing design decisions (i.e. cooperative inquiry, bonded design), whereas others tend to be less product-focused, and more oriented towards exploring the user space from their own perspectives to expand design possibilities (i.e. contextmapping, .design ethnography).

The systematic review enabled both an inspection of the larger landscape and a closer look at the state-of-the-art user research trends with children. The review shows that despite the apparent effort to develop specialised methods for the early participation of children, the dominant form of inclusion is in the role of testers of the prototypes. Naturally, the participation of children usually contributes to convergence of the design space, and the large amount of the information generated from users are utilised to develop, iterate and refine a single product or system. Since the common domain of design is interested in development of technologies with the goal of specific learning outcomes, it is understandable that the general research trends point out to improvement of the learning experience or measuring its impact based on predefined educational criteria, rather than child-driven ones.

Another insight from the systematic review is the apparent lack of interest in explicit means of data collection. This implies that children are rarely directly asked what they like, prefer or expect in their experiences with products and systems designed for them. Mixed methodologies combining observable knowledge with explicit one seem to utilise self-report surveys and scales for measurement purposes, and mostly in the testing phase.

The closer inspection of the methods used in the pre-design phase also reveal valuable insights. Despite the literature being concentrated around co-design methods, the early user involvement trends are skewed towards field observations in naturalistic settings, usually accompanied by expert interviews with educators and requirements coming from learning theories. Interestingly, no specific observation technique or structured requirements for observing child-users are described in the field of design for children. Similarly, the papers included in the review reporting user research in pre-design phase tend not to give specific details of how the observations were conducted. It is interesting that although the use of observation techniques is such a common way of collecting user information, yet no novel techniques specialised for the needs and requirements imposed by the design activities are reported.

Although the use of co-design methods is also common, these studies tend to be quite product-focused, rather than exploring the general user context to explore and expand

the design possibilities through a child-centred lens. Even though the major strength of the early involvement of child-users is to give them the chance to take part in major design decisions, it appears that in many studies utilising participatory methods consult children only after the formation of the design brief, or at least with a specific product or system in mind. It seems as if co-designing some portion of the system with children has somehow become a norm for the legitimacy of the design decisions. This way, as also suggested by Iversen et al. (2010), the focus shifts towards the degree and methods of participation, which not necessarily ensures the incorporation of child-centred perspectives and values into the developed products and systems. Moreover, the use of co-design techniques require collaborative work of the designers with children, and/or long-term collaborations, which may not always be possible or feasible depending on the requirements of the project.

Similar to the results of the systematic review, examination of the pre-design methods also demonstrate a considerably lower rate of self-report methods. Some of these studies do not even mention about the specifics of the interview, some report using known techniques such as focus group but do not describe the ways it was adopted to use specifically with children. Only two studies report the use of interviewing techniques developed to be used for children (drawing and telling, and UX laddering), and describe the procedure in detail.

To summarise, the general overview of the current design and user research practices point out to the following issues:

- The accumulation of the theoretical knowledge on children's involvement in the design process evolve around participatory design methods, which focus on direct formulising of children's perspectives appearing in the form of design through "making". Although this eliminates the step of translating what children say and do into design requirements to inform the design teams, this does not necessarily ensure the design of products and systems which have a meaningful impact on children's lives, unless the reasons behind the design decisions or suggestions by children are also investigated. This leaves the

evaluative methods for the validation of such decisions, which is a typical course of design project in the field of child-computer interaction.

- Despite the emphasis on participatory design methods in the literature and the IDC community, the dominant form of early exploration appears to be field observations. Nevertheless, although observing children is a widely investigated issue in other fields (i.e. education), little, if any, interest has been raised in user research with children.
- The research trends show that asking direct questions to children with the expectation of direct responses is not well-received in user research with children. Whether due to lack of interest or the assumption that children cannot effectively or reliably express themselves verbally is mere speculation, and would not contribute to the focus of this dissertation. Nevertheless, it appears that it is not a common research practice to directly ask children and investigate their expectations and priorities, or how they themselves give meaning to their experiences with the products and systems in question.

To conclude, the focus of inquiry with direct involvement of children in the early design phases concentrates on engineering the planned product in terms of content and interaction. At this point, it is useful to take a step back and investigate the key aspects of product experiences of children, and what designers need to know about the child-users to develop products with a meaningful impact on children's lives.

CHAPTER 3

UX APPROACH TO CHILDREN'S INTERACTION WITH PRODUCTS

The majority of the reported work involving children in design fields are from interaction design. As reviewed and discussed in more detail in the previous chapter, these studies dominantly focus on engineering a product, or children's use of a specific technology, which naturally results in the methodological implications being limited to these specific areas. Also, children's experiences with products are mostly inquired in an institutional context, such as education, family relationships, health, and so on. Considering the fact that children's consumption practices are mostly mediated by these institutional structures, this tendency is understandable. However, an attempt to present a general methodological framework requires a holistic approach for understanding the way children experience products, which can be adapted to different research contexts. Whether in education or leisure, children's interaction with products share common elements that give rise to the experience in question.

As outlined in Chapter 2, the frameworks related to user research with children dominantly focus on the methodological issues, such as the roles children might take in design (Druin, 2002) in relation to its contribution to the design process (Barendregt et al., 2016). An alternative approach is presented by Sluis-Thiescheffer et al. (2011). In their framework, they categorise user-centred design methods to help researchers choose the suitable method based on the required skills by children from a developmental perspective. Additionally, more specialised frameworks are offered to be utilised when specific approaches to design for children, such as learner-centred design (Good & Robertson, 2006) and participatory design (Walsh, Foss, Yip, & Druin, 2013).

The aforementioned frameworks tackle with the issue of designing for children from a methodological perspective, hence focus on either the *process* of design, or *how* and *to what extent* children (and sometimes other relevant stakeholders) should be involved in this process. What is missing in these frameworks is a dedication to gain an understanding about what sort of meaning the products in question should facilitate in children's lives. Even in participatory design practices, which traditionally aim to take users' genuine values and concerns as a source for innovation, the dominancy of the discussions over the methods and degrees of children's participation overshadows the importance of incorporating children's perspectives and values into designs (Iversen et al., 2010).

This tendency may stem from the fact that the dominant form of the research and development done in the field focus on project-specific goals, such as aiming an educational output for children. As mentioned before, current work mostly investigate the user space of children mediated through an institutional lens. For example, when children are seen as "learners" as in most of the cases, the curriculum goals become forefront. However, children, like adults, live in a certain social and cultural world; they have shared values and concerns, as well as their diversities. Children's interaction with products, along with the resulting experience, are as equally affected by these factors as they do by the product characteristics and the context of use. Moving from this concern, this chapter takes user experience models as a starting point to inquire children's experience. This does not mean that the differences of children from adults are ignored. On the contrary, this way, it is expected to come up with a theoretically informed ground of a holistic approach to understand children's subjective attitudes and behaviours to inform the design process.

For this purpose, the experiential approach to user-product interaction will be introduced, and the models of user experience will be reviewed in order to present a general framework forming a theoretical basis to the further methodological inquiry. Then how the UX framework corresponds to the informational needs of the designers will be reviewed. Finally, implications for user research with children will be discussed.

3.1 The UX Paradigm

From 2000 onwards, the term ‘user experience’ has started to become a buzzword.in the field of human-computer interaction. This marks a gradual shift of focus from the product and how the user interacts with it, towards a broader sense of experience with and through it. The fuzziness of the concept brought about hot discussions in the academia to define what UX actually is. For example, in 2007, a call for workshop was announced specifically inviting the research community to contribute to identify, theorise and standardise the UX research and practice, the result of which was a compilation of papers titled “Towards a UX Manifesto” (Law, Vermeeren, Hassenzahl, & Blythe, 2007)

One common definition strategy is to refer to the precedent; as can be seen from the works which have been done by the scholars to differentiate UX from traditional usability. As Hassenzahl & Tractinsky (2006) posit, usability in HCI tradition deals with the task-related *instrumental* aspects of interaction, whereas UX is beyond the instrumental, tackling with issues such as meaning and values. According to this, the authors establish a link between product attributes and the intrinsic and subjective needs and values of users, which are mediated through products. The *experiential*, then, is above the material; apart from the product, it embodies (or embodied by) the goals, expectations and mood of the user. Hence, the focus is less on *solving problems*, and more on *creating opportunities* and making use of possibilities (Desmet & Hassenzahl, 2012).

One significance of the experience-oriented approach is in its premise to demystify the complex nature of the user space by deconstructing experience into its constituents. In this sense, the shift of focus from usability or interaction to experience is not merely a change of terminology, but it marks an expansion of the unit of inquiry through a more holistic lens by taking into account all the possible factors affecting how users engage with products, and the resulting experience. The motivation behind the effort to better comprehend the aspects of experience through conceptual UX models is to come up with design strategies that mediate experiences which are potentially positive and meaningful for users (Fulton Suri, 2003). They also share a commitment to the structural analysis of the way products are experienced. These aspects make the

experiential models also being actionable, meaning they have operational value to study user experience.

One important consensus among the theoretical frameworks of UX is that experience is a subjective phenomenon, and can neither be designed nor fully controlled (Battarbee, 2004; Fulton Suri, 2003). When designers develop a product, they can only control the features of the product, such as form, function and interaction modalities. This, however, is only the *intended* use proposed and communicated by the designer. The way users perceive and engage with the products, and the emerging consequences through this engagement is temporal and always occur in the actual use situation (Hassenzahl, 2004b). The context refers to not only the momentary situations such as the physical conditions and the emotional state of the user at the time of interaction, but also the underlying personal, social and cultural factors that affect how the product is experienced (Desmet & Hekkert, 2007; Hekkert & Schifferstein, 2008).

Why then, focus on to understand the complexity of the experience in the first place, if we cannot even control it? The UX literature, although being cautious about the subjective factors, suggests that a better comprehension of the aspects of experience is vital to inform the design of more pleasurable products and facilitate experiences which are meaningful for users. Even though we cannot design experiences *per se*, we can adjust *design expressions* to be able to influence the experience through formal and behavioural qualities of design by understanding what really matters for users (Fulton Suri, 2003). Hence, an awareness about the 'building blocks of experience' beyond the actual product itself will better inform designers about users' world, and guide the design process accordingly (Forlizzi & Ford, 2000; Hekkert & Schifferstein, 2008).

The conceptual models aiming to deconstruct the user experience can be a solid starting point of departure before working on methodological explorations for investigating the design-relevant perspectives of children. It is important to note that the goal of demystifying/deconstructing is not to come up with a one-fits-all framework. Rather, it is thought to provide a theoretically-sound basis for an

exploration of not only the particularities of children's interaction with products, but also understanding what really matters for them as a result of this interaction.

3.2 Deconstructing the Experience

Existing UX models focus on different aspects of experience such as *affective experience* (Desmet & Hekkert, 2007), *perceptual experience* (Warell, 2008), *user value* (Boztepe, 2007), or *social interaction* (Forlizzi & Battarbee, 2004). In her review of UX theories and frameworks, Battarbee (2004) talks about three different perspectives; (i) product-centred, (ii) person-centred, and (iii) action-centred frameworks. However, a number of models focus on a rather holistic approach with the premise of providing a general framework by unveiling the key elements of experience. These models, which will be investigated in this section, point out three shared constituents within which experience occurs: (i) user/s, (ii) product/s, and (iii) the context in which the interaction between the user and the product takes place. In this section, the models that bring these three spheres together will be focused on.

The theoretical framework will be grounded on three comprehensive models of user experience. Although these models bear similarities in terms of suggested constituents of experience, they differ in their focus. First, Hekkert & Schifferstein's model of human-product interaction will be presented, since their model is based on the various perspectives in research practices, and brings these perspectives into a unified model of product experience[4]. After, Forlizzi & Ford's framework for interaction designers will be discussed. In this early system, they focus on the interaction between users and products, and the role of interaction designers. Lastly, Hassenzahl's model of user experience will be presented, which suggests a product-centred framework.

[4] Although the focus on "product" experience was initially thought to be more relevant from an industrial design perspective, since the personal academic background of the author of this dissertation being industrial design. However, it should be noted that from the UX perspective, the difference between product design and human-computer interaction is hardly significant. Not only that the experiential approach diminishes the materiality of the product by assuming it a role of "means" and not the "ends" (Hassenzahl & Tractinsky, 2006), the appropriation of the approach by both disciplines is similar too, with their emphasis on the subjectivity and contextuality of the experience.

3.2.1 Hekkert and Schifferstein's Model

In their review of the existing work on human-product interaction, Hekkert & Schifferstein (2008) define three main perspectives which are investigated in the field of product experience: (i) *users* with their systems and skills, (ii) *products* and their properties, and (iii) the *interaction* between these two and the components of this interaction (Figure 7). Although included in the model as separate entities, they suggest that these aspects should be considered in relation to each other. For instance, people perceive, act on and give meaning to the physical world through their sensory, motor and cognitive systems, in order to satisfy basic needs coming from their instincts. Products in isolation, on the other hand, possess certain formal and structural properties, which contribute to an overall composition, embedded technology, and labels, such as brand and price. However, meanings attached to products are only constructed through interacting with them. It is the attributes of products as perceived by users that communicate its primary and secondary functions. Hence, we can understand how product properties affect user experience only in relation to users, which is a useful input for designing for experience.

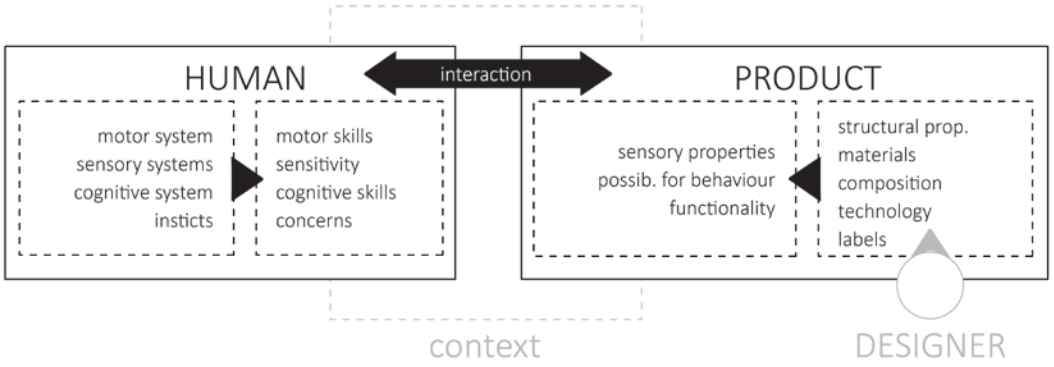

Figure 7. Model of human-product interaction (adapted from Hekkert & Schifferstein, 2008. The elements in grey do not exist in the original model and are added by the author)

The focus of Hekkert and Schifferstein is on affect and pleasure, which requires an awareness of the psychological affect rising from "the interaction with a product, including the degree to which all our senses are stimulated, the meanings and values we attach to the product, and the feelings and emotions that are elicited. It can be debated whether these psychological consequences are always affective in nature." (p.

2). This perspective is comprehensively discussed and modelled by Desmet & Hekkert (2007). Their framework describes three core dimensions of the experience between the product and the user: emotional experience, aesthetic experience, and the aesthetic of meaning. The experience can not only stem from active instrumental or non-instrumental interaction with the product, but also no physical interaction (i.e. visual/passive). Hence, affective response is not only raised by actual consequences of immediate interaction with the product, but also from anticipations of it.

However, subjective experience cannot be limited to the intrinsic characteristics of the individual. Hekkert and Schifferstein also draw attention to the importance of the context; from actual physical surroundings to the larger cultural context (p. 4). These factors all together form subjective experiences, which cannot be controlled by the designer.

3.2.2 Forlizzi and Ford's Model

One of the earliest attempts to model user experience is made by Forlizzi & Ford (2000), through which they aim to 'demystify' the user experience in order to inform interaction designers how they can design to achieve specific user experience goals. They present an interaction-centred perspective, which focuses on the interaction between the user/s and product/s, and the experience resulting from this engagement. Similar to the model of human-product interaction presented by Hekkert & Schifferstein (2008), Forlizzi & Ford also emphasize the user background and product properties as key elements of user experience. Additionally, since their framework aims to provide a basis to "talk about" the experience and understand the role of the interaction designer in it, designer is presented as a key actor of the framework (Figure 8).

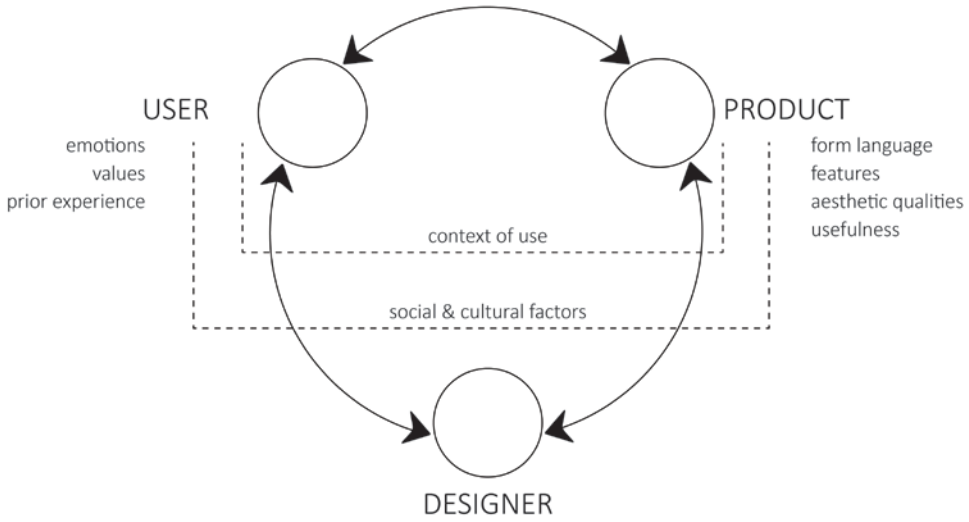

Figure 8. The role of the interaction designer in understanding experience (adapted from Forlizzi & Ford, 2000)

The users bring their personal backgrounds to the interaction, such as emotions, values and prior experience, which play a role in their subjective experience with the products. The formal and structural qualities of products are filtered through the personal background of users. Also, the interaction occurs in a certain context, together with the social and cultural factors affecting the qualities of experience. The designer is not presented as an initial element of the UX framework, but rather positioned as an actor in relation to user and product, and how they can influence the interaction in between two. Accordingly, the designers are invited to have a better understanding about all the relevant factors that would possibly have an impact on user experience, and transfer this information into products in order to design products which are more meaningful and valuable for users.

3.2.3 Hassenzahl's Model

Another framework was presented by (Hassenzahl, 2004b) to define the key elements of user experience. Similar to Forlizzi & Ford (2000), he defines the experience as a consequence of the subjective interaction which takes place between the user and the product. One major difference in his framework is that his model is rather product-oriented, which focuses on design and use as a communicative process: he emphasizes the process of (i) designer's conveying an intended product character or meaning, (ii)

how this meaning is re-constructed by users at the moment of interaction, and (iii) the interaction eventually leading to consequences (Figure 9).

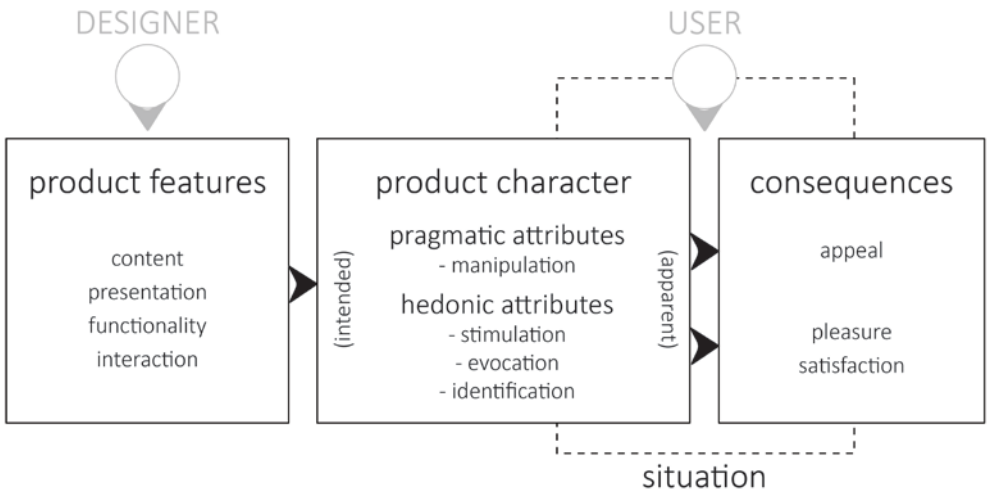

Figure 9. Key elements of the model of user experience (adapted from Hassenzahl, 2004b. The elements in grey do not exist in the original model and are added by the author)

Hassenzahl expands the user-product interaction space by defining categories of product character as conveyed, or in other words, "fabricated" by the designer and perceived by the user. Aiming to achieve certain product characteristics, designers develop products by manipulating product features, such as *content, presentation, functionality and interaction*. By manipulation of these product features, designers intend to achieve certain *pragmatic* and *hedonic* product attributes that contribute to product character. Pragmatic attributes are related to behavioural goals, and define the ways that lead to functionality of the products, such as 'useful' or 'supportive'. Hedonic attributes, on the other hand, contribute to the psychological well-being of the user. He defines three types of hedonic attributes: *stimulation, evocation, and identification*[5]. Stimulating product attributes promote new insights and opportunities for personal development. Evocative attributes provoke past memories and personal meanings by carrying or reflecting symbolic value. Finally, products might embody attributes that communicate identity in a certain social context. As a result, the product

[5] In another publication, Hassenzahl (2008) use the term *do-goals* and *be-goals* satisfied by pragmatic and hedonic attributes, respectively.

character apparent to the user leads to consequences, such as un/*appeal,* dis/*pleasure* and dis/*satisfaction*.

Although product features are organised by designers to achieve the aforementioned product characters, they may or may not lead to the intended product character with users. Because, the ways products are perceived and attached meaning depends on the subjective factors that users bring into interaction, as well as the momentary situations in which the interaction takes place. Hassenzahl's model of user experience relies on the subjectivity of perception and evaluation of product characters, and how this process is subjectively constructed by users. This way, he builds a bridge between the specific product features, and the consequences of the user's interaction with the products holding these features under specific conditions.

The major contribution of Hassenzahl's model is that it draws attention to the potential differences between designer's and user's conceptions of the product, which unfolds during interaction. Consequently, he expands this phase by conceptualising the hedonic and pragmatic aspects of experience from user's point of view, eventually leading to positive and negative consequences. His approach to link product characteristics to its consequences on user experience shows similarities to the means-end chain theory (Gutman, 1982), which has been influential in marketing studies to understand the consumer behaviour by investigating the relationship between concrete product attributes and associated values.

3.3 A Unified Model of User-Product Interaction

The three models presented here, despite their differences in focus, bear similarities in their formulations of the way user experience unfolds, especially their definitions of 'units' of analysis. Based on the inferences drawn from these models, it is possible to summarise these units as follows: (1) the user as a subjective entity, (2) the product as a means for experiences, (3) the immediate context of use in which the interaction takes place, and (4) the broader social-cultural context which embodies the experience (Figure 10).

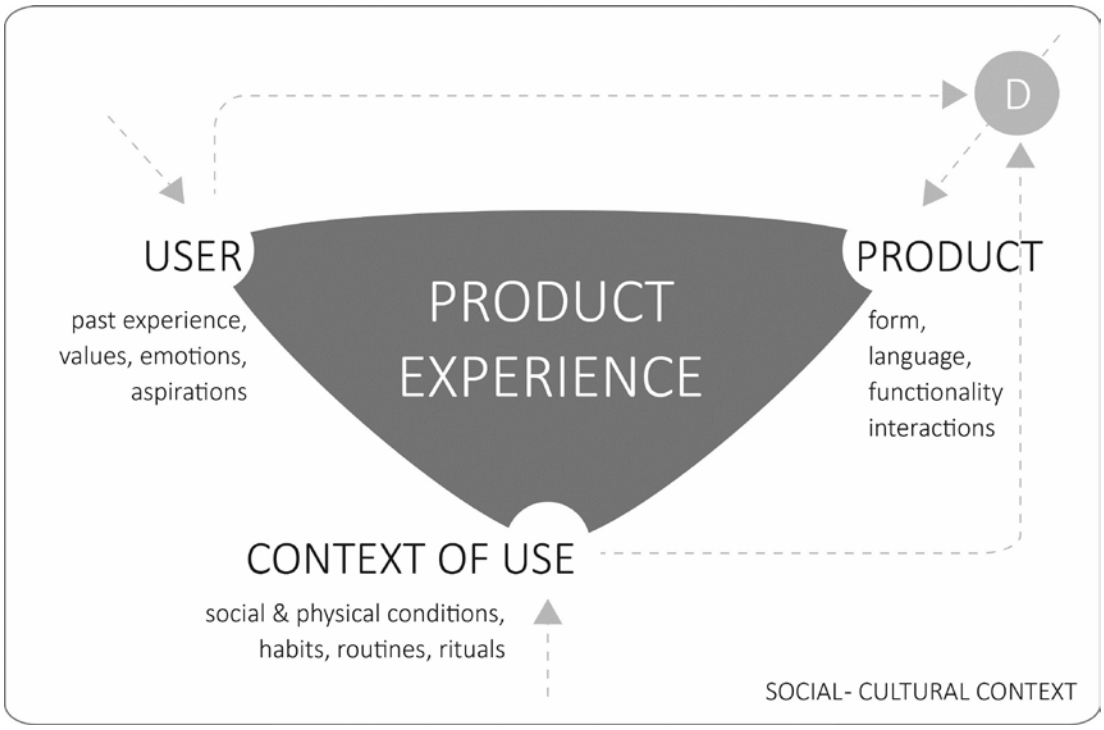

Figure 10. Author's summary of product experience framework

First of all, theoretical grounds of UX suggests that user experience is subjective and cannot be "designed". Previous experience, personal values and attitudes, emotional states, as well as biological factors play part in the perception, judgement and evaluation of products. Although these factors cannot be controlled, an awareness of them will help design teams to formulate better design solutions that address to the actual needs and concerns of users, eventually enabling rather meaningful experiences. Even though we cannot design the experience itself, we can influence it by projecting our awareness of user situations as design interpretations. Product form, language, functionality, the quality of interactions it enables are not only the key aspects of experience, but also the only means designers can communicate the intended interactions and meanings to users.

The immediate physical and social environment, namely the 'context' is another important factor that mediates the interaction and the resulting experience. For example, the willingness, or even joy of waiting for a well-brewed tea from an electrical tea machine after dinner might turn into a rather irritating experience in the morning rush while all you want is to have a glass of tea at breakfast before heading

to work. Although these are the conditions that designers have the least control over, an exploration of the actual context the within which products are expected to be used will expand the possibilities of designers to offer meaningful interactions by putting the user-product relationship in a real-life usage scenario.

Although indirectly, social-cultural context, as well as economic, political, and even legal factors are also influential on the experience. Since people are enculturated in this 'superstructure' within which mundane practices, daily routines and rituals are performed, it has an impact on developing personal judgements. Not only users, but also artefacts are a product of the culture, since designers are not isolated from the society. Nevertheless, culture is neither homogenous nor static, hence it is valuable for designers to gain an understanding on social norms, cultural values and so on, and how they become operational in practice. In a way, it is to aim for the existing or new meanings by focusing on the experiential rather than merely utilitarian aspects of engaging with products. To exemplify, the meaning and value of sharing a pot of tea as a family in Turkish culture can be understood within the broader set of continual, accompanying practices evolving around it, extended from sharing the day at dinner table to watching a family movie on TV afterwards. In such a cultural context, the value of a "keep warm" button on an electric tea machine becomes more meaningful.

3.4 Informational Needs of Designers

The experiential framework outlines the landscape of user experience in relation to products and the context of use. The role of designers, then, is to gain awareness of these conditions in order to develop products and systems which will potentially promote meaningful experiences for users. This is emphasised extensively by the scholars promoting the experiential approach to design. As they are theoretical models, the particulars of this awareness, or the type of information needed for designers regarding the users' perspective, is not well documented in them.

An investigation of the informational needs of the designers is a critical aspect as it will enable the convergence of the conceptual sphere with the operational one. Rather than presenting methodological prescriptions or extensive lists on how to study user experience – as there is already a large body of literature dealing with this-, it is

proposed in this section to turn to the qualities of user information required by the design space.

As the investigation of the design space is not one of the core goals of this thesis, an existing model will be briefly introduced, and its implications will be discussed. For this purpose, Töre Yargın's (2013) model of effective communication of the user research findings with design teams is thought to be useful for the following reasons:

- First of all, this model provides a comprehensive and grounded inspection of the qualities of user information in relation to the requirements of the design space,
- The model is based on empirical studies conducted with designers from different fields of expertise, hence derives directly from designer's own models and needs as articulated by themselves,
- And it presents a quite detailed account of the relationship between user information and corresponding needs, exemplifying which concrete information qualities lead to which conceptual concerns[6].

Töre Yargın's model informs effective communication of the user research findings in terms of both the methods (qualities of the information system) and content (qualities of the information itself) of delivery. Formal methods of delivery is not the focus of this thesis, hence only the informational qualities are investigated in detail in order to understand the relationship between the qualities of the user data and the needs they cater. For this purpose, the core goals of the designers, strategies to achieve these goals, and the attached information qualities were extracted from the overall model. The resulting table is presented in Appendix C, and the summary graph reconstructed from this table is shown in Figure 11 for a compact overview.

[6] Töre Yargın conducted laddering interviews with designers in order to elicit their in-depth needs, which explains the linkages between concrete informational attributes and abstracted concerns and values. More on laddering and the theoretical foundations of the technique can be found in Chapter 4.

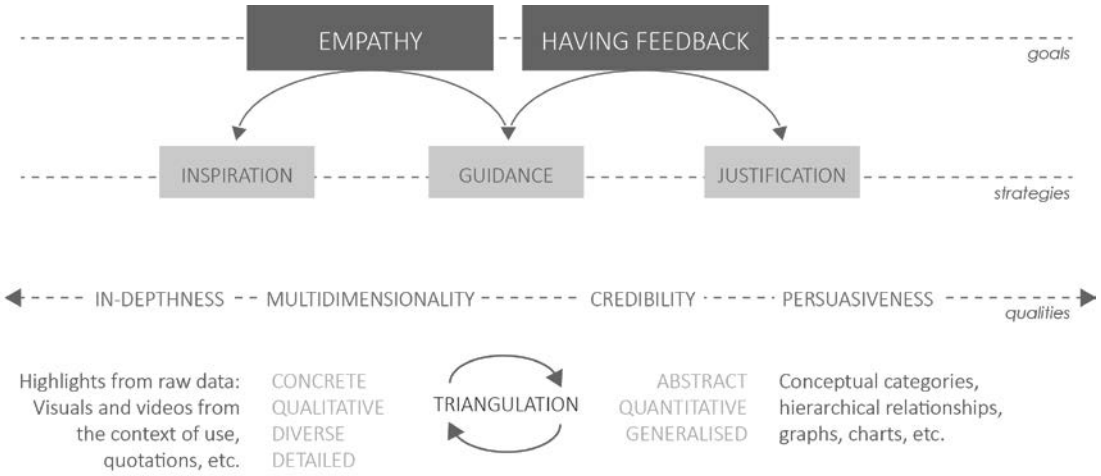

Figure 11. Designer goals, strategies and the attached information qualities (adapted and reconstructed from Töre Yargın, 2013)

According to this, *empathy* and *having feedback* during the design process are the two core goals of designers, which can be supported by user research data. The informational qualities associated with these goals can be traced back to a series of dichotomies regarding the quality of the information, which can be grouped as *contextual* vs. *conceptual*. Empathy is associated with *in-depthness* and *multidimensionality*, which can be provided through communication of concrete and qualitative data, representing diversity among the users in detail. Such informational qualities support *inspiration* and *guidance* during the design process, the two strategies associated by the designers with empathy with the user. Having feedback, on the other hand, is connected with *credibility* and *persuasiveness* of the user research data, which can be supported by abstract, categorical and hierarchical information. These informational qualities are thought by the designers to provide guidance in and justification of the design decisions, which are the strategies to achieve useful feedback when taking design decisions.

When interpreted in accordance with the product experience framework, the informational needs of the designers can be better understood. As presented in the previous section, user experience occurs through product interaction of the users in a certain context. An in-depth investigation of the multidimensional and diverse perspectives of the users, as well as information related to the context of use will help

designers empathise with the users, and visualise more incisively how the designed product will be used and made sense of by them in real life situations. Also, conceptualising these factors in a way that is more generalizable, such as detecting patterns of behaviours and overlapping user perceptions and preferences can contribute to the persuasiveness of the user information, leading to useful guidance and justification for designers during design process.

3.5 Chapter Conclusions

The factors affecting user experience, and how they correspond to the design space have been investigated so far. It is possible to adapt this experiential perspective to interpret the existing methodological approaches and state-of-the-art research practices with child-users, and discuss to what extent they match with the requirements of the UX framework.

The review of the literature on the experiential approach and the deconstructive models showed that there are particular dimensions and their interplay affecting the user experience. These dimensions can be summarised as below:

- Personal background of the user, their attitudes, values, aspirations, and so on,
- The formal and structural qualities of the product with which the user engages,
- The physical and social context within which this engagement occurs, and
- The larger social-cultural context within which the user constructs the meaning of this engagement.

Investigation of these spheres point out to certain methodological approaches. Figure 12 outlines these approaches embedded in the unified model of user experience. They also correspond to the foci of inquiry in contemporary user research practices with children resulted from the systematic review and presented in Section 2.5.5. According to this, four areas of inquiry emerge: attitude-focused, product-focused, context-focused, and practice focused. These major areas of inquiry are not isolated from one another, but rather in an interplay with each other. For instance, user attitudes can be elicited regarding the product features, or the context of use. Similarly, the investigation of the context of use can focus on the user practices with or without a

product. Or, a practice-focused inquiry can investigate user's direct interactions with products, as much as their daily routines.

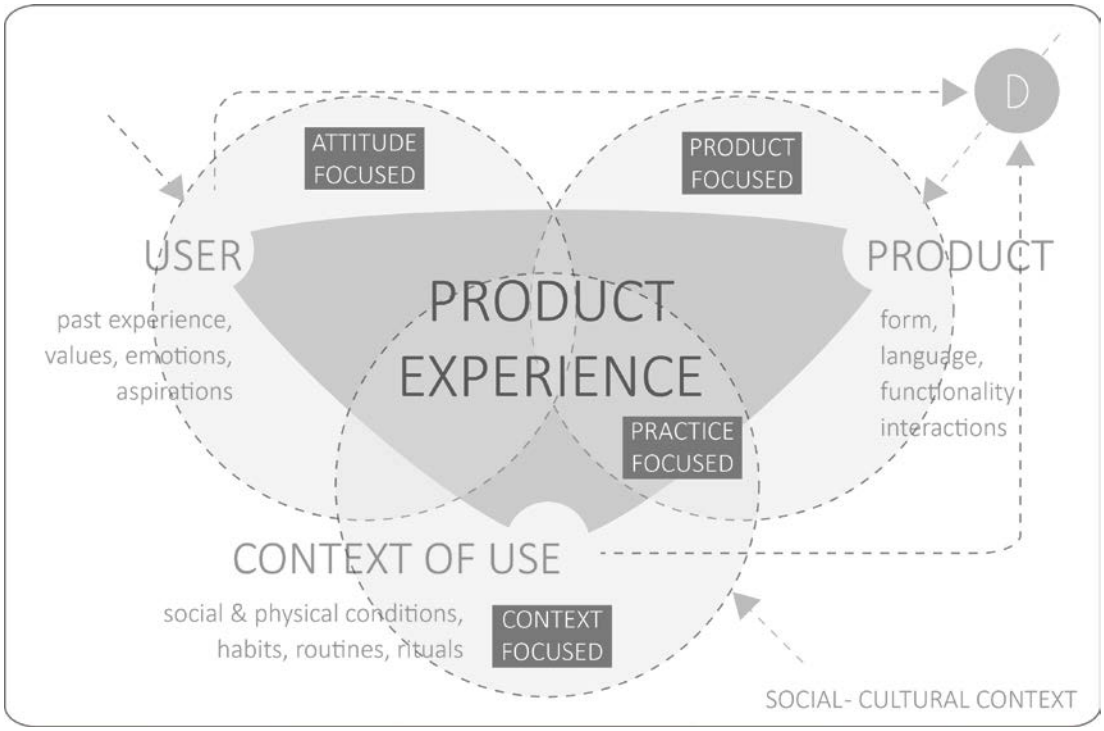

Figure 12. Methodological approaches to explore the dimensions of the user experience

As outlined in Chapter 2, contemporary early design research practices with children concentrate around observations and participatory design methods. Observations usually tend to be context-focused and/or practice-focused, generating information regarding the context of use, current practices taking place within this context, or direct interaction of children with the technology in question. Participatory methods, on the other hand, are dominantly product-focused, with a few exceptions concentrating on user practices or the contextual factors. Attitudinal research, on the other hand, is very rare in early design research practices with children.

From the UX perspective, the attitude-focused research is a core aspect of the inquiry. That gives the basis to the subjectivity of the experience, which is a strong focus in the experiential approach. It constitutes the meaning-driven part of the framework, emphasising the ways the experience is personally construed and made sense by the

users. Without a meaning-driven investigation of the product experience, one of the core aspects of the experiential inquiry will be incomplete.

Another importance of adopting a meaning-driven research methodology is that it can help designers to empathise with the child-users by challenging our adult/designer models and constructions about children. Studying the subjectivity of the product experience can be a strategy for getting familiarised with children's sense making, as much as unravelling their product-related expectations and preferences. This approach also aligns with the theoretical perspectives of the new childhood studies presented in section 2.1, which deals with childhood as a social construction. According to this, as members of the society in which these constructions are generated in the first place, our first and foremost step forward should be to abandon our adult assumptions about children, and accept them as competent and reliable informants.

From the designer point-of-view, such in-depth exploration resulting in communicating both the diversities and patterns of child-user perspectives can support inspiration, guidance and justification during design process. When complemented with contextual information, this conceptual information can provide valuable support to the core designer goals, namely empathy with the users and having feedback.

To summarise:

- In order to be able to make sense of the product experience from user perspective, it is needed to adopt a multi-faceted research methodology, so that the key dimensions affecting the experience can be investigated comprehensively,
- When considered from designer point-of-view, these dimensions of experience also match with the informational needs of the designers in order to support design decisions,
- An evaluation of the contemporary user research practices with children through the UX lens demonstrates that little work has been done to explore how children make sense of their experiences with products.

This gap is the departure point for the methodological exploration in this dissertation. For this purpose, the next chapter begins with theoretical and methodological

investigation of the meaning-driven research, and then presents two hands-on studies exploring the possibilities for user research with children.

CHAPTER 4

ELICITING CHILDREN'S CONSTRUCTIONS OF PRODUCTS

The review of the early user research trends with children point out to a gap in terms of attitudinal research with children. When compared to the UX models, this corresponds to the study of children's meaning-making, which has an impact on their product-related expectations, priorities and preferences. An inquiry into children's product-related meaning structures is an essential part of the experiential approach, as it is directly related to the subjectivity of the experience.

Moving from this gap, this chapter begins with a brief introduction of the theoretical foundations of the construction of subjective meaning, namely Personal Construct Psychology, which will be followed by an overview of the construct elicitation methods. After, two explorative studies conducted to investigate the potential of different construct elicitation methods with children.

4.1 Construction of Meaning

A recent line of research in constructivist developmental psychology portrays children as scientists. According to Alison Gopnik (1996), this is more than a mere analogy. She suggests that "children and scientist both employ the same particularly powerful and flexible set of cognitive devices [which] enable scientists and children to develop genuinely new knowledge of the world around them" (p. 486). This similarity in cognitive functions can be exemplified by empirical evidence of how children, like scientists, develop and revise 'theories' as foundations of constructing knowledge through finding patterns of prediction, interpretation and explanation.

The theoretical foundations of the study of personal construing lies beneath the Personal Construct Psychology (PCP) founded by George Kelly in the 1950s. In its very essence, Kelly (1991) portrays every person as a scientist or having scientist-like aspects, who is constantly developing, testing, and evolving hypotheses about the encountered and upcoming events, to update and adapt an ever-changing construction system. For him, this construing system, which consists of a network of constructs, is how a person give meaning to the world they live in:

> "Man looks at his world through transparent patterns or templets which he creates and then attempts to fit over the realities of which the world is composed. The fit is not always very good. Yet without such patterns the world appears to be such an undifferentiated homogeneity that man is unable to make any sense out of it. Even a poor fit is more helpful to him than nothing at all." (Kelly, 1991, p.7)

According to Kelly, these patterns are composed of *constructs*, which are used for construing the world. Constructs enable an individual to make sense of and act on the encountered events. Hence, whether explicitly articulated or implicitly acted on, these repertory of constructs exist in every human mind, and forms the basis of human behaviour. The idea behind this is "constructive alternativism", which assigns people an active role in developing, testing, and modifying their construing. Constructs have a predictive ground for people to forecast and assess the anticipated events. This may motivate a person, or discourage them from acting on them. One outcome of this idea is, stating that constructs give the person the ability to predict, Kelly builds a bridge between past experiences and future anticipations. This is, however, fundamentally different than the psychoanalytic tradition of his contemporaries, which looks for the clues from the past experiences of their patients to understand the problems they 'unconsciously' encounter today. Instead, Kelly casts people a conscious and active role, since construing is a dynamic process, and he recognises the individual's role in construction and reconstruction of it (Kelly, 1999). "*A person's processes are psychologically channelized by the ways in which he anticipates events*", writes Kelly (p.32), referring to the inner construing process of the individual, the dynamism of this process as the individual has the alternative ways to decide to channelize the process

of construing, and the role of the experience with the outer world, namely *events*, in the dynamic nature of the construing process.

The notion of the individual consciousness in making sense of the experience in PCP was a novel stance at a time when the deterministic and positivist approach was dominant in psychology. Compared to his contemporaries, Kelly's theory is often aligned with the constructivist approach, which puts emphasis on the individual construction of knowledge. However, according to Chiari & Nuzzo (2003), this alignment, is not accepted by Kelly himself. They do also posit PCP next to constructivism in the sense that they both highlight the interaction of human and their environment in construction of knowledge. However, they also state that PCP differs from constructivist theory in its emphasis on individual *interpretation* of the events as a core process in construing, whereas in constructivism, the construction is perceived as a representation or *appropriation* of the 'reality', which is the outer world. The notion of interpretation instead of appropriation, and the emphasis on the events rather than a static world, makes PCP a dynamic approach to individual knowledge and meaning making. Fransella & Neimeyer (2003) draw attention to another discussion about the proximity of PCP to the cognitivist approach. They state how Kelly, despite widespread attributions, refused to label PCP as a theory dealing with merely cognitive processes of thinking. The fundamentals of PCP actually has much to offer about human action and emotions alongside the thinking process. They see this as a result of the common cultural construction of thinking vs. feeling dichotomy. Kelly's approach is action-oriented, and he presents thinking and emotion as intertwined, rather than separated. Nevertheless, his work affected and was expanded by constructivists and cognitivists (Chiari & Nuzzo, 2003), and PCP not only shares much with those approaches, but also offers more (Fransella & Neimeyer, 2003).

Kelly (1999) presents eleven statements, namely *corollaries*, within the framework of his theory (Figure 13). To better understand the construing system, its functions, and how it is relevant to the user experience framework, we need to address them:

1. Construction: "*A person anticipates events by construing their replications*" (p.35). It means the person creates a structure to assume the meaning of the

world. It requires interpretation and abstraction. By separating events into manageable lengths, the person can start searching for recurring themes (abstraction). Construing takes place by attributing similarities and contrasts to elements, both of which are inherent in the construct (interpretation). This is an inner process of the person, and not originated from the outer source.

2. Individuality: "*Persons differ from each other in their construction of events*" (p.38). Along with the differences in personal construing, the action-based nature of the theory comes into play to explain the individuality. Even though two person anticipates identical events, the construing of the self and the other actors differs from one to another, hence results in a different construing of the same events.
3. Organization*: "Each person characteristically evolves, for his convenience in anticipating events, a construction system embracing ordinal relationships between constructs*" (p.39). This corollary explains the hierarchical nature of the personal constructs; meaning, they are in an ordinal relationship as some subsume the others. It is a dynamic process of systematizing the constructs by concrete arrangement and abstraction. For example, such hierarchy might be seen in *descriptive* (small - large) vs. *evaluative* (useful - unpractical) constructs. Investigation of the ordinal structure of the constructs led to the *laddering procedure*, which is discussed in section 4.3.3.1.
4. Dichotomy*: "A person's construction system is composed of a finite number of dichotomous constructs"* (p.41). According to this corollary, the elements (objects, people, events, etc.) are construed on the grounds that is common in two, and different from the third. For instance, apple and pear are *healthy*, while chocolate is *unhealthy*. Healthy – unhealthy dichotomy is not inherent in the world of foods, but is construed by the person. Comparison of chocolate to different elements in the same range (see "range corollary" below) is likely to lead different constructs. The dichotomy not necessarily means opposites; the poles of a construct are not black and white, they are the interpreted and abstracted tags to give meaning to the world. Eliciting these personal constructs through triads of elements have a methodological implication, namely *repertory grid technique*, presented in section 4.3.1.1.

Figure 13. Summary of the corollaries, adapted from Butler & Green (2007)

5. Choice: *"A person choose for himself that alternative in a dichotomized construct through which he anticipates the greater possibility for extension and definition of his system"* (p.45). The practical value of the constructs are evident to the extent they provide a basis for the person to make choices. The judgement the constructs posit (e.g. *safe* vs. *challenging*) give the grounds to a person which way to go. Each choice means elaboration or enhancement of the anticipations. Be it derived from practical concerns or ethical principles, the choice is guided by the values attached to both ends of the constructs. If the construct do not guide the choice, then it has no practical value for the individual.
6. Range: *"A construct is convenient for the anticipation of a finite range of events only"* (p.48). This statement suggests that there is a range of convenience in the application of constructs. For instance, the *delicious* vs.

tasteless dichotomy applies to foods and beverages, while *exciting* vs. *dull* might apply to a wider range of objects, people, events, etc.

7. Experience: *"A person's construction system varies as he successively construes the replications of events"* (p.50). The construing system enables the person to anticipate an event by construing their replications. Experience, then, refers to the real event, which proves this anticipation either right or wrong. If the experience is well predicted, then the construction system is validated. When something unexpected to the individual happens, then the systems undergoes a change by the reconstruction of it.
8. Modulation: *"The variation in a person's construction system is limited by the permeability of the constructs within whose range of convenience the variants lie"* (p.54). The modulation corollary is about the plasticity of a construct to assimilate new events. Permeability is an issue mainly with superordinate constructs, which allows variation of new subordinate constructs. In other words, a construct is permeable to the extent it allows to embrace new elements into the construction system. Although the system slightly changes with the introduction of new elements, the plasticity of the construct to adapt the new situation makes it more durable.
9. Fragmentation: *"A person may successively employ a variety of construction subsystems which are inferentially incompatible with each other"* (p.58). The subsystems of constructs are not necessarily derivative of each other, and may incompatibly coexist, as long as they are compatible with the superordinate framework of construction. In this sense, fragmentation is related to modulation. The permeable nature of the superordinate structures tolerate inconsistency of subsystems. Hence, the investigator must refrain from drawing conclusions or predictions from fragments of constructs through making generalizations. At this point, Kelly suggests a conceptual analysis rather than a deterministic one. To have a better prediction of future anticipations, one must pay attention on the ways of the construing process, make conceptual abstractions, and look for patterns across population.
10. Commonality: *"To the extent that one person employs a construction of experience which is similar to that employed by another, his psychological*

processes are similar to those of the other person" (p.63). This corollary deals with the implications of the construction systems for interpersonal relations. Although individuality corollary suggests that no two people are identical in their construing even if they have had the same experiences, by putting the construing process under the highlight and dimming the attention from the experience itself, the commonality corollary emphasizes the possible similarities of different individuals in their constructions. A person may be able to employ another's anticipation to the extent of the similarities in their construing processes. One implication of the commonality corollary is that one who investigates the construction system of others must inquire the ways those people themselves construe the experience, to better understand them without bias.

11. Sociality: *"To the extent that one person construes the construction processes of another, he may play a role in a social process involving the other person"* (p.66). Sociality corollary, similar to commonality, also deals with the interpersonal dimension of the construction system. However, there is a fundamental difference between the two. Sociality not necessarily requires commonality in the construing systems. Surely, such similarity makes it easier for one to subsume the construing of the other, but in an incidental fashion. Sociality, on the other hand, is about a conscious effort to understand the construing of others and the higher motives to have a social role in their lives. Hence, sociality not necessarily requires commonality, and commonality not necessarily leads to sociality.

Kelly's theory is a holistic look at how people deal with their experiences through their construction systems. He carefully analyses the contemporary philosophical developments, such as phenomenology, pragmatism and constructive alternativism, to transcend the psychological approaches of his day (Fransella & Neimeyer, 2003). PCP provides a bridge between past experiences to future anticipations, between the individual and the social, between small constructions to bigger systems, between mundane anticipations to guiding values, and between constructions to behaviours.

The comprehensiveness of PCP is also evident in its applicability to all generations. As Butler & Green (2007) state, the scientist metaphor applies to every person, and children are no exception to it. Children, like adults, actively engage with their environments and construe meaning based on their experiences, rather than merely reacting to it. According to Mancuso (2003), by categorising the possible outcomes with their personal constructs, children construe "self-guiding anticipatory narratives" to anticipate how their actions will be perceived and themselves will be construed by others. (pp) This tendency of Kelly was deliberate, say Fransella & Neimeyer (2003), as he never mentions about "development" in the sense it is dealt within developmental psychology. According to them, Kellian development does not mark the maturing process from childhood to adulthood. Instead, it refers to the dynamism and constant change in the construction of all persons. Hence, children should be no different than adults in their process of construing. The limitation, then, is in adult construction of childhood:

> "We think of childhood as essentially entailing incompetence. Children's lack of competence forms the constant basic theme of psychological research, which typically focuses on what a child cannot do rather than on what she or he can. More generally we view the young in the perspective of helplessness, ignorance, neediness – as requiring to be guided, taught, brought up." (Salmon, 1985, p.25)

The behaviours and motivations we attribute to children merely represents our constructions about them. Adults develop theories about children, and every analysis starting with such assumptions will be confirming or disproving these adult-held theories, rather than understanding children. We may find their actions bizarre, unusual or uneasy; however, these are our interpretations of, or more precisely, constructions about them (Butler & Green, 2007). Individuals are experts and authority on their own understanding, so what we need to do is to try to "understand children's understanding" (p.5) by adopting a "credulous approach" (p.15), which requires challenging our dominant perceptions about children being 'limited' or 'immature'. The fact that Kellian perspective casts an active and conscious role for children in their anticipations is also compatible with the new childhood studies presented in Section 2.1. For the reasons outlined here, PCP is expected to provide a valid theoretical point

of departure for the methodological inquiry of understanding children's user experience from their own perspective.

4.2 Implications of PCP to Study User Experience

Being a theory of personality within the domain of psychology, psychology of personal constructs firstly aims to understand the human behaviour and the underlying higher motivations through a careful study of the construing systems of individuals. This requires a commitment to a meticulous investigation of how people give meaning to their experiences, and following their construing systems, come up with a clinical diagnosis before any therapeutic intervention. Hence, first there is a *definition* phase, where the therapist is supposed to have a comprehensive understanding, before moving on to the solution area. In design process, especially in the fuzzy front end where the problem is yet to be defined or potential elaboration areas are explored, it is vital to *understand* how users themselves construct and give meaning to their experiences in question. This user-centred understanding is a powerful means for designers to empathise with potentials users, hence gain a fresh perspective outside of the box. This is especially critical when working with children, since it might help us to free ourselves from our adult/designer constructions of children. This is where the potential of PCP comes in to guide the theoretical and methodological basis of inquiry through adaption of clinical methods to design research.

Before reviewing the methods of studying personal constructs, it is important to explain how theoretical foundations of PCP is in line with the study of user experience. In the following sections, the corollaries of the PCP will be reviewed, and merged with the unified UX model presented in Section 3.3. Second, examples of product perception and meaning studies will be introduced, and the way they are related to personal construing will be discussed. Finally, an overview of the methods and techniques of construct elicitation in clinical applications and as adapted by user research studies will be presented, both in general and specific applications with children.

4.2.1 PCP and the User Experience

The interpretation of the unified model of user experience through the lens of the PCP corollaries is diagrammed in Figure 14. According to PCP, *experience* is a key corollary, and whether it is 'real' or 'anticipated' is not of importance. It is a continuum, and a medium for personal *construction*. Our interpretations of anticipations of the events, along with the actual experience, mediates our construing about the world. Designers have no control about the actual experience, since it is subjective, but it is the construction of the experience that we need to commit to understand about our users. Similar to the real world experience, construction of the experience is also an *individual* process and not necessarily directly stems from the actual interaction. However, we can have a better grasp of it with a commitment to understand users' understanding, or in Kellian terms, 'subsume' their construing. This is where the *sociality* corollary becomes significant. To step into users' shoes, one should leave aside being a spectator leaning on personal constructions, but rather adopt a more credulous role to investigate how users themselves attribute meaning to their experiences.

If the construction of personal experience is such an individual process, then how is it even helpful for the design process to explore the construing systems of users? The answer lies beneath the potential of the PCP in studying cultural construing. The *commonality* corollary reminds us that similarities in construction of events by different individuals means that they are similar in their processes, regardless of the experience. Scheer (2003) draws attention to the potential implications of commonality and sociality corollaries for cultural studies, such as "[…] *youth culture, corporate culture, national culture, Islamic culture. It can be said that inasmuch as someone shares important ways of construing with a group of people, he or she is part of that culture*." (p.154). It does not mean that people sharing a similar cultural context have the same values. They might have different attitudes, but similar construing systems. Hence, differences of individuals does not always mean they have different constructs, but they might locate themselves at the opposite pole for some constructs. This perspective will steer the direction from individual ways of understanding to looking for patterns of construing across population. Although it will never give us a

statistical certainty, it will provide to some extent a predictive basis through finding conceptual patterns by a conscious effort to subsume the processes of the users.

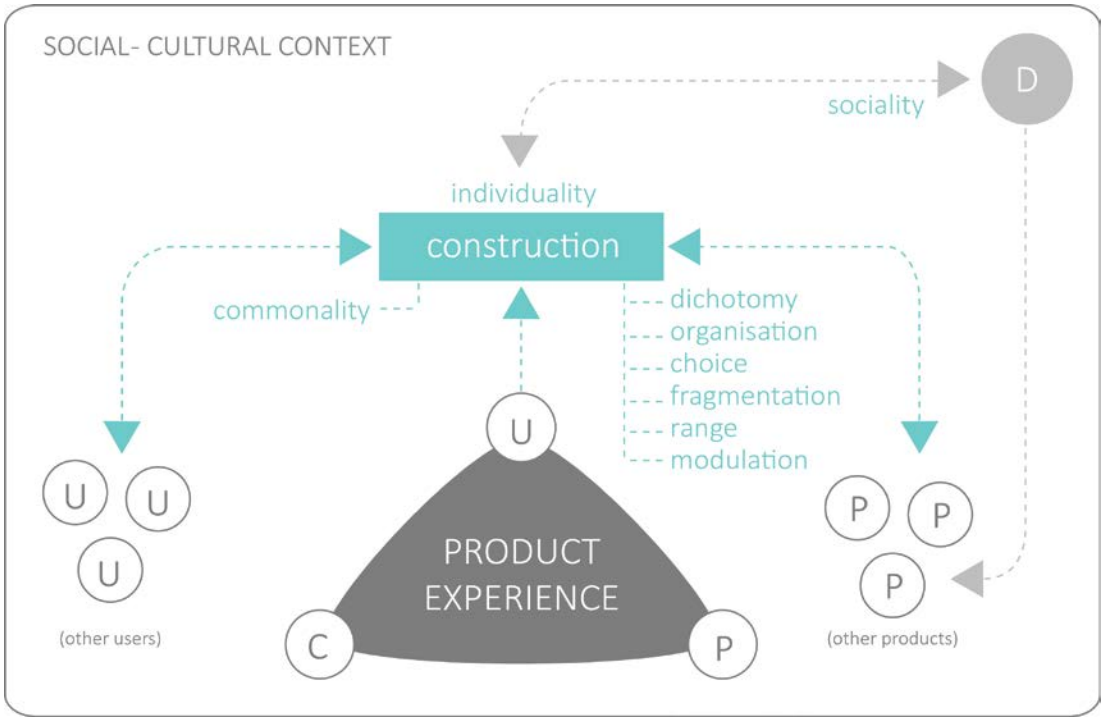

Figure 14. Interpretation of the unified UX model with PCP corollaries (U = User, P = Product, C = Context of use, D = Designer)

The rest of the corollaries are about the structure and operation of the construing process. For example, we can elicit the *fragments* of *dichotomous* constructs as *organised* by children within a given *range* of convenience, we can try to understand the motivations behind (*choice*), identify superordinate, permeable constructs with a wider range of convenience (*modulation*). However, these should also bring about certain reservations. To begin with, although construing is an inner process, the verbal labels we use for constructs are only means of communication. It brings the risk that our understanding of the dichotomous constructs, such as *calm* vs. *vibrant*, may not have the same meaning attributed by the user. That's why we should pay attention to understand what is meant by these labels. Constructs are there, whether put into words or not. But when put into words, there is always room for misunderstanding. Hence, focusing on the meanings imposed by users rather than being limited to our own constructions is vital.

The second issue worthy of notice is not to miss the holism of the construction system. Fragmentation is an important feature, but we should not forget the fact that constructs are attached to a bigger network, and they are organised in a hierarchical fashion. We fragment our construction system to be able to handle, but these fragments are related to each other, and not isolated. This can be a ground for a strategy to trying to elicit high-order constructs. The ordinal organisation of the constructs remind us the fact that hierarchically superordinate constructs are less prone to change and have wider range of convenience. The methodological implications on this issue will be addressed in Section 4.3.3.

The third issue, also related to the previous one, is regarding the dynamism of the construing system. We should take into consideration that construing is a continuous process, hence the construction system is ever in motion. When we inquire a certain experience, we are in fact taking a fragment of the system and relating it to the bigger picture, but it is just an instance and is prone to change. Unless there is a ground breaking change, such as a shift in the cultural paradigm, the change will be minor. However, elicitation of superordinate constructs will strengthen the gained perspective and increase the predictive and interpretative power of the findings by providing a stronger framework. Even so, we should be well aware of that it is not the future behaviour to be predicted, but the attitude and the possible construction of the experience.

To wrap up, grounding a user research methodology on PCP has the potential to better understand and empathise with the users, as it presents a framework for inquiry with less bias (Butler and Green, 2007). This issue is more critical when it comes to studying children's experiences due to uneven power relationships with adult researchers. A credulous approach to studying children's product experience may free us from dominant constructions on children and childhood by making an effort to understand their perspectives in their own cultural context.

4.2.2 Product Perception and Construction of Product Meaning

Product perception and perceived experience is similar to "anticipations" in PCP in the way that they are both grounded on interpretation of the stimuli/situation based on

personal construing systems. Study of perceived attributes of products and associated values is a well-established topic in marketing research. Main focus is on the importance of understanding the underlying values of customers, which lead their product choice patterns and buying behaviours (Gutman, 1982). This is a cognitive and attitudinal approach to understanding the decision-making process of the end users, which links concrete object properties to cognitive categorizations of the products and product attributes by the users (Grunert & Grunert, 1995). This in-depth investigation of personal, product-related values are expected to create a "potential not only for understanding the 'cognitive' positioning of current products but also permits the development of positioning strategies for new products" (Reynolds & Gutman, 1988, 11).

Gutman (1982) propose *means-end chain* model for understanding how perceived product attributes are linked to more abstract customer values through product categorization. According to this model, tangible product attributes (*means*) create certain physical or psychological consequences, which eventually result in satisfaction or dissatisfaction of high-order personal values. For instance, eating low-fat (*attribute*) food might be thought to control body fat (*consequence*), which is associated with increased self-esteem (*value*). In this framework, cognitive categorization plays an important role in how and why people concentrate on certain product attributes and ignore others. Categorization mostly take place through distinctive and alike properties, and in the form of dichotomies, such as warm/cold (Gutman, 1982, p.63). The significance of means-end chain and alike marketing models for design research lies behind their effort to conceptualize how certain product attributes are associated with subjective meanings by the users.

A similar approach to design research can help producing information on product-related meanings constructed by the users, hence provide an important source in new product development (Töre Yargın & Erbuğ, 2012). For example, visual stimuli received from products create certain cognitive responses on users' end. According to Crilly, Moultrie & Clarkson (2004), visual consumption of products is a communication process, destination of which is the end-user, who interprets and judges the products based on tangible stimuli and previous knowledge. They define

three types of cognitive responses to products: (i) *aesthetic impression* refers to the perceived attractiveness of the design, (ii) *semantic interpretation* is the assumptions on function, purposefulness and qualities of the product, and finally (iii) *symbolic association*, which is about the social and subjective significance of the product, and what it says about its user on a reflective level. A similar framework is presented by Warell (2008) to better understand the perceptual experiences of the users through non-instrumental interactions with products. According to this framework; *personal* (previous experiences and motivations), *product-related* (product attributes and brand), and *external* factors (environmental, social and economic context) play equal role on subjective perceptual experiences of the users. He highlights the importance of having a better understanding about how products are and maybe experienced by the users as it allows the designers to effectively direct the focus of their work, evaluate their concepts, and design products for more pleasurable and meaningful experiences (Warell, 2008, p.13).

Warell's work on perceptual experience also shows similarities with means-end chain model. He describes the perceptual product experience process in three levels: (i) *recognition* is the direct stimuli received from products, (ii) *comprehension* is focusing on the semantics of the products by making sense of this stimuli, and finally (iii) *association*, which is the symbolic level of how products are conditioned based on socio-cultural norms. This three level process is similar to what means-end chain framework hierarchically refers to as attributes, consequences and values. This process is also consistent with Crilly and his colleagues' model of cognitive response to design on aesthetic, semantic and symbolic levels.

Investigating user-oriented meanings of product attributes is an effective way of understanding product experience from user's space. Meaning making is a socio-cultural process, and it is important to close the gap between intended meaning presented by the designer and meaning perceived by the user (Warell, 2008, p.13). According to Bloch (1995), users make judgements about products even solely based on their forms by holding certain mental categories and beliefs regarding what the product has to offer, and this judgements stem from previous experiences and existing construct systems, affecting how we engage in future experiences with products.

Similar to Gutman, Bloch also emphasizes the importance of mental categorizations based on perceived similarities and differences between products, which depend on previous experiences and impact future product engagements (p.20).

Based on the theoretical background presented here, it is possible to infer that we can draw connections between physical product attributes and attached personal meanings in order to give a direction to the design process. Perceptual information gathered from the products result in certain cognitive, affective and behavioural responses on different levels based on existing cognitive schemes shaped by personal experiences and culturally shared meanings. However, investigation of these product-related cognitive schemes should have a different focus than that of marketing research. Marketing scholars concentrate on product choice and buying behaviours, whereas design research should focus on how users respond to certain product attributes, and how they can be a medium for meaningful interactions. Scrutinizing these complicated cognitive schemes help building patterns between tangible product attributes and user-centred meanings, hence providing a better understanding and prediction about how users do and will engage with products.

4.3 Methods of Exploring Personal Meaning

As described in the beginning of the chapter, personal construing is an inner process to make sense of the world. In order to investigate these processes, several techniques are utilised in clinical psychology and marketing field, some of which have already been adopted in user research. The literature on elicitation techniques propose different categorisations. For example, in requirements elicitation, the techniques to elicit personal meanings are categorised under cognitive (Tiwari & Rathore, 2017; Yousuf & Asger, 2015) or analytical (Zhang, 2007) techniques. In this context, it is found to be more relevant to refer to them as ‘meaning-driven techniques’, as the theoretical foundation (PCP) highlights the use of personal constructs as a meaning-making process.

The relevant literature point out to two main directions of inquiry: elicitation and elaboration (Figure 15). *Elicitation* techniques aim to surface personal meanings in a rather horizontal fashion with no particular direction to understand the hierarchical

structure among them. Here the elicitation techniques will be presented in two parts based on the application: *comparative techniques* and *non-comparative techniques*. *Elaboration* techniques, on the other hand, are useful to deepen the personal meaning structures and how they are organised in relation to each other. Naturally, the elaboration techniques are complementary procedures to elicitation techniques, and they will be presented separately.

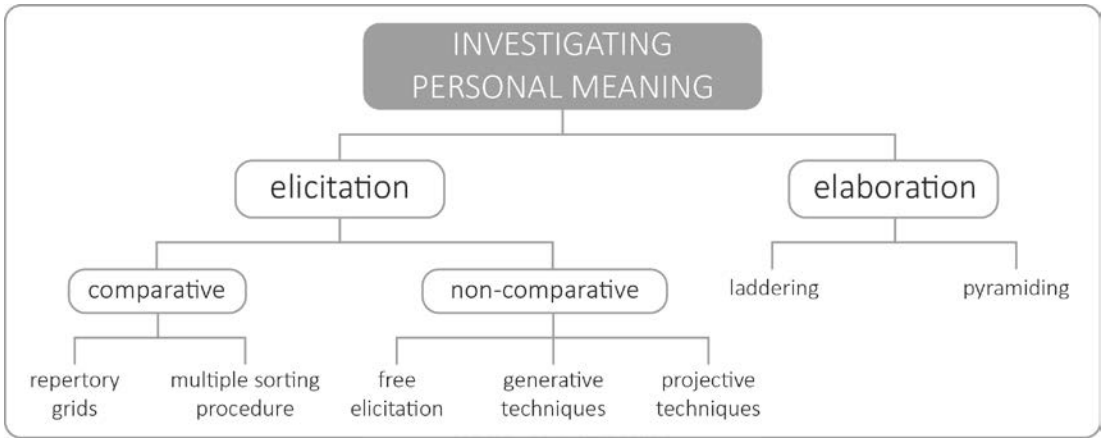

Figure 15. Techniques of investigating personal meaning

It should be noted that there are other meaning elicitation techniques that are not included in this chapter, as they rely heavily on marketing literature. The techniques included in here are selected in accordance with their representativeness to the categorisation above, as well as applicability in user research. Detailed discussions on comparison of various meaning elicitation techniques can be found in Bech-Larsen & Nielsen (1999) and Breivik & Supphellen (2003).

4.3.1 Comparative Elicitation Techniques

Comparative elicitation techniques consist of procedures based on comparison of multiple items to probe revealing of the fragments of personal meaning structures. In accordance with the subject of inquiry, the comparative items can be virtually anything; such as people, events, places, brands and objects. Repertory grids and multiple sorting are the most popular examples of comparative elicitation.

4.3.1.1 Repertory Grids

Repertory Grid Technique (RGT) is perhaps the best-known implication of the PCP. It was developed as the clinical inquiry into personal construing by George Kelly himself. Given its theoretical foundation, RGT has the ability to unravel personal cognitive structures in any domain, such as people, environments, objects, and so on (Fransella and Neimeyer, 2003).

RGT is fundamentally a structured interview technique. A repertory grid comprises a *topic* (i.e. gaming experience), *elements* (i.e. various video games), *bipolar constructs* (i.e. fun-dull) and ratings of each element in relation to each construct. Elements and constructs can be supplied or elicited from the interviewee. If the goal is to explore how the individual themselves make sense of the topic, then it is more purposeful to elicit constructs during the interview.

In a typical interview procedure, different elements are compared for similarities and differences, and this process results in the naming of a number of personal bipolar constructs through which the individual gives meaning to the topic in question. RGT is sometimes referred to as *triadic sorting*, as this comparison procedure is typically conducted by presenting the interviewee three elements at a time, and asked the ways in which two of the elements are similar to each other and different from the third. This questioning continues with different sets of elements to elicit a diverse range of relevant constructs. The session ends with rating of the elements for each construct.

Constructs in a repertory grid are always bipolar (i.e. exciting/mainstream) in the way that an originally named construct (exciting) is only complete with a construct pole (mainstream), and together they serve as a scale by which each element is evaluated and positioned. The different constructs elicited from different participants can be analysed qualitatively through content analysis to form categories of meanings among the sample (Fransella, Bell, & Bannister, 2004; Jankowicz, 2004). The ratings are the way of relating the constructs to elements. This is the quantitative side of the grid, which can be analysed with statistical methods to demonstrate the relationship between constructs and elements (Bell, 2003).

Beginning from the early 2000s, RGT has gained popularity in UX research. It is suggested to provide design-relevant information from user's point of view, and enable researchers to explore design possibilities through the user's own mental models (Hassenzahl & Wessler, 2000; Verlinden & Coenders, 2000). RGT has the power to reveal subjective meaning structures related to the experience in question, and help identify meaningful patterns between various dimensions affecting user experience.

Furthermore, RGT is a structured yet flexible procedure which can be adapted for various research contexts (topic), being applicable to almost any artefact (elements), and able to unravel both pragmatic and hedonic aspects of experience (constructs) in a holistic way. It is possible to integrate products, images, lo-fi or hi-fi prototypes, and conceptual sketches into the data gathering procedure as elements. This flexibility gives researchers the power to adapt the methodology to various research settings. Studies of user experience have shown that RGT has been utilized not only for overall product evaluation (Hassenzahl and Trautmann, 2001; Khan, 2012), but also to elicit the dimensions of user-product experience for early exploration (Steed & McDonnell, 2003; Fallman & Waterworth, 2010; Karahanoğlu & Erbuğ, 2011).

The use of RGT is not uncommon in studying with children, however it may require certain modifications in the application of the technique. For instance, the use of triads for comparison is suggested to be too complicated to be comprehended by children under 10, and it is recommended to use *dyads* instead, which is presenting children pairs of elements at a time and asking for similarities and differences (Fransella et al., 2004, 28). This procedure is also known as *dyadic method*, and is proposed to be applicable with children as young as 5 years old (Butler & Green, 2007, 51). Another recommendation is to replace the procedure of rating the elements with *physical ranking* of the element cards, as it would be cognitively less demanding for children younger than 12 years old (Fransella et al., 2004, 190).

RGT is often described as a "value-free" technique which allows exploration of subjective experiences from the personal point of view of an individual with minimum researcher bias (Fransella and Neimeyer, 2003; Alexander and Van Loggerenberg, 2005). It is "an attempt to stand in others' shoes, to see their world as they see it, and

to understand their situation and their concerns" (Fransella et al., 2004, 6). Given the tendency to investigate the experiences of children as filtered through adult perspectives, the importance of understanding children's needs and aspirations without pre-defined criteria comes to the forefront. Being a clinical tool of the PCP, RGT can help to "understand children's understanding", which requires finding a way of looking at how children create meaning from the inside-out rather than from the outside-in (Butler & Green, 2007).

4.3.1.2 Multiple Sorting Procedure

Multiple sorting task or multiple sorting procedure (MSP) is a variation of RGT. MSP is based on the theoretical assumption that not all constructs are significantly bipolar, hence weighs less on the dichotomy corollary originally proposed by Kelly in PCP. It aims to elicit the categories and classifications people make use of in any given context and in a flexible fashion. Canter, Brown, & Groat (1996) suggest MSP can also provide a structure to the interview by staying focused on the enquired issue.

The procedure involves presenting multiple elements (such as pictures or cards) to the participant, and asking them to sort these elements into groups; each group falling under the same category by showing similarities within and differences than the others. Then, they are asked to explain each category. This procedure can be repeated multiple times, each time revealing a different categorisation the participant have in mind. Similar to RGT, these categories (or constructs) can be *elicited* this way, or be provided to the participant to come up with *forced* sorts (Canter, 2007).

Rugg & McGeorge (1997) points out to the little recognition sorting techniques received compared to other knowledge acquisition and requirements elicitation techniques such as RGT and laddering. They propose *repeated single criterion sorts* as a flexible and easy to apply technique to elicit the categories the participants hold. They described three different sorting types based on the medium used as elements: *object sorts, picture sorts,* and *card sorts*. Objects are tangible artefacts, pictures are image cards representative of different objects, and cards are written statements. Each time the participant is given a criterion and asked to group the elements (objects/pictures/cards), and then name each pile, which reveals the categories.

MSP can be used to elicit personal constructions of people regarding the experience with a particular product group. For instance, Al-Azzawi, Frohlich, & Wilson (2007) report using different MSP techniques to elicit personal constructs of the users regarding beauty and aesthetics in portable MP3 players. They utilised picture cards in three different sorting procedures: *free sorting, semi-structured sorting* and *structured sorting*. In free sorting, participants can create as many piles as they like based on any criteria they have in mind, and later label these piles with categories, and explain the meaning and purpose behind this categorisation. In semi-structured sorting, participants are given the criteria (kinds of beauty), and asked to create any number of piles based on this criteria. In structured sorting, participants are given both the criteria (preference) and the categories (7-point preference scale), and asked to group the cards under them.

Sorting, as well as RGT, is a technique utilised in marketing research in order to explore the relationship between product attributes and consumer choices. In a study comparing different elicitation techniques, Bech-Larsen & Nielsen (1999) found that triadic sorting (RGT) and free sorting techniques reveal significantly more attributes[7] than other elicitation techniques. However, they also report that attributes elicited through these techniques tend to be more focused on concrete qualities of the products rather than abstract qualities.

Similar to RGT, the suitability of the MSP to exploring user experience is evident in its flexibility in being adopted in different research contexts, and the integration of visual stimuli which can represent different products. Since it is somehow concretised with the use of tangible stimuli such as objects, images or cards, it requires less reliance on verbal explanations for the participant, which makes it cognitively less demanding for child-users. However, it should be noted that assigning labels for each sorted pile is the part of the procedure to reveal the personal categories, and children should be asked to explain each label as the use of a certain term may not correspond to what it means for the interviewer.

[7] Although they refer to George Kelly's PCP in explaining the triadic sorting procedure, the authors do not directly use the term "constructs", and name the elicited categories as "attributes". It is seen to be a common choice of nomenclature in marketing literature.

4.3.2 Non-Comparative Elicitation Techniques

Contrary to comparative elicitation techniques, non-comparative techniques are not based on comparison of multiple elements. The elicitation procedure can be done with no concrete stimuli, single stimuli, or multiple stimuli but without comparison against each other. The non-comparative techniques are usually less structured and open-ended in comparison to comparative elicitation techniques.

4.3.2.1 Free Elicitation

Free elicitation (FE) is a popular technique in consumer studies. It is based on spreading-activation theory, which is a cognitivist approach to exploring how semantic processing work associatively by creating links in memory structures (Collins & Loftus, 1975). Therefore, FE techniques are based on unravelling free associations of the people, and rather open-ended and unstructured compared to comparative techniques. Its use in marketing studies is product-driven, and requires participant familiarity to the product or brand in question so that they can express associative networks retrieved from memory associations (Van Kleef, Trijp, & Luning, 2005).

In typical application, the participant is presented a certain stimuli, such as a brand or a product, and asked to quickly verbalise the associations it triggers in their minds (Breivik & Supphellen, 2003), or “first three things” that comes to mind (Reilly, 1990). The results can be presented as networks of associations or classification of statements through content analysis. In this sense, FE seems like a semantic approach focusing on verbal expression of descriptive adjectives and word associations. However, modified versions include combination with laddering procedure to reveal latent meaning structures (Miles & Frewer, 2001), and the use of image cards to stimulate the perceptive associations with visual cues, hence no previous knowledge of that particular product is needed (Radford & Bloch, 2011).

In a comparative study, FE is reported to reveal significantly more attributes and more abstract attributes compared to RGT, and is to be more time efficient (Steenkamp & Trijp, 1997). However, although inquiring the semantic response of participants to product stimuli is an established field in user research, strong focus on abstract verbal

labels can pose challenges when working with children. Therefore, efforts to concretise the procedure can be useful in both helping children articulate easily, and establish a more reliable communication between the participant and the researcher.

4.3.2.2 Generative and Projective Techniques

This section focuses on the open-ended construct elicitation techniques with children as an alternative to RGT. Tom Ravenette is perhaps one of the pioneers of such work:

> "A personal construct approach to this task lays stress on the ways in which children make sense of themselves and their circumstances. Although much may be found out through a verbally structured interview, there are likely to be many areas of experiencing not so easily accessible. It is a worthwhile assumption that a child's drawings will point to aspects of knowing that exist at lower levels of awareness than that of verbal articulation. This then is the justification for asking a child to draw." (Ravenette, 1999, p.127)

Ravenette suggests drawings, storytelling and projective techniques as effective methods of interviewing with children. Butler & Green (2007) provided a comprehensive collection of these techniques to investigate personal construing of children. The clinical practice dominantly focus on how children construe themselves and the events around them, hence the techniques include drawing of *self-portraits* and creating *portrait galleries* through drawing (p.54), or projective methods such as *drawings in context* (p.60). These techniques are proposed to provide a structure and guidance to the interview procedure. The difference of projective methods than generative techniques such as drawings is that in the former, visual stimuli depicting persons in different contexts are shown to children, and the constructs are elicited from their reactions to these stimuli. Projecting self-construing on "someone else" is expected to relieve the child from the stress of talking about self-experiences.

Generative methods have now become a stand-alone research method in user studies (Stappers & Sanders, 2003). They are suggested to reveal latent user needs and expectations which are difficult to verbally articulate. It is possible to integrate generative tools and techniques as a part of an interview procedure as well (Turhan et

al., 2011). The use of generative techniques in user experience research with children is also common. A detailed review of such work can be found in Section 2.4.2.1.

4.3.3 Elaboration Techniques

As the name suggests, elaboration techniques aim to elaborate on the elicited constructs. It adds depth and clarification to the meaning implied by the participant, and reveals the relationship between constructs at different levels of importance and abstraction. Therefore, elaboration techniques have the power to unravel the hierarchical nature of the personal construing system (Fransella et al., 2004).

4.3.3.1 Laddering

Laddering is a procedure devised to elicit constructs from constructs. It is a strong tool for the eliciting in-depth, value-laden "superordinate" constructs (Fransella, 2003). Having a wider range of convenience, laddered constructs are central, and more resistant to change (Jankowicz, 2004). Although being a structured technique, laddering generates richer and more in-depth information when compared to quantitative methods of data gathering, and yet is easier to conduct than unstructured techniques.

Although the laddering (although not with this name) as a procedure within RGT was originally proposed by Dennis Hinkle, who was George Kelly's student, it has perhaps been more popularised through consumer studies after Gutman's (1982) Means-End Chain (MEC) model. According to his model, *means* are the objects or activities, whereas *ends* represent the valued states of being by the users of these products. In order to link how the means can lead to these valued states, he recommended the use of the laddering technique to explore the relationship between product *attributes* and the attached *consequences* and *values*.

According to Fransella et al. (2004), laddering is more of a skill than a standard procedure, which requires practice and experience. In a practical guide, Jankowicz (2004) recommends to constantly probe the participant with "why" questions to achieve related, higher-order constructs. According to his description of the ways to differentiate values it that they are usually more abstract, universal, intimate and self-

referred. Nevertheless, two types of laddering procedures are described in in consumer studies (Grunert & Grunert, 1995). *Soft laddering* is similar to that of described above; it is less structured and flows in a natural conversation with little interference from the interviewer except some verbal probing. *Hard laddering*, on the other hand, forces the participant to follow the attribute-consequence-value chains proposed in MEC. Hard-laddering impose little interviewer bias and can even be applied computerised data collection software, however soft laddering can provide richer data.

Although the use of RGT in design research with children is not very common, laddering have been often applied in the field of child-computer interaction. Abeele, Zaman, & Grooff (2012) use triadic sorting for attribute elicitation from preschool children about three cuddly toy interfaces of video games, for further use of them in conducting laddering interviews. Although they mention the challenges of reaching "values" level with young children, they suggest the laddering technique to be suitable for children as young as 5 years old. Celis et al. (2013) utilised laddering with five-year-olds to investigate player motivations in order to define guidelines for video game design for young children. Saarinen, Partala, & Väänänen-Vainio-Mattila (2013) employed a mixed methodology combining laddering and a questionnaire in order to investigate children's experiences during "backpack tours", an interactive exhibition environment. As a novel laddering procedure, they conducted interviews as pairs to encourage children to talk more confidently about their experiences. Evaluating the likeability of the video games, Zaman (2008) proposed *contextual laddering* as interviews conducted with children in natural use (home) environments.

4.3.3.2 Pyramiding

Pyramiding is essentially the opposite of laddering, and often named as "laddering down" to detail the meaning by achieving subordinate, concrete constructs. Sometimes the participant may begin with an abstract construct, and the meaning can be clarified through asking "how" or "what" questions, and this question may have multiple answers (Jankowicz, 2004). To illustrate, imagine exploring personal constructions of users about wristwatches. When the participant assesses a watch to be "elegant", this maybe a consequence of different product attributes, such as material, texture, colour,

form, and so on. Multiple concrete attributes influencing a consequence, or consequences a value, forms a pyramid-like structure, hence the name pyramiding.

In terms of user research, linking abstract constructs to concrete ones through laddering and pyramiding can be useful for designers as it gives concrete exemplification (Töre Yargın & Erbuğ, 2012) of which characteristics are associated with desired or problematic consequences. Additionally, when working with children, such exemplification can contribute to clarification of the meaning of the constructs proposed by the participant.

4.4 Exploration of Construct Elicitation Techniques with Children

The review of the methods of exploring personal meaning shows that the use of non-comparative, open-ended elicitation techniques are more common in studying personal construing of children. The use of comparative, structured techniques can also be found in the literature, although not common. This section will present two explorative field studies, one adopting an open-ended, generative elicitation methodology, and the other exploring a structured, comparative procedure. Both studies will be briefly introduced in terms of the methodology and the methodological inferences.

4.4.1 Explorative Study 1: Open-Ended Construct Elicitation

The first explorative study aimed to investigate the potential of open-ended techniques in terms of eliciting product-related construing of children. For this purpose, a data collection procedure was designed to explore the sliding experience of preschool children through different generative techniques. This product category was chosen for the following reasons: sliding is a familiar and inclusive activity for all children without any physical constraints, and the slide is not a complicated product in terms of form and function, hence can be easily reflected on with different generative techniques.

This study was published elsewhere (Süner & Erbuğ, 2014b). Here the methodology will be presented briefly, and the findings will be discussed around the potentials of the data collection procedure in terms of eliciting design-relevant constructs from children.

4.4.1.1 Participants

The study consisted of individual generative sessions for co-designing children's slide with 20 preschool children (age 5 to 6 years old) from the kindergarten in Middle East Technical University. Consent forms (Appendix D) were distributed to the parents and the study was conducted with every child whose parents responded positively.

4.4.1.2 Materials

Three diverse generative techniques were used during the sessions: *drawing*, *clay modelling*, and *drama/role playing*. A4 size descriptive posters for each technique, and one A0 size poster containing the pictures of several types of slides with different materials, sizes and forms, as well as depicting children sliding were provided during the sessions (Appendix E). Also, modelling clay, and paper and crayons were prepared for each session for the generative activities.

4.4.1.3 Data Collection Procedure

Before each session, a questionnaire asking the child's extent of interest in and competence with these techniques to the child was administered to the parents (Appendix F), and their written consents were obtained. Each participant was familiar with all three techniques as they are included in the kindergarten curriculum.

Figure 16. Data collection procedure

Data collection procedure is presented in Figure 16. Individual sessions were conducted at a private room provided in the kindergarten building (Figure 17). The sessions started with a brief warm-up chat with the participant and introduction of the project with the help of the A0 size slide poster. Then the participants were asked for their help for the design of a new slide. Following the verbal consent of the child, they were briefed with three techniques presented in A4 size descriptive posters. Children

told that they were free to use any of these techniques, or combine whichever they like, as long as they feel comfortable in expressing their ideas.

Figure 17. Sample session venue

The session is essentially an interview procedure during which the participants are probed to explain the reasons to their design suggestions, and the generative tools and techniques were expected to relieve the child from the stress of leaning only on verbal expression. Each session was audio and video recorded, and lasted 13 minutes in average.

4.4.1.4 Analysis

The videos were transcribed and imported in an Excel sheet separated into meaningful statements, or notes describing children's actions at that particular moment Each statement was then coded to highlight the product-related construct mentioned (i.e. safety, material, form) by the participant, and the type of the technique(s) they used

(i.e. verbal expression, drawing, physical expression) in order to communicate this particular construct.

4.4.1.5 Findings

The analysis resulted in 9 construct categories communicated with 6 different techniques (or "mediums"). Although the participants were originally presented with three techniques, they were observed to frequently refer to the slide *poster,* which was designed for the warm-up discussion, for clarification of ideas. *Verbal expression* was also used as a medium of communication, and some children used *mixed techniques*, such as combination of *drawing* and *clay modelling*. Also, although none of the participants chose drama as a communication medium, they were observed to employ *physical expressions* such as gestures to emphasize size, or jumping to depict an action. These mediums were used to express different product-related constructs, which are presented in a construct-technique frequency matrix (Table 4). Since all the tools and techniques in the matrix were expressed together with verbal expression, the "verbal expression" column in the matrix refers to plain oral statement of children, which were not accompanied by any other means.

Table 4. Construct-technique frequency matrix

	Verbal exp.	**Poster**	**Clay mod.**	**Physical exp.**	**Drawing**	**Mixed tech.**	TOTAL
Form	11	9	9	9	7	6	**51**
Action	10	6	5	9	5	7	**42**
Size	8	8	2	3	4	2	**27**
Emotion	9	11	2	0	0	0	**22**
Safety	7	1	2	1	0	5	**16**
Novel idea	4	2	3	3	1	0	**13**
Colour	5	0	3	0	4	0	**12**
Theme	5	1	2	0	1	0	**9**
Material	3	3	0	0	0	0	**6**
TOTAL	**62**	**41**	**28**	**25**	**22**	**20**	**198**

The product categories emerged from the analysis are as follows:

- Form: Slide parts and their physical forms;
- Action: Physical actions such as climbing, jumping and body postures;

- Size: Dimensions of the slide parts, such as height, length and thickness;
- Emotion: Feelings associated with the sliding experience such as happiness, fear and joy;
- Safety: Concerns and suggestions regarding physical safety of the slide and its parts,
- Novel design idea: Suggestions for original design ideas for the sliding experience, such as falling through the holes on the slides,
- Colour: Suggestions for colour or tactile properties for the slide and its parts,
- Theme: Conceptual themes such as 'pirate slide' or 'water slide',
- Material: Types or attributes of materials such as wood, metal, softness or conductivity.

As seen in the matrix, the most frequently elicited constructs were related to product form, which was followed by bodily actions related to sliding experience. The frequency of the size-related constructs as well as the emotional experience of sliding were moderately high, whereas constructs related to slide theme and the use of material were expressed considerably less.

The findings show that children used particular techniques to express certain types of information. Verbal expression was the dominant form of conveying ideas for many product categories. Although it was not planned, the slide poster proved to be a useful tool to communicate emotional experience associated with sliding, as well as physical features such as form and size. Clay modelling seems to have been used more frequently than drawing, however it should be noted that except one participant, all children used clay in 2-dimensional form as if they are drawing, rather than modelling in 3-dimensional form.

4.4.1.6 Discussions on the Methodology

This explorative study was useful to see how children express design-relevant information when exposed to different types of tools and techniques. The degree of mastery with the given technique was an important issue as observed by the researcher, and expressed by some of the participants. For instance, one child told that she would have selected clay modelling if she knew how to use it properly. Another child

mentioned about having difficulties in drawing the back part of the slide, as he made the whole drawing from the side view. Even though the children were ensured that the quality of craftsmanship is not an issue and it is their ideas that matter, some children were seem reluctant to use the tools provided them, even after they were encouraged by the researcher multiple times.

Similarly, children were often seen to have referred to the images in the poster slide to clarify their ideas and preferences in a comparative manner, whenever they get distracted from the generative tools. Pure verbal expression, although being the most common method of conveying ideas, were often found limited and lack of depth. Children tended to use abstract or generic expressions verbally, such as “I like big slides” or “you can climb on it with the ladder”. Such generic statements were exemplified by directing the child towards the poster, which led to comparative clarification through concrete examples.

All except one child used clay in 2-dimensional form as if they were drawing, and the drawings were usually the side views of the slides (Figure 18). These techniques were presented to ease probing and the communication between the researcher and the participant to relieve them from the stress of relying on verbal communication. However, some children wanted to take their time for drawing and colouring properly, which took away from the time allocated for the interview. Although drawing takes less time compared to clay modelling, it does cause loss of time when they want to change their mind and erase/correct the drawings they made. Similarly, mixing different methods raised time concerns, even though it provided rather in-depth information compared to the use of single techniques.

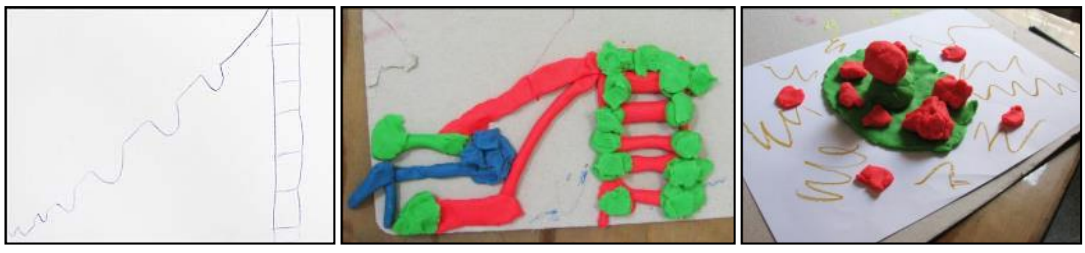

Figure 18. Left to right: sample drawing (6, m), clay model (5, f), mixed technique (6, m)

These efficiency concerns, as well as the unexpectedly frequent comparative referral of children to the concrete images on the poster pointed out to a need for a more structured methodology to allow children their ideas and preferences in a rather comfortable and effective fashion. This deduction informed the methodology of the second explorative study.

4.4.2 Explorative Study 2: Structured Construct Elicitation

The methodological assessment of the first study demonstrated the potential of a structured procedure in terms of efficiency and effectiveness of communication between the researcher and the participant. For this purpose, the second study focused on exploring the potential of a construct elicitation procedure adapted from RGT to investigate children's product experiences.

The study consisted of individual construct elicitation interviews with primary school children investigating children's construing about mobile phones. This product category was chosen for the following reasons: (i) the mobile phones designed for children currently reflect parental concerns rather than child-users', hence it would provide an opportunity to explore child perspectives; (ii) almost all children are familiar with mobile phones from their social environment, although products targeting specifically children are not well-known in the local Turkish market; and (iii) mobile phones embody not only pragmatic, but also hedonic aspects of experience, as it is designed for personal use, but it also is a "showcase" product consumed in the social world.

This study was also published with detailed discussions on the findings and design implications (Süner & Erbuğ, 2016; Süner, 2016). This section will focus on the methodological implications of the data collection procedure.

4.4.2.1 Participants

A pilot study was conducted with 7 children in preschool and primary school (age 5 to 7) at Utest test room in METU Department of Industrial Design prior to the main study. The goal of the pilot interviews was to test the comprehensibility of the data collection procedure. These ages mark the transition from preoperational to concrete operational

stage, which was distinguished by Piaget (2001) with development of intellectual functions such as being able to sort objects by features, make categorisations, inductive thinking and understanding causality. These are the cognitive functions required by a data collection procedure based on comparative construct elicitation. The pilot study showed that children primary school children could follow the procedure easier compared to the younger children. The main study was conducted with 44 children at first and second year of a public primary school in Ankara (age 6 to 8). Permit was obtained from the Ministry of National Education prior to the study, and verbal consent of the participants were obtained at the beginning of each interview.

4.4.2.2 Materials

Real size images of five different mobile phones, three of which are designed specifically for children, were used as elements with brands covered in the interviews (Figure 19). Apart from the product images, a separate grid sheet was used for each interview in order to note down the elicited constructs and the ranking data.

Figure 19. Mobile phone images used the study

4.4.2.3 Data Collection Procedure

Data collection procedure was a modified version of the RGT, with laddering procedure (Figure 20). Following the recommendations in the literature, the elements were presented to children in dyads instead of triads, and at the end of the procedure these elements were ranked instead of rated.

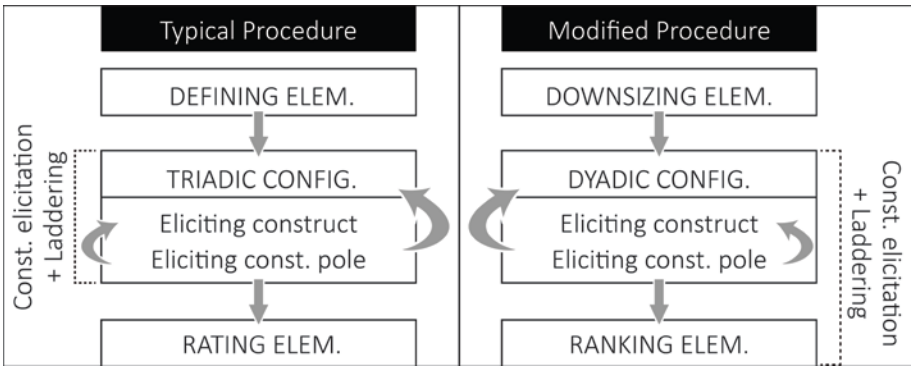

Figure 20. Data collection procedure

The interviews began with selection of the elements to be used for construct elicitation by downsizing them from five to three. In order to randomise this, the child was asked to rank the five products from least to most liked ones. First, mid and last products in the sort was picked for dyadic elicitation, which is the process of showing the products to the participant in three consecutive pairs and asking for similarities and differences. Once an attribute is expressed by the child, they were asked whether this is a good thing or not. Then they were probed to elaborate on the meaning of it by asking questions such as “why this is a good thing?” or “why is it important for you that a phone has…?” This was the beginning of the laddering procedure, and was repeated until the child could not come up with any more reasons. For each stated construct, the child was also asked to state a contrast pole, and they were both noted on a grid sheet. This procedure was repeated for each product pair, until he child could not come up with differences or similarities any more. After all product pairs were presented, we proceeded to the ranking phase, where the child was asked to rank all five products in accordance with the elicited constructs separately. Since the goal of the study was not product evaluation, ranking phase was taken as an opportunity to continue construct elicitation, as there are two new products included in the ranking.

The interviews were video recorded and lasted 21 minutes on average per participant. A total of 15 hours of video recordings and 44 grid sheets with construct and ranking data were collected.

4.4.2.4 Analysis

The video recordings were transcribed and transferred into a spreadsheet, and divided into meaningful chunks of statements and subjected to content analysis (Krippendorff, 2004). Each raw was coded with the construct and its pole as stated by the participant, the product attribute, and the consequences of this attribute (Table 5). These consequences form the categories of dimensions related to the mobile phone experience from children's perspective.

Table 5. Sample data coding

Constructs		**Statement**	**Talking about**	**Product attrib.**	**Causal**	**Affected**
for kids	for adults	It is bad to have these ears [P2]. No way has a phone had ears! Looks like it is something for kids.	has ear-like parts	body form	personification	age appropriateness
easy to find things	difficult to find things	[P5] has this square button, so easier than [P1]. We first push the square and it is on, then we say "mmm there is some stuff here".	has visible menu button	control type	visibility	accessibility

4.4.2.5 Findings

The content analysis resulted in 18 dimensions (Table 6) reflecting the participants' cumulative construction of the mobile phones. Some of these dimensions are related to pragmatic issues such as accessibility, understandability and portability of the phone, whereas others refer to the hedonic aspects of experience, such as product expression, age appropriateness and aesthetic appeal. The frequencies of each dimension, as well as the multidimensional cause-effect relationship between them were transferred in a cross-impact matrix (Appendix G), which was used to construct a cross-impact chart (Appendix H) and a cross-impact map (Figure 21).

Table 6. Dimensions of mobile phone experience

Dimension	Explanation
Accessibility	Ease of navigation through the menu, screen or within particular apps
Aesthetic appeal	Being visually pleasant and appealing
Age appropriateness	Being suitable for use by a specific age group, such as children or the elderly
Audibility	Audio quality, volume level, etc.
Durability	Physical and technical endurance
Ease of use	Ease in use of a particular application or task completion
Familiarity	Previous experience or familiarity with the product or certain features
Fun	Being entertaining in qualities, applications or looks
Gamability	Enabling a satisfactory gaming experience
Personification	Having a person-like "character" as a result of physical form features
Multifunctionality	The extent of functions and technical capacities of the product
Novelty	Being new, original and state-of-the-art
Portability	Ease in handling and carrying the product
Product expression	Looks, resemblances, expressions
Readability	Ease in reading the written items and images
Understandability	Being cognitively compatible with the user
Visibility	Visibility and clarity of controls
Writability	Ease in writing texts

The cross-impact map shows the interdependencies of the dimensions. For instance, ease of use is affected by many dimensions such as visibility, writability, accessibility and understandability, also has impact on several other dimensions. Visibility is an active dimension, mostly affecting other dimensions. Aesthetic appeal and gamability, on the other hand, are rather passive dimensions as they are largely affected by others and not the other way around.

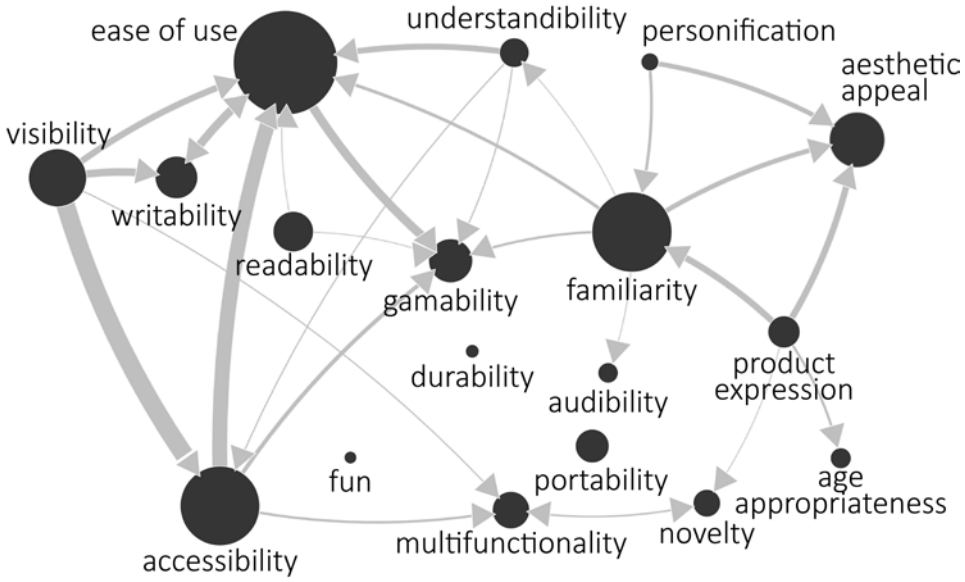

Figure 21. Cross-impact map

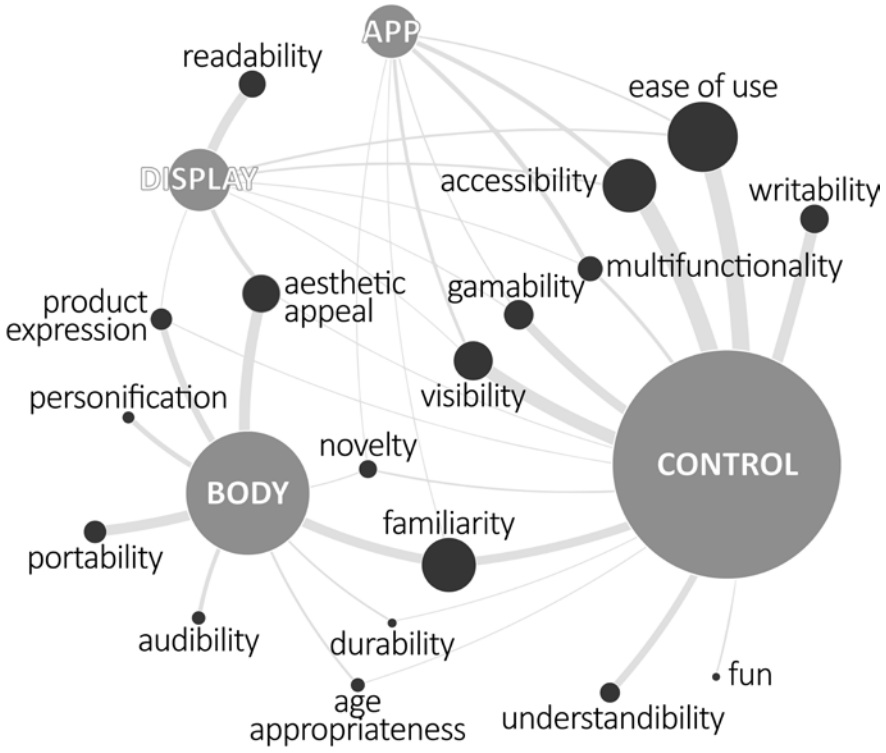

Figure 22. Attribute-dimension map

The frequency of the attributes affecting the dimensions was displayed in a separate attribute-dimension impact matrix (Appendix I), which was utilised to construct an attribute-dimension map (Figure 22). This map shows which product attributes have an impact on different dimensions. For instance, the control features such as type, size and number largely affect the pragmatic dimensions, such as ease of use, accessibility and visibility. A detailed discussion on the interdependency of the dimensions, the impact of product attributes on dimensions, and design implications can be found in Süner & Erbuğ (2016) and Süner (2016).

4.4.2.6 Discussions on the Methodology

The structured, comparative procedure with the use of concrete images was well understood by children. They had a good grasp of the procedure after being probed a few times, and started to elaborate on the constructs without further probing. They were also observed to take initiative in the ranking process; following the ranking of the products for the first few constructs, they began to initiate the ranking for the rest. In terms of the quality of the data, the comparative elicitation proved to be promising too. The interviews generated meaningful patterns of information reflecting children's product-related personal constructs, which could be transferred into multidimensional relational charts and maps, displaying the child-driven perspectives. The methodology posed some limitations as well:

- *Distributed construct elicitation.* The extension of the construct elicitation to ranking phase extended the interview duration and resulted in repetitions, which sometimes caused boredom and distraction on participant's end.
- *Eliciting construct poles.* Eliciting the construct poles was somehow inefficient. Most poles were stated as the opposite (i.e. easy to… / difficult to…) or simply adding "not" in front of the positive construct (i.e. easy to… / not easy to…). For this reason, it was not meaningful to ask for the construct pole in most cases. Hence, the effort was paid more on laddering.
- *Achieving the values level.* As confirmed in the literature, achieving the values level in laddering was also challenging. Insistent probing to ladder up often took to a dead end, since such generic responses as "because I like it this way"

or “because it is nice”. When further probed, children were observed to get uncomfortable perhaps because they feel like they can’t give the “correct” or satisfactory answers.

- *Prioritisation of the constructs.* In order to represent the findings in a hierarchical way, the dimensions were displayed according to the frequency they were mentioned by the participant. However, this is not reliable, as it is possible that children stated some constructs more often simply due to their being more visible or easier to articulate verbally.
- *Lack of contextual information.* Since the goal of this study was the exploration of a certain construct elicitation procedure, the elicited data is based on the “perceived” attributes interpreted by previous experience of children. As explained in Chapter 3, a comprehensive investigation should involve contextual factors raised during actual product use as well.

Overall, the comparative elicitation methodology adapted from RGT and laddering showed potential in capturing design-relevant meaning structures from children. When assessed in the light of these insights, the next study should maintain the strengths stated above while overcoming the limitations. The main study presented in the next chapter aims to improve and enrich this procedure.

4.5 Chapter Conclusions

This chapter focused on the conceptual exploration of how children give meaning to product experiences. Starting the inquiry based on the PCP allowed grounding the methodological investigation on a theoretical frame. Explorative studies stand as evolving “technical” explorations informed from one another, also informed from the theory. These studies helped investigating what kind of information we can elicit from children with different procedures, what the practical challenges are, and illuminated how we can overcome such limitations.

The methodology of the first study was based on a non-comparative, open-ended procedure. The evaluation of the methodology in terms of the generated information and practical challenges pointed to the efficiency of a more structured comparative procedure. The second study was built on these insights, as well as the technical

directions available in the literature. A comparison of the two procedures in terms of operational issues and practical suggestions can be found in (Süner & Erbuğ, 2014a). This methodology of the second study showed significant practical and informational premise compared to the first one, although brought about certain limitations as well.

Both the strengths and limitations of using mobile phones as a product category in the methodological investigation is also assessed based on the relevant dimensions of designers' needs proposed in Töre Yargın's model. The insights are summarised below, and a comparative table with the final study can be found in Appendix J:

- Strengths of the methodology:
    - *Multidimensionality*. Being a product that is favoured both in terms of its technical specifications and its social significance helped exploring both pragmatic and hedonic aspects of meaning.
    - *Multidimensionality*. There are various product alternatives designed specifically for children's use. These are available in the international market but not the local market, hence not familiar to the participants. This provided the opportunity to explore and detect the mismatches between the adult and child perspectives (i.e. reduced function, "child-friendly" form and interface, etc.).
    - *Credibility*. Although the participants were not the owners/holders of mobile phones, being observers or "part-time" users allowed them to be able to reflect on these experiences during interviews.
- Limitations of the methodology:
    - *In-depthness*. Mobile phones support multiple functions, which prevents us from narrowing down the scope and focus on a particular experience. This resulted in the expansion of the comments in a comprehensive way, while limiting the in-depthness of the investigation.
    - *Multidimensionality*. In a potential contextual exploration session, children may potentially focus on the software qualities due to the high number of functions supported by the product, which would shift the scope of the study.

- Practical limitations:
    - *Credibility*. Products designed for children's use are not available in local market. Even if they could be obtained, they would not fully function since they are sold with pre-paid contract that is available only in the sold country, which means no GSM service. This would lead to technical limitations in actual use during a potential contextual exploration session.

In addition to the above assessment of the second study based on the requirements of the design space, mobile phones as a product category bring forth the following practical limitations:

- *Language support.* For the same reasons specified above, there is no Turkish language support. This limitation is valid for most technological products designed for children due to the lack of a significant local market, firms rarely offer Turkish language support.
- *Controversy and bias*. Parents don't want their kids to own phones at this age, which makes it a product of desire for children, marking a "rite of passage". This shows a bias toward full-spectrum phones, which is observed in ranking and interview data.

In the next chapter, the improved construct elicitation methodology combined with contextual exploration will be presented through the case of children's photography experience.

CHAPTER 5

INTEGRATION OF CONCEPTUAL AND CONTEXTUAL MEANING

The final step of the cumulative methodological exploration, which began to be presented in the previous chapter, led to an inquiry of both conceptual and contextual dimensions affecting children's product experiences. For this purpose, a field study was devised in order to elaborate on the potentials of the comparative elicitation technique employed in the second explorative study on children's perceptions of mobile phones, and enrich this conceptual information with data gathered from the context of use. This chapter introduces the field study combining these two aspects of experience with cameras, presents the findings in terms of children's photography-related expectations, priorities and behaviours, discusses implications for design, as well as methodological implications.

5.1 Methodology

The aim of this study is to explore children's experiences with image capturing devices. The methodological and pragmatic reasons to the selection of this product category is presented in a comparative table in Appendix J. To summarize, photography was thought to be a meaningful experience to investigate both conceptually and contextually, hence a suitable inquiry to test the efficiency and effectiveness of the proposed methodological frame. Image capturing devices not only embody interactive features, but also trigger interaction between the user and their social and physical environment. This way, it is expected to enable investigation of both personal and social aspects of the user experience. Since the use of image capturing devices is not technically restricted as in the case of mobile phone use, it can be possible for children to explore the product features to their full extent. Also, the

variety in the market will be helpful to specify diverse elements for a comprehensive exploration.

5.1.1 Participants

Children who took part in the study are first, second and third year primary school students, except one fourth year student who was included in the study since she is within the age limit. At the time of the interview, the youngest participant was 6 years and 6 months old, and the oldest was 9 years and 4 months old. To recruit participants, announcements were sent to e-mail listings of (1) *Çiğdemim Derneği*, an association active in the Çiğdem Neighbourhood of Ankara, and (2) *METU campus housings*, which are inhabited by the university personnel. Together with the respondent parents, the individual interviews were scheduled first, and later they were contacted for the group workshop. A total of 26 children participated in the study. Due to health issues, one child could not attend the group workshops, hence the workshops were completed with 25 children. Table 7 shows the age and gender distribution of the participants.

Table 7. Participants of the study

Age	Male	Female	**TOTAL**
7 years	4	6	**10**
8 years	7	2	**9**
9 years	4	3	**7**
TOTAL	**14**	**11**	**26**

A background questionnaire was administered to one of the parents of the participants in order to understand the sample's daily interaction with technology (Appendix K). Written consent (Appendix M) for participation to the study was obtained from the same parent. The questionnaire included questions regarding the participant's access to and usage patterns of the various technological products, as well as questions asking their photography experience. The parent of one participant could not be reached for the questionnaire, hence 25 parents responded. According to the responses of the parents:

- All participants have access to the internet connection at home.
- All participants have access to tablet computer at home, and all of them are independent users. The frequent reasons for tablet use are: gaming, doing research for homework or using educational applications, taking photographs and videos, and watching videos and cartoons.
- All participants have access to desktop or laptop computers at home. The frequent reasons for their use is similar to tablet computers.
- 11 participants have access to stationary or portable game consoles at home, but not all of them are users. 12 participants have used game consoles before, either at home or elsewhere (i.e. at their friend's).
- 21 participants have access to camera at home. 12 of them have not used a camera before, however 6 of these participants have used smart phone or tablet for taking pictures.
- 12 participants have access to video camera at home, however only 3 of them have used before.
- The frequent contexts in which children have used (or are likely to use) cameras are: holidays, weekend trips (i.e. picnics, museums), special days (i.e. birthdays), and family gatherings.

5.1.2 Materials

Three different cameras were used in the study. The selection criteria was to maintain the diversity of the product line, while still keeping the range relevant to children. One of the three products is specifically designed for children, and the other is promoted as suitable for children. The third camera, although not designed for child-users, is also a compact, point-and-shoot camera (Figure 23). At the workshops, children used these three cameras, whereas during the interviews, real size images of front and back views colour-printed on A4 paper were used.

Vtech Kidizoom is a camera designed specifically for children. It is recommended for children aged between 3 and 8 years old, which encompasses the pre-operational and transition to concrete operational stages in Piagetian terms. It has a playful menu with draft layouts and filters, one front and one back (selfie) camera, game menu, and

parental controls. Technical specifications of the camera are somewhat limited compared to compact cameras, with little to none image quality controls, while the design effort seems to be concentrated on after-photo effects to enhance the 'fun factor' of the user experience, as well as the product language. Vtech is not available in the national market, hence does not have a Turkish menu support. ***Nikon Coolpix S33*** and ***Panasonic DMC-XS1*** are compact, 'point-and-shoot' cameras, which is a term used in photography to refer to the ease of use, but at the expense of limiting the technical capabilities. While Panasonic is intended for adult users, Nikon comes with two built-in menus, one for adults and one for children. One of its marketing slogans is "one camera for all", since it commits to be a family camera that is suitable for the use of all family members. Being waterproof and shockproof are the other aspects that are highlighted in marketing to emphasize the 'child-friendliness' of the product. Both Panasonic and Nikon are available for international the market, and offer Turkish menus.

Figure 23. Cameras used in the study. Left to right: Panasonic DMC-XS1, Vtech Kidizoom, Nikon Coolpix S33

For each interview, an empty grid sheet is used to note down elicited constructs and product rankings. In addition, a Smiley Face Likert Scale is used to rank the constructs according to their level of importance as perceived by the participants (details of the procedure are presented in the next section).

5.1.3 Data Collection Procedure

Data collection procedure consists of two parts: individual interviews and group workshops (Figure 24). In accordance with the goals of the project, first part aims to collect conceptual data on how children give meaning to the attributes of different camera designs, while the second part aims to collect contextual/observational data to gather a holistic understanding of children's photography experience. To make the workshops more appealing to children and parents, the second part was designed as a photography workshop, consisting of a short theoretical course on the basics of photography, which is then complemented with a hands-on photography session.

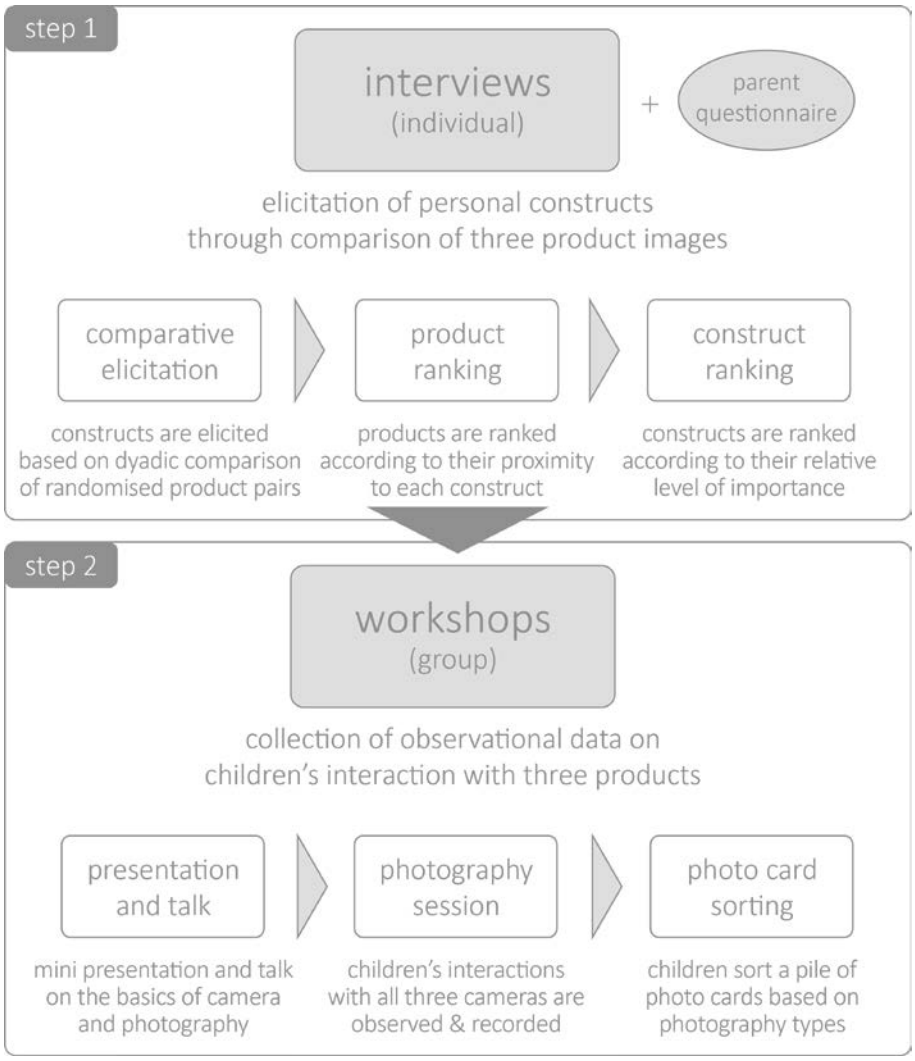

Figure 24. Data collection procedure

This structure was decided upon following a pilot study conducted with two children individually (6 years old male and 7 years old female). In the pilot study, children were first asked to use the cameras, and it was followed by construct elicitation. It was observed that their comments were mostly evaluative and lack of depth, showing bias towards the most liked camera. For this reason, it was decided to move the construct elicitation step before the actual product use phase.

5.1.3.2 Venue

The interviews were conducted at the test room in BİLTİR-UTEST Product Usability Unit in METU Faculty of Architecture, Department of Industrial Design. The presentations of the workshops were held at UTEST meeting room, while the photography sessions took place in and around the faculty building. The faculty is actively used by students, staff and visitors at different times of the day, and the interior architecture and surrounding nature of the building presents various points of attraction, including open exhibitions and social activities. This gives the children the opportunity to experiment with various types of photography taught in the workshop.

5.1.3.2 Individual Interviews

At this first meeting for the interview, the parent accompanying the child to the venue is asked to fill in the "Children's Daily Interaction with Technology" questionnaire (Appendix K) along with the consent form. Verbal consent of the child was obtained after briefing them with the aid of an informative leaflet (Appendix N) describing the aim and procedure of the study, the method of data collection, and how their information will be used. Individual interviews (Figure 25) with children last approximately 20 minutes and consist of three phases: (1) comparative elicitation, (2) product ranking, and (3) construct ranking. In ***construct elicitation*** phase, children are shown dyadic combinations of all three products, asked for similarities/differences and the preferred attribute, which are then further probed to obtain attribute -> consequence chains (e.g.: it has many buttons -> looks sophisticated and valuable -> fragile/needs special protection). These constructs were immediately noted down on the grid sheet (Figure 26). Positive constructs were written on the left pole, and negative constructs

were written on the right pole. For each product pair, children continued to be probed until they could no longer come up with new constructs.

In ***product ranking*** phase, the child was asked to assess each product based on elicited constructs. For example, if the construct is “for kids (+) / for adults (-)”,the child was asked which one of the three cameras is most and least suitable for kids, and their rankings were noted down on the grid sheet. At the same time, the constructs were written on small, separate cards to be used in the next phase. Only the positive (preferred) constructs were written on the cards as desired qualities of a camera, such as “to be able to hold easily” or “being sophisticated”.

Figure 25. A scene from the interview at UTEST test room

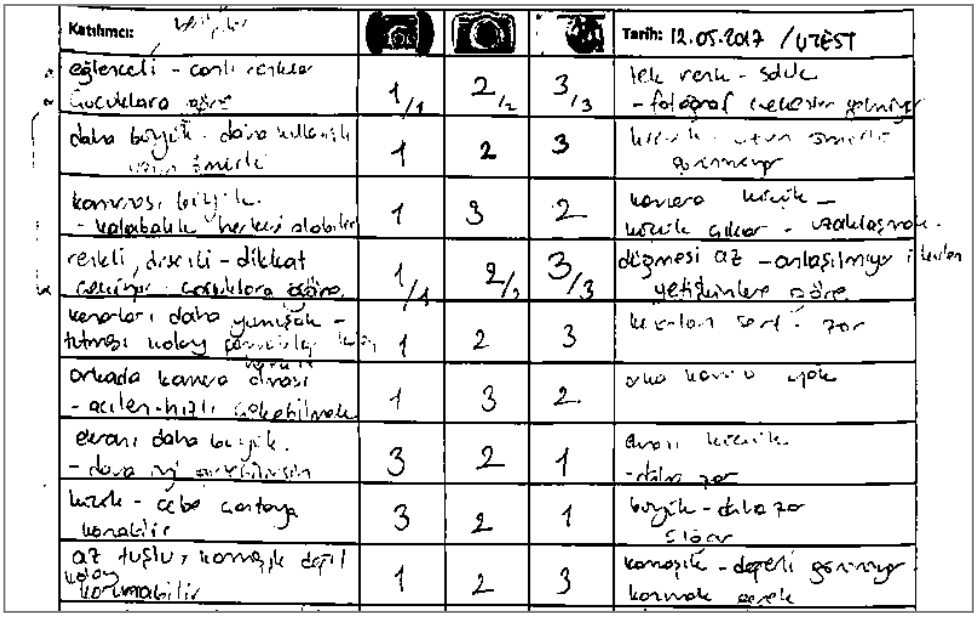

Figure 26. Sample grid sheet filled with elicited constructs and product rankings

Last phase of the interview, namely ***construct ranking***, aims to gather quantitative data regarding the level of importance of each elicited construct (Figure 27). For this purpose, a Smiley Face Likert Scale (SFL) was designed, under which the child was asked to rank the construct cards prepared in the previous phase. SFLs are used in evaluative studies with children to measure dimensions such as overall "fun" or "likeability" of a design (Janet C. Read, 2008; Zaman, Vanden Abeele, & De Grooff, 2013). Although there are no previous work utilising SFLs to measure "importance", the tool proved to be useful in concretising the somewhat abstract concept of rating with numbers when doing research with children. One study (Hall, Hume, & Tazzyman, 2016) suggests that children are prone to give positive ratings rather than negative ones, and scales from "slightly happy" to "very happy" scale endings leads to more evenly distributed ratings. Also, since all the constructs children are asked to rate were stated to be desirable by them, the use of a happy-to-happy scale was found more reasonable. First, the child was briefed that these are the features they mentioned to be desirable for a camera, but it is possible that some of these features are more important for them than the others. Next, they were introduced with the SFL, explaining in two different ways to make sure that they understand what the scale represents. First, it was clarified that one end represents the least important features, and the other, the most important ones. Then, to make it more understandable, it was explained once more: "this one is as important as 1, this one is as important as 2…" They were also told that they are allowed to place more than one feature under any face or leave some of them empty, as long as it reflects how important they find those features.

Figure 27. One participant ranking the construct cards

5.1.3.3 Workshops

The aim of the photography workshop was to recreate a natural setting to allow children to explore different cameras, in order to collect observational data about their product interactions and behaviours. Five workshop groups were organised at METU Faculty of Architecture. The first workshop consisted of seven children. Initially, a two-hour workshop procedure was designed for groups of 6-10 children, during which children would explore the cameras in pairs. The aim for this decision was to facilitate children to use the cameras in turn, hence initiate a dialogue between them to be recorded for further analysis. However, post-workshop investigation of the recorded materials show that pairwise structure did not facilitate dialogue between children, since the ones who were not using the cameras at the time got distracted and bored, which also made it difficult to keep the group together. Another limitation was to be able to find a shared convenient time slot for all the participants of a large group. For these reasons, the workshop procedure was modified to keep the group size smaller (3 to 5 children) so that children could take pictures all at the same time.

The workshops began with a 20-30 minutes presentation at the meeting room on the basics of photography, followed by a 45 minutes photography session in and around the faculty, during which each child had approximately 15 minutes to use each camera. After the photography session, the group went back to the meeting room and children were given one final task to sort a pile of photo cards into four different photography types they were taught in the presentation and explored in the photography session. The whole procedure was concluded in around 1.5 hours. The presentation and the photo sorting activity were included in the workshop only to make it more appealing for the participants by giving back something in exchange of their time to participate in the study.

The presentation phase was planned as a guided discussion, aiming to bring forth what children already know about photography, as well as to build on it (Figure 28). The first part of the presentation covered how a camera works to make it more transparent for children. This segment focused on the components of a digital camera, such as lens, flash, viewfinder, screen, buttons, memory and batteries. Second part aimed to provide

an introductory background to improve the quality of children's photography. This included camera holding and body posture tips, reverse light, framing and composition. Finally, children were introduced four different types of photography: portrait, texture, nature and architecture. These photography types are chosen due to the availability of such attraction points around the workshop venue. Finally, to provide a flexible structure to the photography session, children were encouraged to try at least three samples of each photography type. After the photography session, children were asked to sort a pile of photo cards based on taught photography types to reinforce what they learned (Figure 29).

Figure 28. Presentation at the photography workshop

Figure 29. Children sorting the photo cards based on photography type

Figure 30. The “wizard hat” with action camera attached on the front

Figure 31. Group interaction during photography session

For the photography sessions, asynchronous observation strategy was adopted to collect contextual data unobtrusively. Children's interactions with cameras during photography sessions were video recorded with action cameras for further analysis. To make the action camera less conspicuous through a game-like experience, "wizard hats" were designed to attach the camera in front. Children were explained that this wizard hat can see and record everything as children themselves see it with their eyes (Figure 30). Although children were fully aware of the existence and function of the cameras, they embraced the story and played along. Each child put on one hat throughout the photography session, so that both physical interaction with all three cameras and their verbal comments and conversations could be recorded (Figure 31).

5.2 Analysis

Recordings of the individual interviews and workshop sessions were transcribed into separate spreadsheets, and content analysis (Krippendorff, 2004) was applied by open coding the statements and moments to define construct and behavioural categories. The analysis procedure for the interviews and observations will be presented separately.

5.2.1 Interviews

A total of 9 hours of voice recording was collected from the individual interviews. The analysis was conducted as follows:

- The voice recordings were transcribed in a spreadsheet and content analysis was applied by open coding the constructs children mentioned based on product attributes (Appendix O).
- Then, these constructs were thematically categorised to define the dimensions as perceived by children.
- The construct rating data was also transferred to a separate spreadsheet matching the constructs under each dimension.

5.2.2 Observations

From the workshops, around 14 hours of video footage was collected. For the photography sessions, the videos were coded by noting and describing both individual interactions with the camera, and the moments when the camera initiates social interaction (e.g. exploration of the menu, laughter, sharing). Sample coding can be examined in Appendix P.

5.3 Findings

In this section, the findings of the interviews and observations will be presented separately, and the emerging dimensions will be discussed. After, differences/diversity among the sample will be investigated based on the findings.

5.3.1 Children's Construction of Cameras

A total of 215 constructs were elicited from the children. When the repeating constructs from a single participant were omitted, 203 constructs remained. The analysis of these constructs resulted in 15 different dimensions, as presented in Table 8.

Table 8. Dimensions elicited from interviews

Pragmatic dimensions	Hedonic dimensions
Age appropriateness*	Aesthetic appeal
Durability	Age appropriateness*
Ease of holding	Familiarity*
Familiarity*	Fun
Ease of use	Product expression
Multifunctionality	Salience
Photography performance	
Portability	
Screen visibility	
Understandability	
Usefulness	

**These dimensions show both pragmatic and hedonic characteristics*

5.3.1.1 Expectations

Since only the positive constructs were included in the data, the emerging dimensions from these constructs also reflect the expectations of the participants from cameras.

For each dimension, attribute-consequence maps were constructed, which link the product features to the attributed consequences as elicited by the participants. These maps can be found in Appendix Q.

Aesthetic appeal (23/26 participants) refers to what children find visually pleasant and appealing. Judgement of aesthetic appeal is strongly connected to personal taste, hence there is no visible consensus among the sample about what makes the product "look good". Nevertheless, there seems to be a dichotomy of *simplicity* vs. *flamboyance*. Some children prefer monochrome colour and simplistic form for the sake of modesty, whereas others favour colour and significance, which makes the product's presence felt. Aesthetic appeal is dominantly associated with the use of colour and colour combination, as well as overall product form.

Age appropriateness (8/26 participants) is the term coined to describe children's distinctions regarding for whom the product is supposedly suitable. This term is a direct reflection of the genuine assessments of children for the products to be "*suitable for kids*", "*for adults*", and "*for babies*". Such judgements imply that children identify with a certain self-image through associations regarding the product language. Therefore, it is not only about how they perceive themselves, but also how they want to be perceived by the others. For some children, monochrome body colour and having many buttons is favoured as a sign of the product to be more adult-like. For others, resembling a gaming product due to familiar body form or controls makes it understandable and easy to use, hence suitable for kids. Ease of holding on account of small size, as well as fun and salient outlook due to colourfulness are the other aspects children associate with child-friendliness, which are found childish by the participants who favour an adult-like product language.

As the name suggests, the constructs categorised under ***durability*** (6/26 participants) refer to the resilience of the camera to damage, and maintainability. Durability is mainly connected to the use of material. In terms of body form, roundish edges were interpreted to be less fragile compared to the sharp edges. Interestingly, for some children, the size of the camera affects their impression of product longevity, as bigger forms were interpreted as longer-lasting and more durable.

Ease of holding (17/26 participants) describes the constructs related to perceived ease and comfort in holding the camera. Some of these constructs emerged from the resemblance of the form to other products that the participants are familiar with, namely smart phone and video game controller. Additionally, extended corners, material and texture for better grip, small size, as well as curvy or rectangular forms are the product attributes which children linked with ease in holding the camera. Ease of holding is occasionally associated with ease of use, as the better the grip, the easier the finger movements to reach out to the controls will be.

Ease of use (19/26 participants) is the dimension which defines the perceived ease, comfort and practicality of the interaction with the product interface. Accessibility, familiarity and understandability of the buttons are the most important attributes which affect ease of use. Accessibility of the buttons refers to both physical accessibility of the controls, and legibility and understandability of the control icons. Visibility of certain controls (turn on/off, selfie camera) are also the factors that children think have impact on ease of use.

Familiarity (6/26 participants) defines the extent to which the camera resembles products or interfaces known from past experience. Familiarity is an active dimension, having a significant impact on other dimensions such as product expression, understandability of the interface, and ease of use. For example, familiar control icons seen in phones, computers and games are perceived to lead to understandability and ease of use. Or, resemblance of the product language to a smart phone is interpreted as "new technology".

Fun (4/26 participants) is judged by the product language and the number of applications/skills embodied in the product. Colourful body and unusual curvy form is interpreted as fun. Also, large number of buttons is associated with multifunctionality, which is also seen as entertaining for a camera.

Multifunctionality (4/26 participants) is described by the participants as the multitude of applications and skills offered by the camera. Often associated with the large number of buttons, multifunctionality gives the product the impression of being high quality, advanced, and fun. In another occasion, the resemblance of the product

language to a tablet PC due to familiarity of the control icons is also interpreted as the embodiment of many functions.

Photography performance (13/26 participants) is a concern expressed in different constructs, by half of the participants. As the term implies, this dimension is related to the satisfactory operation of the camera, which positively affects the photography output. As in durability, some children build a direct relationship between the size and the quality. For instance, bigger lens or screen is interpreted as the sign to take bigger, clearer and wide-angle pictures. In some occasions, the useful functions of the camera, such as being waterproof or conspicuous zoom in/out controls or a selfie camera, are thought to have impact on the photography performance.

Portability (5/26 participants) refers to the ease and comfort in carrying the camera around. Smaller size, as well as neck straps are found favourable attributes that impact the portability of the camera.

Product expression (17/26 participants) stems from the associative judgements made by the participants based on product language, comparative to the 'world of cameras'. Hence, these constructs reflect children's expectations of how a camera should look. The judgement can come from un/familiarity of the form, colour or controls. The more the product is perceived to be realistic, high-tech and contemporary, the more it resembles a camera. On the other hand, the features that are judged to be imaginary, comical and salient makes the product rather toy-like, a quality also favoured by a number of children.

Salience (10/26 participants), like product expression, is closely linked with the expectations of the participants from product language. It describes the constructs related to attracting attention by standing out among others. Eccentricity of the form and colour, as well as unfamiliarity of the controls, are some of the attributes that draw attention.

Screen visibility (7/26 participants) is exactly what the name suggests; the extent to which the screen is legible to the eye. In this sense, screen visibility is strongly

associated with the screen size and position. The bigger the screen, the better one can see the display of the preview or the picture taken.

Understandability (15/26 participants) is the dimension under which the constructs judging the clarity and comprehensibleness of the interface have been grouped. Almost always linked with control features, constructs related to understandability are about knowing, easily learning and not forgetting how to control the functions without leading to any confusion. Understandability of the interface is also linked to error prevention and child-friendliness.

Usefulness (11/26 participants) is related to the product's embodiment of the specific functions that are found useful by the children. These functions include speakers, zoom in-out buttons, selfie camera and being waterproof. Zoom function is also attached to photography performance and product expression, as it is interpreted as advanced and of high quality.

5.3.1.2 Priorities

Frequency of each dimension determined by the number of participants mentioned, and the average importance rate from the construct ranking were used as two dimensions to generate a frequency-importance matrix ( ). Although the sample is not large enough to make generalisations, it is possible to make the following inferences:

- Some pragmatic dimensions, although not expressed by many participants, are highly valued. These include *screen visibility*, *durability*, and *multifunctionality*. Similarly, f*un*, which is a dimension associated with features such as product language and multifunctionality, is expressed only a few participants. Nevertheless, it seems to have more than average importance for those who mentioned this construct.

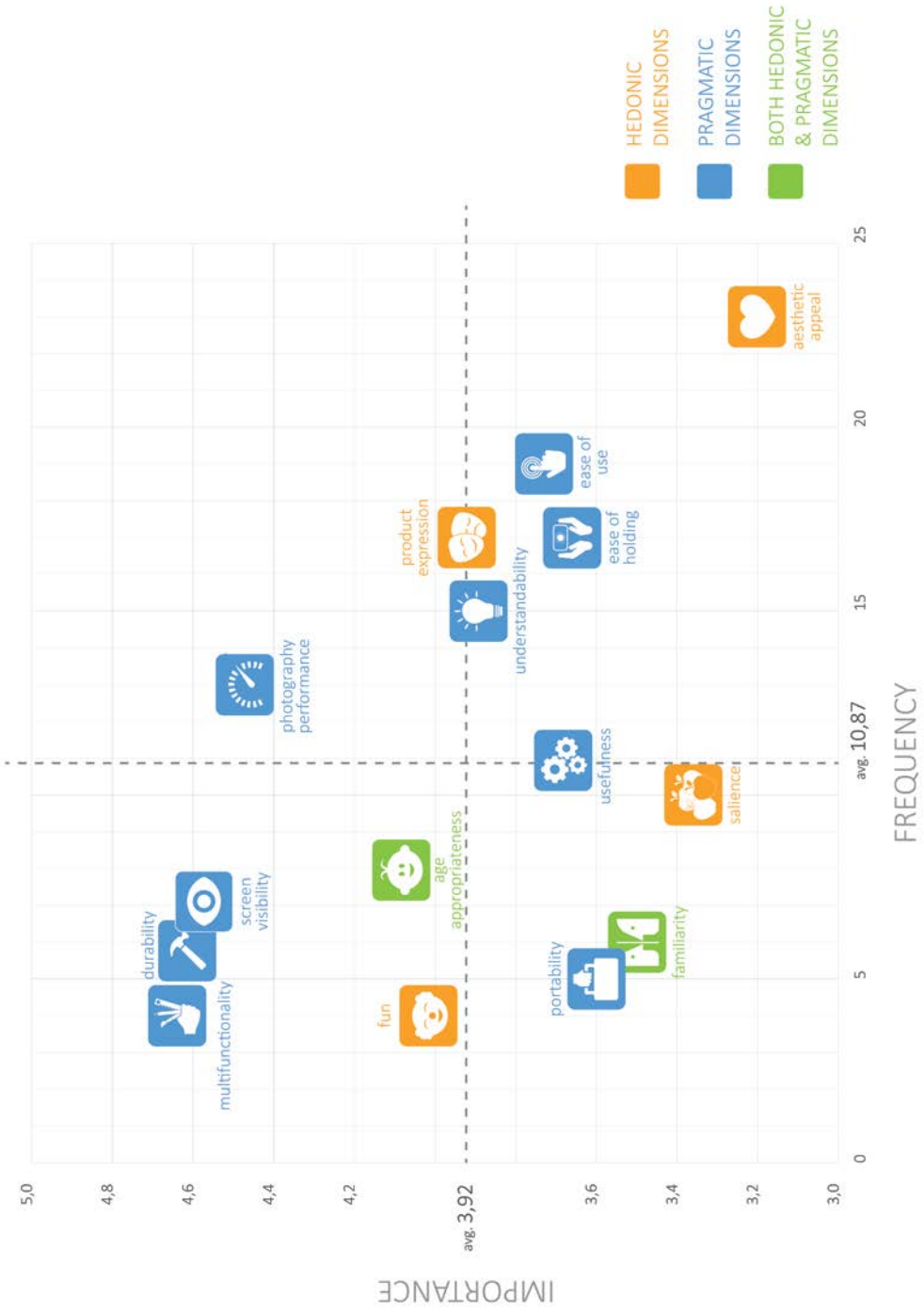

Figure 32. Frequency-importance matrix

- *Aesthetic appeal* is the most frequently mentioned dimension, but it is rated as the least important one. Similarly, *salience* of the product language is rated relatively low, coming second least important dimension after aesthetic appeal. This shows that aesthetic qualities and attention-drawing features of the product form are, as expected, quite obvious to children. However, this not necessarily points out to a critical expectation children would have from these products as designers would think, which is apparent in their conscious efforts to design products visually appealing to children.
- Compared to the other constructs related to visual language, *product expression* seems to have more importance for the participants. The constructs under this dimension include the two ends of the continuum representing the level of "camera-likeness", and impressions communicated by the product such as high-quality, high-tech and advanced. Apparently, such expressive qualities matter more for children than aesthetic appeal based on personal taste, or the extent to which the product draws attention and stands out among others.
- *Portability* and *familiarity* do not seem to have critical importance. However, although familiarity itself is not a critical dimension, the constructs that are seen as a consequence of the familiar attributes matter relatively more. For example, familiarity of the button control interface and the icons are associated with understandability, which is also connected to ease of use. In this sense, the fact that the control interface of the camera resembles the mapping of a game controller, or the button icons are familiar from mobile apps, is not alone an important aspect. What is relatively more important is that it leads to better understandability and ease of use in controlling the camera.
- It is possible to see from the frequency-importance matrix that there is a group of dimensions frequently mentioned, and moderately rated for importance, namely *understandability*, *ease of use* and *ease of holding*. Understandability contributes to ease of use in a cognitive level, whereas ease of holding affects the ease and comfort in the physical accessibility of the buttons. These interrelated pragmatic measures show that children possess a general concern in terms of the usability of the camera.

- *Photography performance* proves to be a key dimension. It is described by the constructs related to the aspects which improve the photography output, such as taking bigger and clearer pictures, and wide angle lens to frame a crowd. This is an interesting insight, considering the fact that quality of the photography is usually ignored in cameras designed for children.
- *Age appropriateness* also has more than average importance for the participants. This means it matters for children that the self-image they associate themselves with is reflected and communicated by the product.

These are some of the insights that can be drawn based on the frequency-importance matrix. To have a better comprehension, it is crucial to deepen and enrich them by having a closer look at how children construct these dimensions. These constructions can not only differ from adult/designer constructions of the same dimensions, but also different perspectives can be found for each dimension, as favoured attributes may also change from one child to another. The level of the diversity of the perspectives for each dimension may not be the same. For example, dimensions encompassing child-user constructs related to usability issues show greater consensus in terms of the perceived meanings certain product features possess. On the other hand, it is clearer to observe personal orientations and preferences for other dimensions, such as age appropriateness, aesthetic appeal, product expression, and so on. A more comprehensive discussion on the representation of diverse perspectives can be found in Section 5.4.1.

5.3.1.3 Age-Based Differences in Constructions

An investigation of age-based differences in the constructions of children may have implications for design, as well as insights for the application of the methodology. For this purpose, the elicited constructs and categorised dimensions were grouped based on age groups to search for differences, if there exists any. Possible changes in the frequency, importance and diversity of the constructs could be looked for, so the data was investigated to answer the following questions:

- Does the average number of constructs per child change with age?
- Does the average number of diverse constructs per child change with age?

- Is there a difference between the pragmatic-hedonic concerns based on age, in terms of frequency and attributed importance?

First of all, the sample was divided into three groups based on age (Group 1=6,5 to 7,5 years old, Group 2=7,5 to 8,5 years old, Group 3=8,5 to 9,5 years old). After, to answer the above questions, the total 203 constructs were treated accordingly:

- All constructs were separated according to the age groups.
    - For each group, average number of elicited construct were calculated.
    - To calculate the construct diversity, the following strategy was applied: for each participant, categorised dimensions were checked for each construct, and the repetitions were removed. For example, if one participant expressed more than one construct which were categorised as “ease of use”, it was counted as one. In other words, for each participant, it was defined how many of the 15 dimensions were expressed by them.
- All 203 constructs divided into age groups were also sub-grouped into hedonic and pragmatic dimensions.
    - For each age group, the total numbers of hedonic and pragmatic constructs were calculated.
    - For each age group, average importance of pragmatic and hedonic constructs as rated by the participants were calculated.
    - The dimensions which show both hedonic and pragmatic characteristics (familiarity and age appropriateness) were individually checked and coded in accordance with the participant statements, and distributed into the relevant category (hedonic *or* pragmatic).

The results are presented in two separate tables. Table 9 shows the average number of constructs and dimensions per child, as well as minimum-maximum numbers of constructs and dimensions elicited from one participant, all divided into age groups. Table 10 includes the figures of frequency, percentage and importance rates for hedonic and pragmatic constructs, separated for age groups.

Table 9. Age-based differences in construct and dimension figures

Age	Number of constructs		Number of dimensions	
	Avg	Mn-mx	Avg	Mn-mx
Group-1 (6,5-7,5 yrs)	7,30	4-16	5,50	3-9
Group-2 (7,5-8,5 yrs)	7,89	5-14	5,56	4-10
Group-3 (8,5-9,5 yrs)	10,14	4-16	8,00	4-11
ALL	8,26	4-16	6,19	3-11

As seen in Table 9, the average number of constructs is 8,26, and the average number of dimensions is 6,19 per participant. The minimum number of constructs elicited from a single participant is 4, and the maximum number is 16. In terms of diversity, the minimum number of dimensions mentioned by a single participant is 3, and the maximum number is 11. Min-max figures do not show significant differences based on age. However, when the average numbers are compared, it appears that older children could express higher numbers of constructs and dimensions. An average of 7,3 constructs from Group-1, 7,89 constructs from Group-2, and 10,14 constructs from Group-3 were elicited. A similar change can be observed in diversity as well. Group-1 and Group-2 expressed 5,5 and 5,56 dimensions in average, whereas Group-3 mentioned 8 different dimensions per person.

Table 10. Age-based differences in hedonic and pragmatic construct figures

Age	Frequency (#)		Percentage (%)		Importance (x/5)	
	H	P	H	P	H	P
Group-1 (6,5-7,5 yrs)	27	41	39,71	60,29	3,11	4,22
Group-2 (7,5-8,5 yrs)	27	40	40,30	59,70	3,69	4,03
Group-3 (8,5-9,5 yrs)	26	42	38,24	61,76	3,38	3,68
ALL	80	123	39,41	60,59	3,39	3,98

The difference between the pragmatic and hedonic concerns based on age are shown in Table 10. Generally, pragmatic concerns are seen to have been mentioned and valued more than the hedonic concerns, as the frequency, percentage and importance values for whole sample shows. In terms of the age-based differences, Table 10 shows

close figures for the frequency and percentage for both hedonic and pragmatic constructs. However, there are differences in the attributed importance to the hedonic and pragmatic constructs for different age groups. For Group-2, hedonic concerns matter more (3,69/5) than Group-1 (3,11/5) and Group-3 (3,38). Also, it appears that younger children give more importance to pragmatic concerns. Group-1 and Group-2 rated the importance of pragmatic constructs relatively higher (4,22/5, 4,03/5) than Group-3 (3,68/5).

5.3.2 Children's Behaviours in Camera Use

The content analysis of the observation material revealed several dimensions regarding the camera use of children (Table 11). These dimensions are grouped into three categories and will be presented accordingly.

Table 11. Dimensions elicited from observations

Pragmatic behaviours and concerns	Hedonic behaviours and concerns	Differences in interaction and approach
Accessibility	Exploration*	Interaction with the camera
Feedback	Photography quality	Approach to photography
Camera hold	Over-zoom	
Shake	Laughter	
Touch	Share	
Exploration*		

**Shows both pragmatic and hedonic characteristics*

The emerging dimensions and how they are related to each other with brief explanations are presented in Figure 33. In the following sections, these dimensions will be presented in detail. To be able to convey them accurately by preserving the richness of the observation material, mini scenarios will be used to explain each dimension and their interrelations. These scenarios were constructed based on real instances from the workshops. For efficient communication, some of these instances were combined to communicate patterns of behaviours. Hence, they are not untouched recreations of the video excerpts, and pseudonyms were used to retain anonymity of the participants.

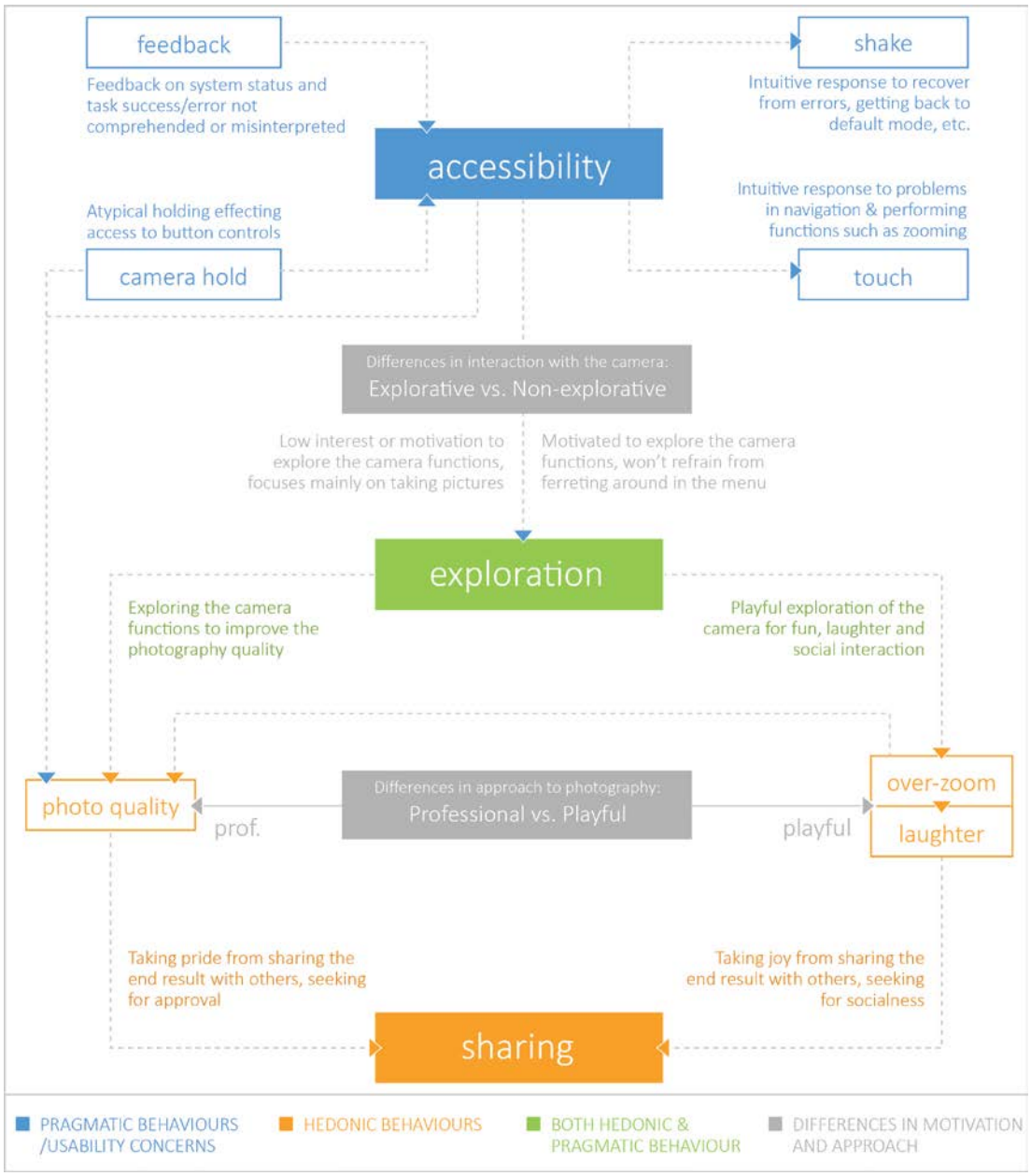

Figure 33. Behavioural dimensions of camera use

5.3.2.1 Pragmatic Behaviours and Concerns

The core of the pragmatic behaviours observed are related to the immediate usability issues in the camera interface. Since usability assessment was not a central topic of inquiry within this work, these dimensions will be only briefly explained. A comprehensive summary of the problems and recommendations based on Nielsen's usability heuristics can be found in Appendix R.

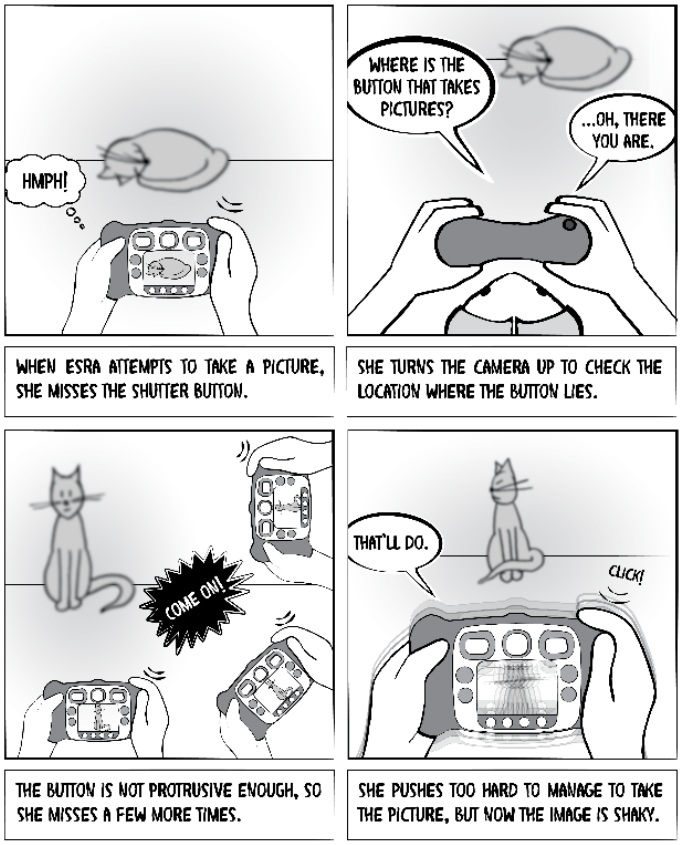

Figure 34. Sample scenario for problems with camera hold

Camera hold is an issue affecting both the accessibility of the buttons, and photography quality. For example, atypical holding causes stabilisation problems, which results in shaky pictures. Also, the grasping of the camera sometimes leaves the shutter button out of reach. When the shutter button is not visible and conspicuous enough, it also adds to the accessibility problems. Another issue observed was that children, due to their being shorter than adults, frequently need to raise their arms to capture the desired frame, which makes the shutter button all the more inaccessible (Figure 34).

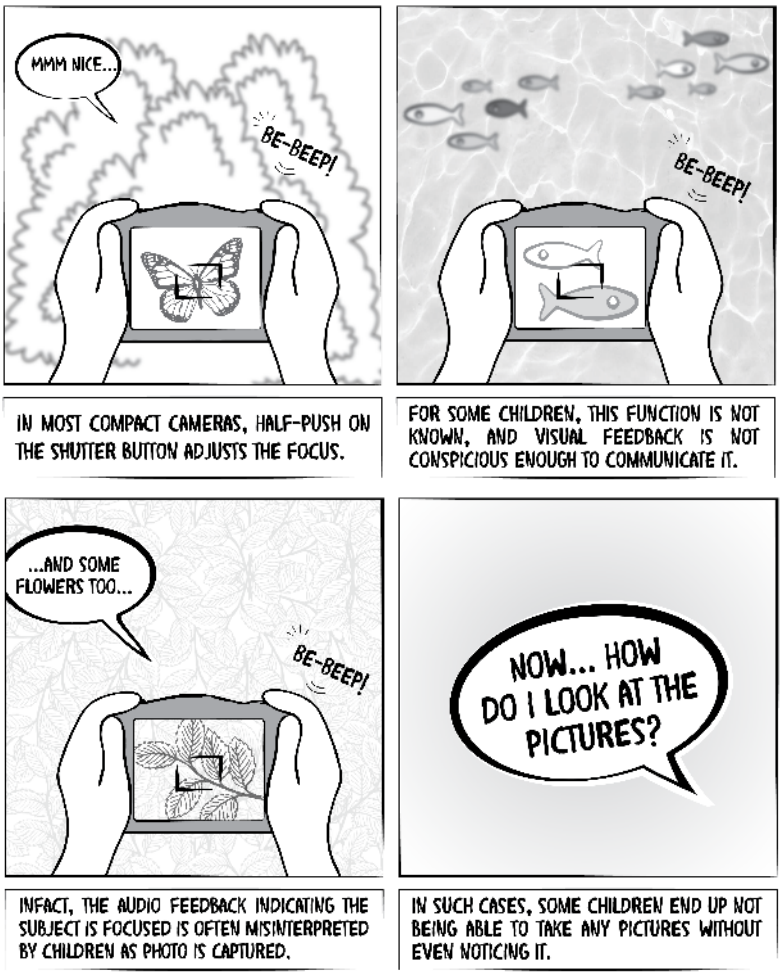

Figure 35. Sample scenario for 'false' feedback

Insufficient ***feedback*** on the system status and task error was commonly observed during the sessions. In many compact cameras, soft push on the shutter button focuses on the subject that is desired to be captured, whereas full push captures the image. In several cases, children's push on the shutter button was not strong enough to take the picture (probably due to limited fine motor skills), and the audio-visual feedback indicating that the subject is focused was sometimes mistaken by children for the feedback for successfully taken picture. From the child-user's perspective, this situation can be named as *false feedback*, as the feedback is received by the user, but falsely interpreted. Although some children eventually noticed the problem, others ended up with taking just a few pictures by the end of the session, and some even none at all (Figure 35).

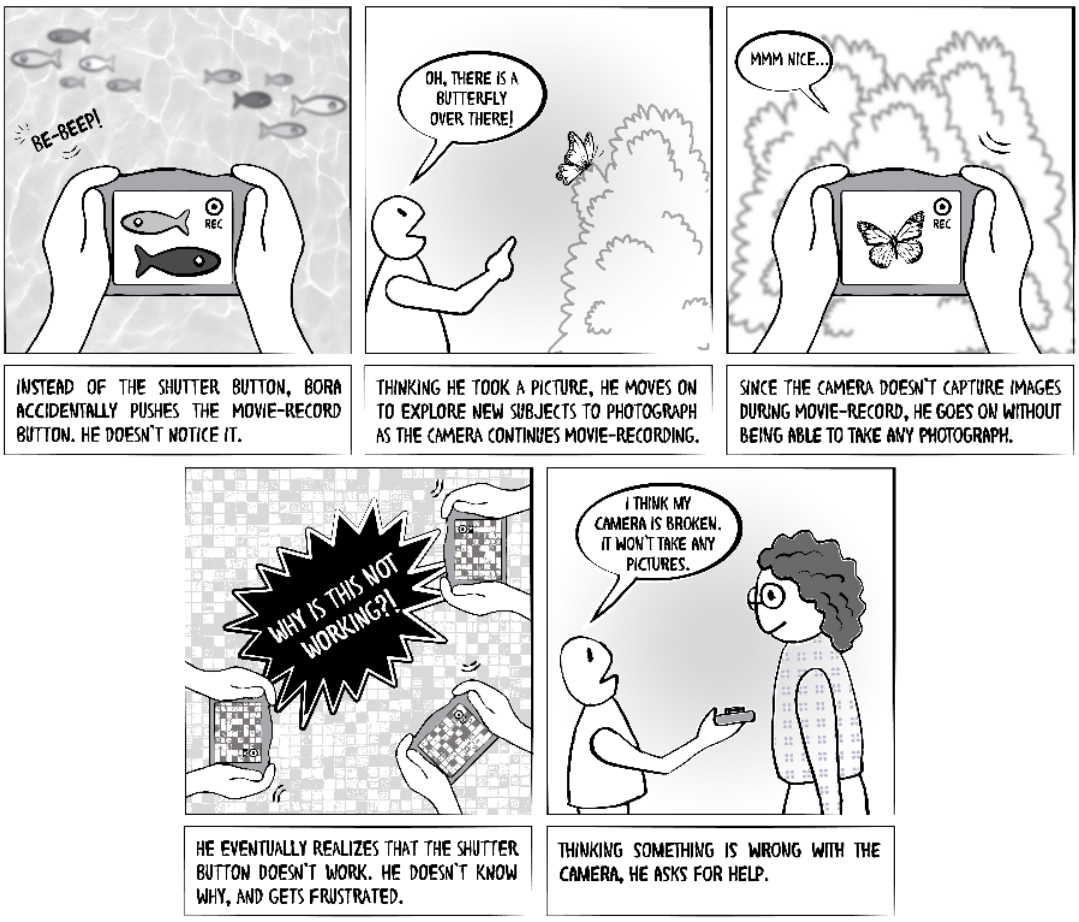

Figure 36. Sample scenario for feedback on the system status

Another commonly observed feedback issue was on *indicating the system status*. There were multiple instances when children accidentally started video capturing by pushing the movie record button instead of the shutter button. As the system was not successful in informing the child about the current status, which is the video mode, they continued trying to take pictures. Some children noticed the problem after a while and recovered by pushing the movie record button once again to exit from the movie mode, or accidentally pushed the movie record button again for the purpose of taking a picture and exited. On the other hand, few could not understand what the problem is, and asked for help (Figure 36).

Most commonly observed problem was the poor ***accessibility*** of the menu and the buttons. All three cameras used in the study offer traditional interfaces, mapping button clicks to the graphical user interface. This mapping was comprehensible for almost

none of the participants, though in varying degrees. A few children seemed to have previous knowledge regarding certain controls with a familiarity with the icons indication the function, such as zooming or accessing the photo gallery to browse the previously taken pictures. However, navigation through the menu was observed to be quite challenging for almost all of the participants, as they were often seen to get lost when trying to access a particular function, and ask for help.

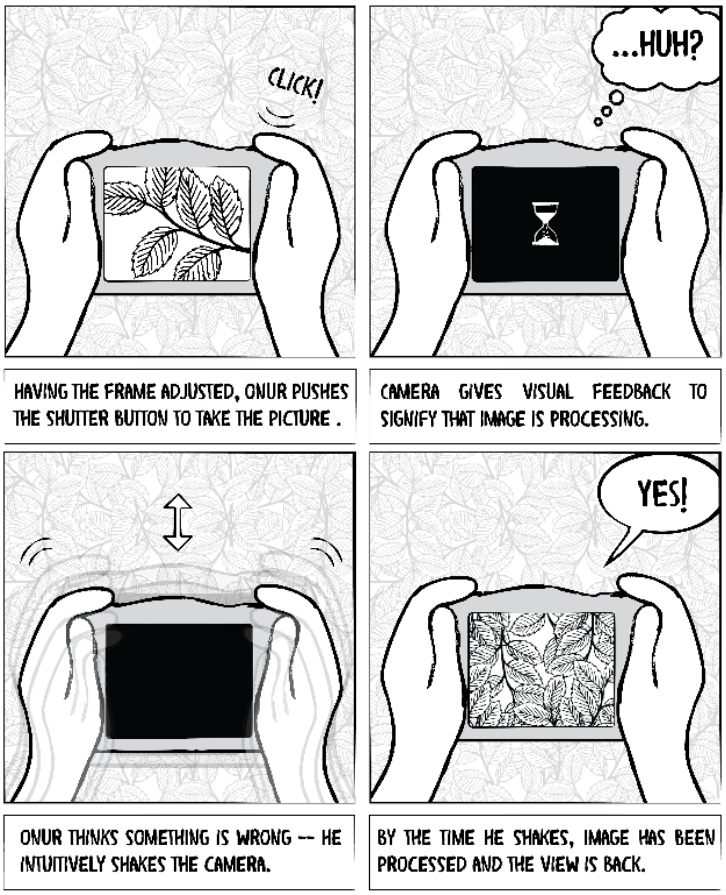

Figure 37. Sample scenario for shaking gesture to go back to image capturing mode

Problems with the accessibility of the buttons are partly exemplified in Figure 34, Figure 35 and Figure 36. What is more interesting is the intuitive responses of children to such accessibility problems. One behaviour observed in most of the participants was ***shaking*** the camera. Children were observed to shake the camera in an attempt to recover from an unexpected situation, and go back to the default image capturing mode. For example, in some occasions the feedback for image processing after the photo was captured was misunderstood as an error for the child, and their response

was to shake the camera to *go back to the image capturing mode*. In the meanwhile, the mode is restored, and the child thinks shaking the camera works (Figure 37).

Children were also observed to shake the camera when they wanted to *fix an image focusing problem*, and *avoid or undo an unwanted situation* (Figure 38). Shaking behaviour indicates that children are impatient when they face a problem, and expect an instant solution or exit. This way, shaking behaviour could be interpreted as a potential *shortcut* to avoid several steps to recover from the error or the unwanted situation, and go back to the perceived default mode (Figure 39). This behaviour matches with the usability issues for children's websites described by Nielsen (2010). He states that children have lower willingness to wait, and expect instant gratification. Younger children were observed to avoid using "back" buttons, and finds multiple/redundant navigation very confusing. Additionally, he reports that younger children rely on bookmarks rather than searching, which can be interpreted as the importance of providing visibility and shortcuts in the interfaces designed for children.

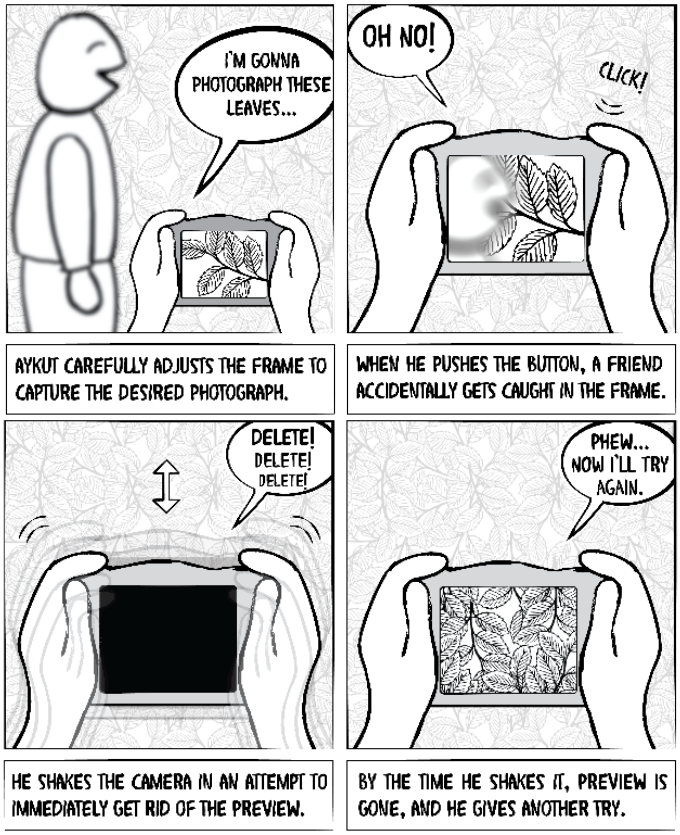

Figure 38. Sample scenario for shaking gesture to undo an unwanted situation

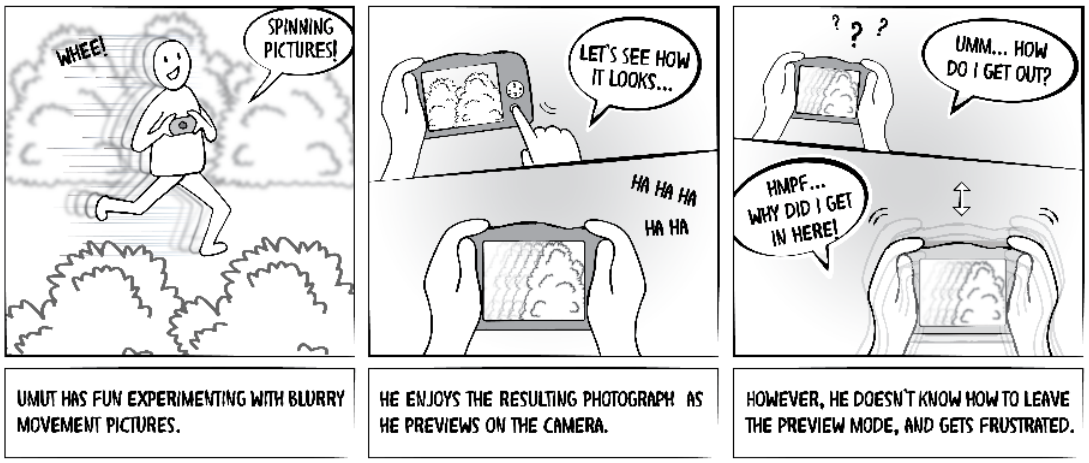

Figure 39. Sample scenario for shaking as shortcut

Another commonly observed intuitive response to accessibility problems was to try ***touch screen control***, even though it was not an interaction modality offered by any of the cameras children used during the sessions. This behaviour was usually observed in difficulties in *navigation through the menu*, and *performing zooming function*. As illustrated in Figure 40, the first attempt of children to access a certain function in the menu was through touching the screen and waiting for a response. When they do not get the response they were expecting, they try pushing a button. However, they are quick to go back to touch screen interaction, even though they tried before and did not get any response. This was observed many times, when children insistently wanted to explore the menu by touching the items on the menu interface.

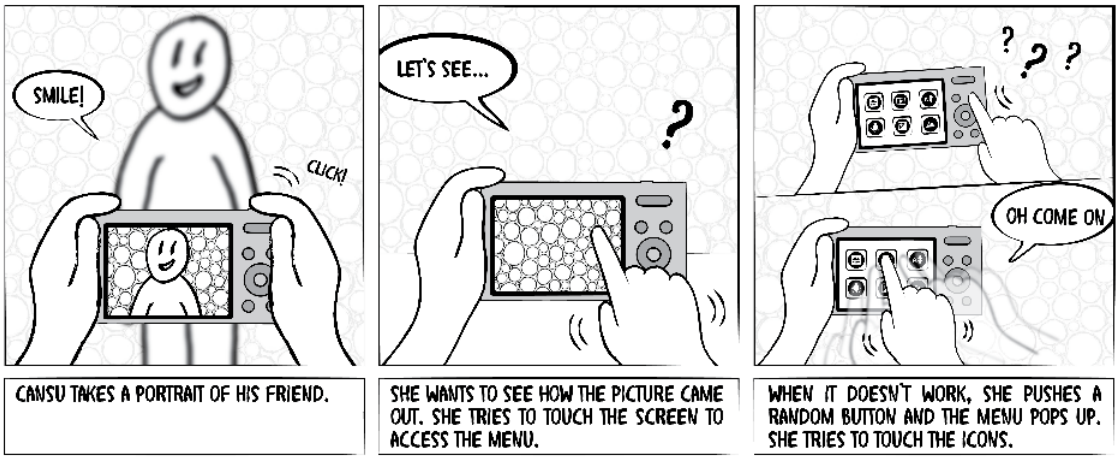

Figure 40. Sample scenario for touch screen control for menu navigation

Similar to the menu navigation, *trying to zoom in and out* of the frame with spread gesture of the movements was also common to the sample. In some occasions, even though children learned to access this function through the buttons, they continually attempted to touch the screen the next time they wanted to zoom (Figure 41). This persistent behaviour shows that children are following the conventions they are used to from other familiar technologies. The responses of the parents to the "Children's Daily Interaction with Technology" questionnaire show that all of the participants have access to smart phones and tablet computers in the household, and children are active users of these technologies for gaming, photography or media consumption purposes. Although the sample is not large enough to make general assumptions, it is possible to say that children who are lucky enough to have been born in a technology-immersive environment have been largely affected by the changes in the interaction paradigm. Hence, the norms and conventions for younger users can be different than that off adults, as gestural interaction comes quite natural for them having been immersed in this environment.

Figure 41. Sample scenario for touch screen control for zoom

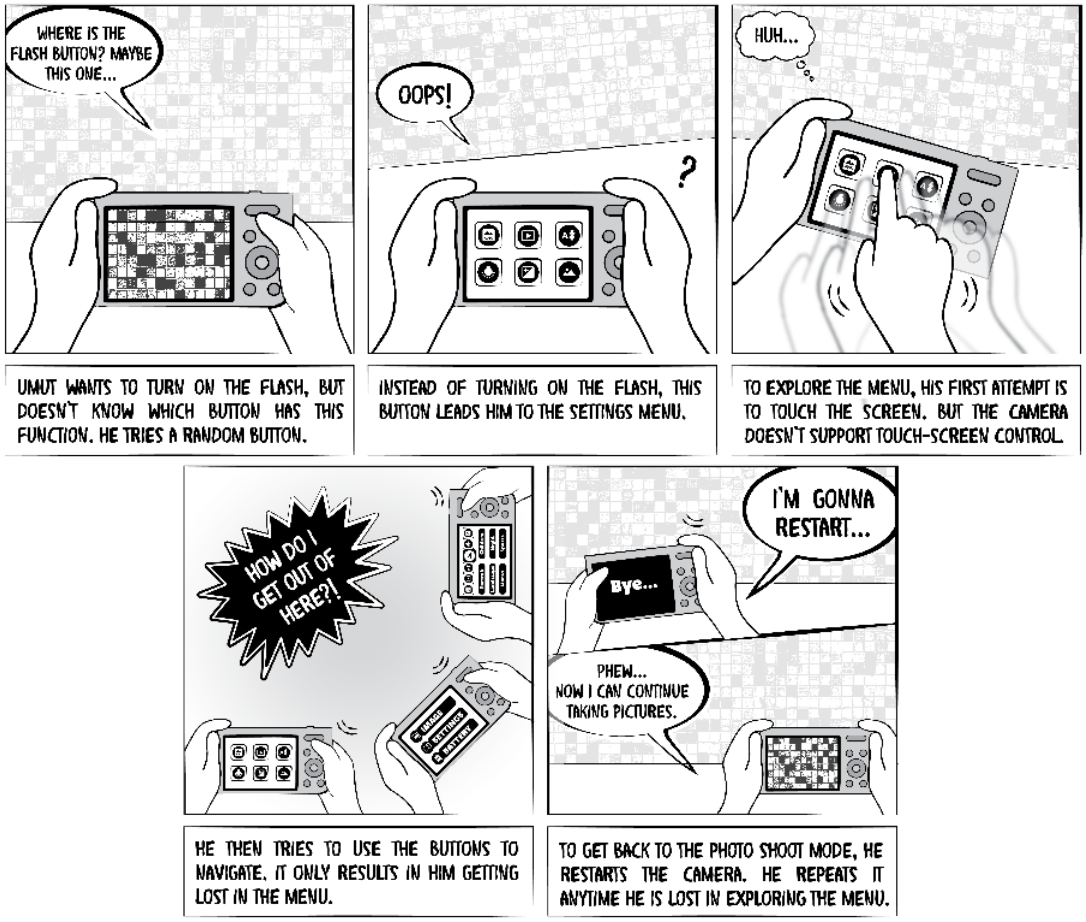

Figure 42. Sample scenario for restarting the camera as a shortcut

Exploration behaviour is connected to both pragmatic and hedonic concerns. Accessibility issues have a significant impact on the level and the efficiency of exploring the camera functions. One commonly observed situation is that exploring activities were often interrupted when children were lost in the menu, or sometimes did not even start exploring because they did not know where to begin. In several cases, children asked for help on where to find certain functions. The functions most commonly asked and used are: *on/off*, *shutter*, *zoom*, *picture gallery*, and *flash*. Although they all have designated buttons, they were not conspicuous or understandable enough for children to use and learn. When it comes to recovering from getting lost in the menu, asking for help served as a 'shortcut' for most children. In one case, the participant found the solution in restarting the camera every time they did not know how to go back (Figure 42). This was an interesting case, as after discovering this "recovery shortcut", they were observed to be more courageous for

browsing the menu and checking out different functions. This suggests that a comprehensible “emergency exit”, perhaps in the form of an intuitive gesture such as the shaking behaviour that children perform naturally, can increase the level of interaction with the camera and allow children to make the most of the functions of the product.

5.3.2.2 Hedonic Behaviours and Concerns

Hedonic behaviours differ from pragmatic ones in the sense that they are related to the *motivations* to, and *satisfaction* obtained from using the product. ***Exploration*** behaviour is affected by the pragmatic aspects, but it is also a way of getting joy from product use. Two different exploration behaviours were observed in the sessions: exploration to improve the quality of the photography, and for amusement.

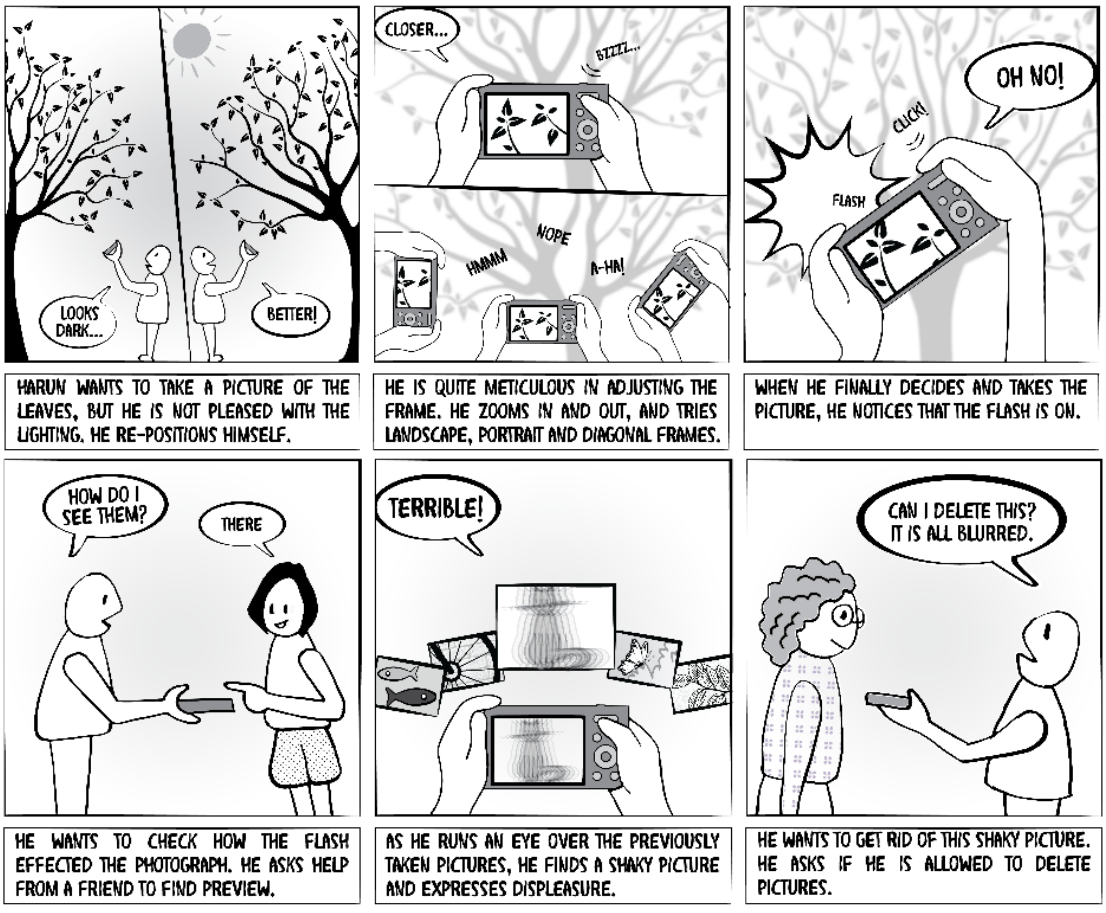

Figure 43. Sample scenario for concerns of photography quality

Photo quality should not be mistaken for a pragmatic concern. It refers to the behaviours which are motivated by the satisfaction coming from taking "good" pictures. These include seeking of the functions, as well as behaviours which have an impact on the photography output. Such attempts should not be compared to professional photography performed by adult users; but instead seen as an observable effort and sensitivity to improve or try out capturing different photographs of the subjects. The behaviours serving for this purpose are; *efforts to adjust a desired frame* by exploring different angles and zooming in-and-out, *sensitivity to lighting* by considering the reverse lighting and use of flash, and *assessment of the resulting picture* in terms of success or failure (Figure 43).

Another exploration behaviour is rather playful, which mostly results in ***laughter*** or giggles. Laughter can be observed in both solo interaction of the child with the camera, and as a social experience they share with peers. Children who feel confident to explore the camera functions without the fear of getting lost seemed to have shown more signs of having fun. For some children, going to the wrong direction when seeking for a function in the menu can be an opportunity to enjoy the unexpected, accidental discovery of other functions. For example, the playful interface offered by the camera designed for children were usually discovered by such accidental detours while they were trying to access another function (Figure 44), or simply when they accidentally hit a button while running around.

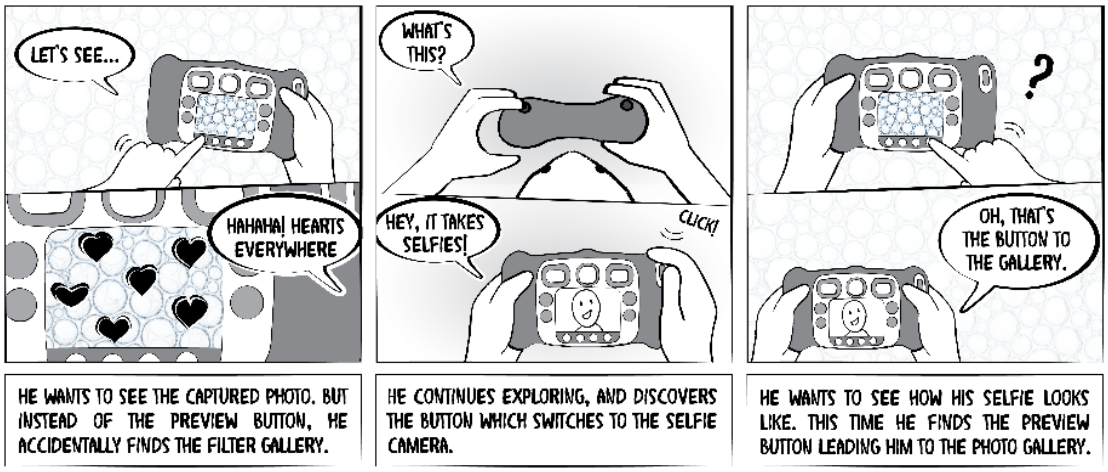

Figure 44. Sample scenario for joy raised from exploration of the camera functions

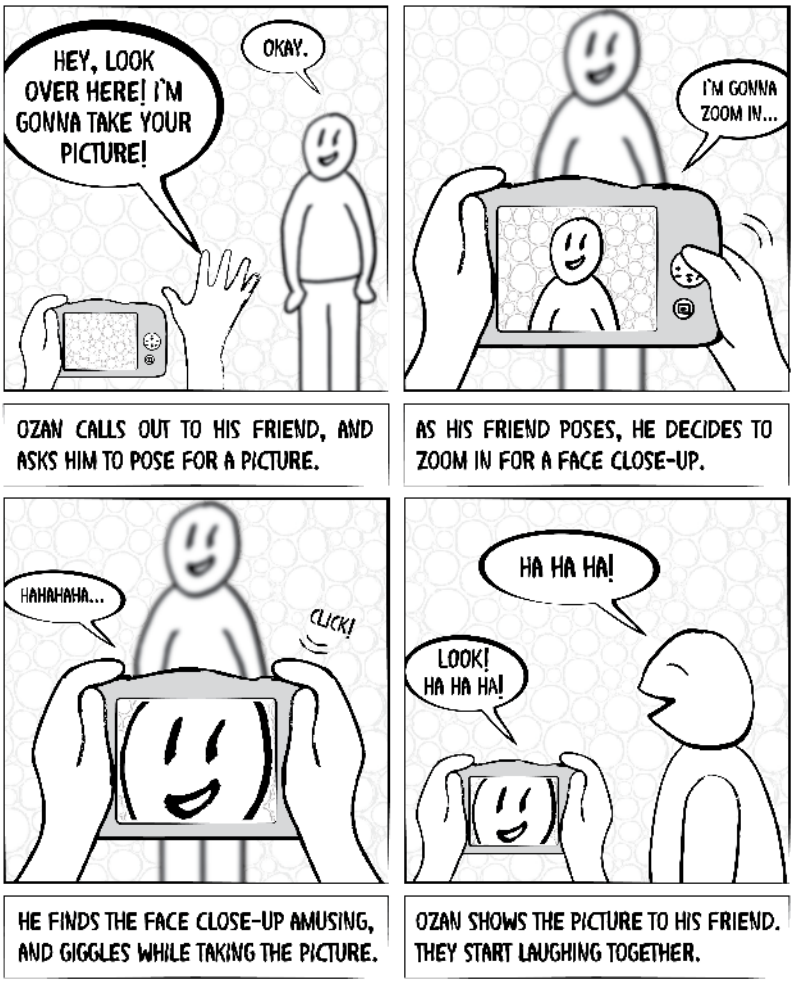

Figure 45. Sample scenario for playful social interaction

The playful, social exploration was mostly observable with the use of the zoom function, but as ***over-zooming*** the subject. Many children took each other's pictures as portrait photography. Some of them were seen to use extensive zooming, which enabled *playful social interaction* between them (Figure 45). Over-zooming behaviour was commonly observed among the sample. They seemed to have enjoy this function in general and used it extensively once discovered, even when it was not necessary, as they could simply walk closer to (or further away from) the subject. As much as they found joy in close-up shoots, when combined with a degree of photographic sensitivity, it sometimes led to unpractical issues. They were often seen to have difficulties in finding a balance between zooming in and getting physically closer to the subject. This had an impact on the *quality of the photography*, as the problem with

image stabilisation is amplified and becomes more visible in a close-up shot (Figure 46).

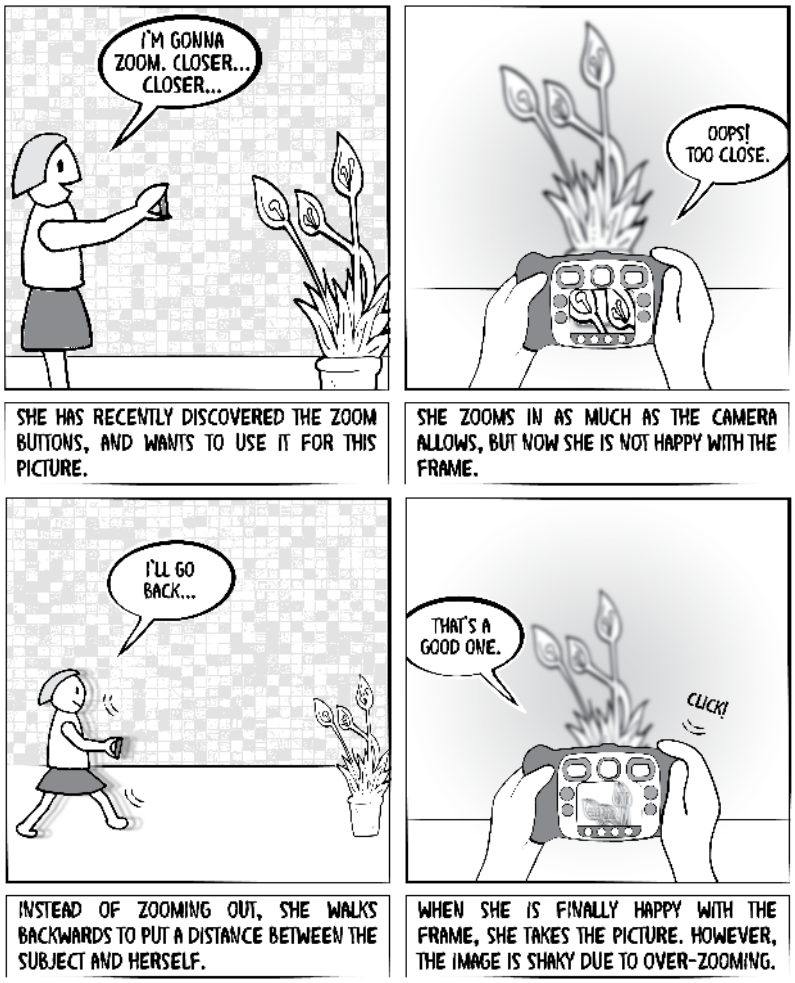

Figure 46. Sample scenario for problems with over-zoom

Entertainment is most visible at moments when the camera becomes a tool for playful social interaction. Those are the moments when interaction with the camera comes to a minimum, and it becomes a medium to *initiate and/or maintain the play* (Figure 47).

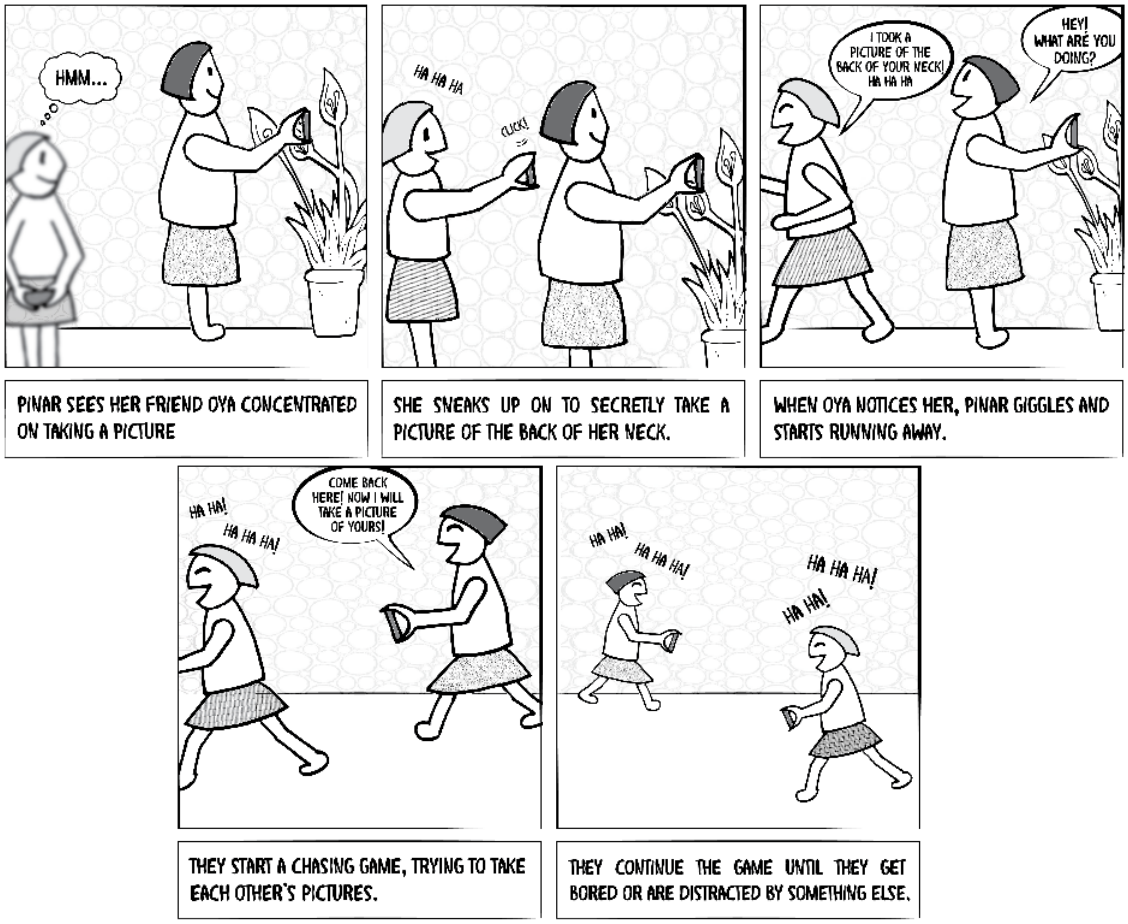

Figure 47. Sample scenario for photography as medium for play

Sharing is a key component of both playful and professional approach to photography. For the playful approach, children seemed to take joy from the moments when the camera could be a medium for social interaction and sharing a laugh with peers. They were often observed to take and share "funny" pictures depicting silly faces, over-zoomed subjects and eccentric frames, and enjoyed browsing those pictures together. As for the professional approach, children were eager to show the pictures they took to others (both peers and workshop facilitators) if they believed it was a good frame (Figure 48). So, for the playful approach, proudness and seeking for appreciation is a core motivator.

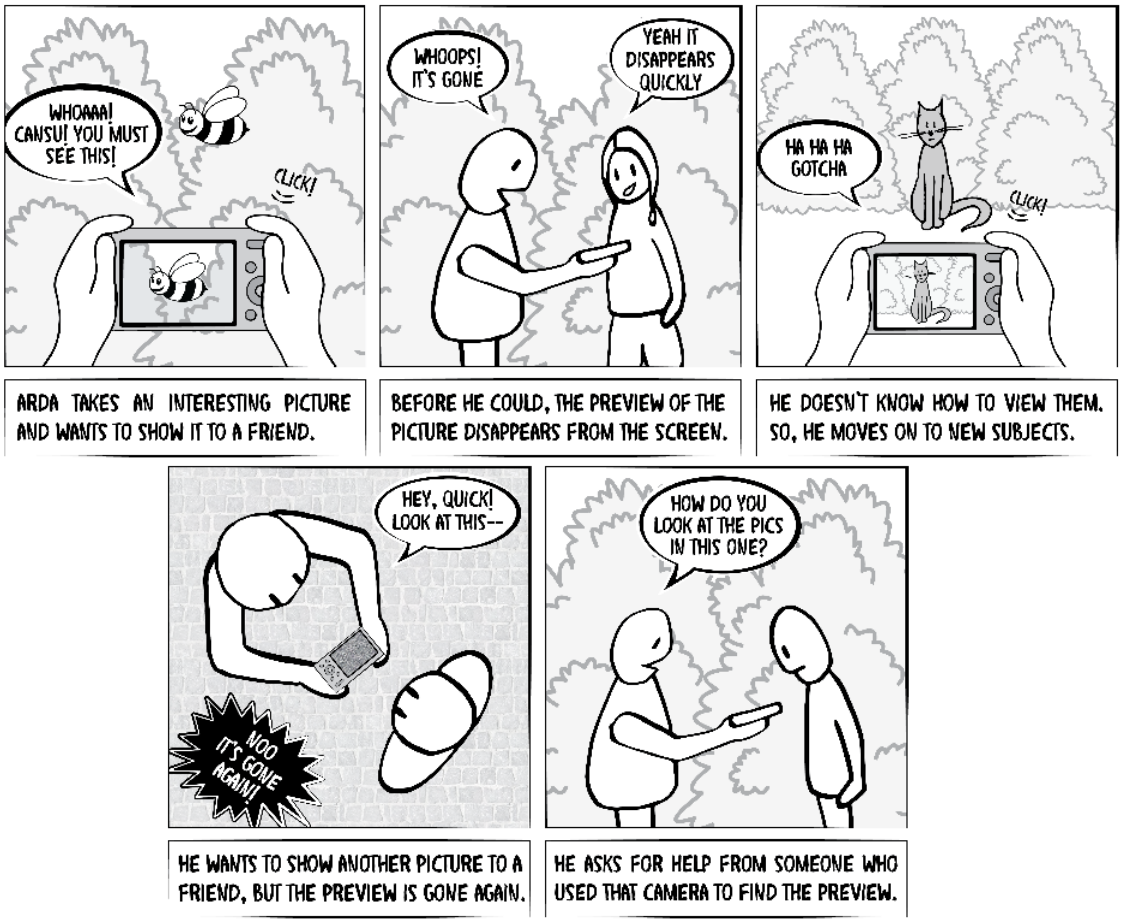

Figure 48. Sample scenario for sharing behaviour

5.4 Implications for Design

The findings show both common patterns and differences in children's expectations and behaviours regarding the experience with cameras. For this reason, instead of giving one-fits-for-all design requirements, it is more meaningful to provide design directions that meet the diverse needs and expectations of children in order to expand the design space by supporting generation of different design concepts. The implications for design will be presented in three groups:

- Implications for product language discusses the different meanings and expectations of the participants from the communicative aspects of cameras elicited from the interviews,

- Implications for product interaction and content are grounded on the differences in interaction style and approach to photography retrieved from observation findings,
- Implications for usability and intuitive interaction are based on the patterns of behaviours from observations of children's one-to-one interactions with cameras, from which a larger population of child-users can benefit.

5.4.1 Implications for Product Language

Interview findings show how camera attributes are made sense of by children, along with revealing their preferences and expectations. Although many pragmatic dimensions point out to concerns commonly observed in the sample, such as the relationship between the camera size or form and ease of holding, some other dimensions unravel differing meanings and expectations attached to cameras. These dimensions are mainly related to the expressive meanings inscribed into product language, namely aesthetic appeal, product expression and age appropriateness. These three dimensions remind us that a camera is not only a tool to perform a task, which is taking a picture. In a social environment, it becomes a medium through which one communicates taste and self-identity.

These three expressive dimensions have one thing in common: based on the self-reported preferences of children, they fit on the two ends of a continuum, one end being *camera-like*, and the other is *toy-like*, which refers to the extent it corresponds to their expectations from what a camera should look like. It should be noted that both ends are positive, depending on which end the child shows affinity towards compared to the other. Camera-like versus toy-like dichotomy also matches with children's constructions of product expression, aesthetic appeal and age-appropriateness (Figure 49).

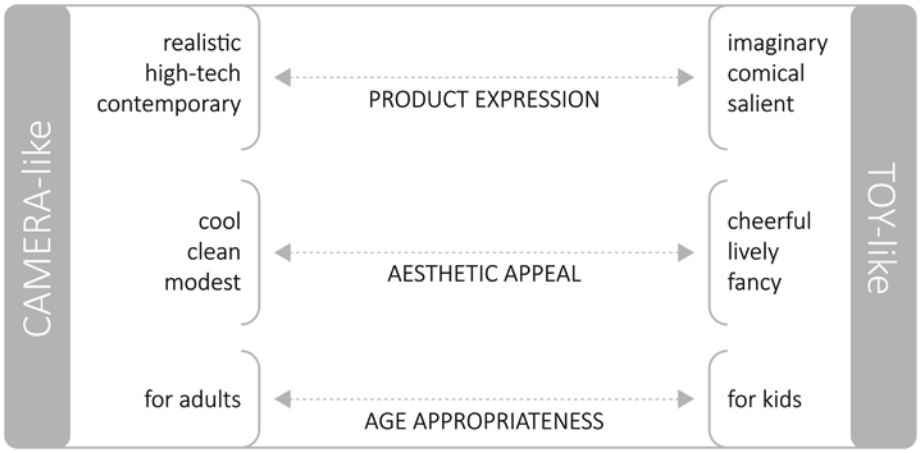

Figure 49. Dichotomous structure of the preferences in expressive qualities of the camera

As explained in the interview findings in Section 5.3.1, *product expression* refers to children's associative judgements based on their past experiences with cameras and other relevant technological products. The product language is evaluated in accordance with existing mental categories they possess, and to the extent the design language of the product shows similarities and differences from them. The features that make the product perceived as contemporary, realistic and high-tech also make resemble more to a camera. A toy-like camera, on the other hand, is marked with attributes which are assessed to be standing out among others, comical and imaginary.

The constructs associated with *aesthetic appeal* point out to personal taste, and raise from the attributes which are perceived to be visually pleasant. For some children, modesty of the visual attributes is favoured more, which is evident in their affinity towards simplistic forms and colours, and lack of colourful patterns. On the other hand, a number of children prefer colour and flamboyance, which make the product's presence felt.

Age appropriateness has an indirect connection to aesthetic appeal and product expression. It refers to the supposed target of the product; "for babies", "for kids", and "for adults", as described by children. These judgements demonstrate that the participants identify themselves with a self-image, which is associated to and reflected by the design language of the camera. It is evident that children are well aware of the reflections of childhood connotations inscribed on the products, and they take a

position towards acceptance or rejection of this attributed identity on them. “Child-friendly” codes of designers can be appreciated by some children as they are found cheerful and fun, but they can as well be rejected due to being judged as childish and not serious.

From this point of view, expressive features of the camera design should be perceived as an opportunity for the child to explore alternative ways of reflecting and emphasizing the preferred self-image for children. A professional, “grown up” look can be achieved by making use of the connotations of the contemporary consumer technologies, such as clean and simplistic forms, and avoidance of the use of bright colours. Conversely, drifting away from the culturally shared identifiers of the design language of a camera can allow integration of playful connotations, which can be achieved by eccentric and comical use of forms and colours that are unexpected to be seen in cameras. This might help its user build an identity around a product designed specifically for them, and not for adults.

5.4.2 Implications for Product Interaction

As mentioned in Section 5.3.2, observation findings point out to two aspects of behaviours that show diversity among children; *interaction with the camera* and *approach to photography*. For an effective communication of these differences as an empathetic and inspirational source for design, they are transferred to persona-like representations. These representations are not detailed or complete personas, neither are they based on imaginary features as is usually done in marketing studies. They are rather like brief summaries of the product-related concerns and behaviours observed in sessions to demonstrate the diversity among the sample. Therefore, the personas were constructed based on children’s different approaches to photography, namely *professional* and *playful* approaches, and their different interactions with cameras, which are described here as *explorative* and *focused*. These two dimensions were crossed to generate a matrix for the constructions of four types of personas, and the questionnaire responses of the parents were compared to the observed behaviours of the participants for additional interpretations (Figure 50).

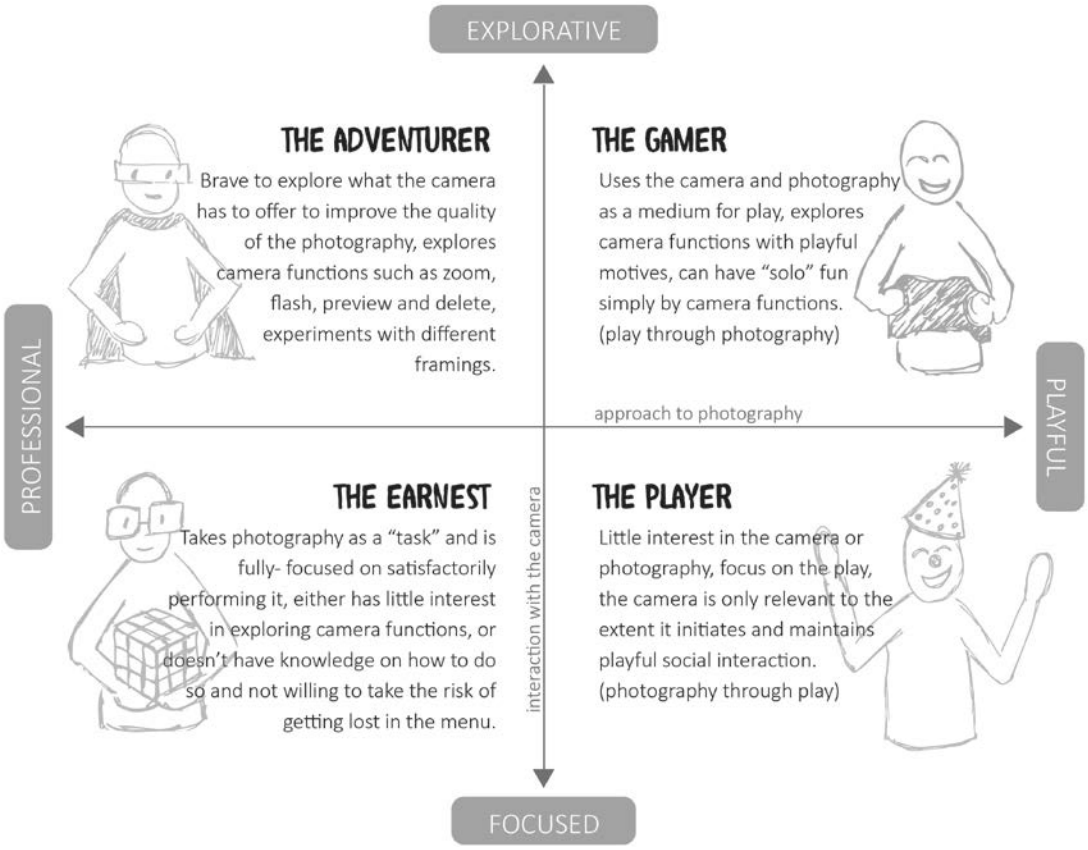

Figure 50. The four personas

- *The Adventurer* is brave to delve into the features offered by the camera to see what they can do to get better photographic results. They have probably has some previous experience with a camera, observed others use, or they took pictures with other products such as smart phones or tablet computers. Therefore they feel confident to transfer this knowledge into the new product, hence they may have elevated expectations from the technical capacities of the camera compared to others. Basic functions related to photo quality should be made easily accessible, as these will be the functions most frequently used by them.
- *The Earnest* is very meticulous and focused on taking "good" pictures. When taking photographs, they are quite focused with little social interaction. They like to spend time on framing and re-framing until they come up with a picture they are happy with. However, this sensitivity to the photographic quality is not reflected on their interactions with the camera. Whether from lack of

previous experience and knowledge, or lack of interest, they don't explore the potentials of the camera to improve their photography as The Adventurer would. In any case, simplistic interfaces and visible controls to the basic functions can help The Earnest make the most of the photography experience by lessening their concerns of getting lost.

- *The Gamer* sees the camera and photography as an opportunity for play. They explore the camera with playful motivations, hence they do not focus on the photographic quality. They enjoy exploring the menu with non-photographic purposes, show signs of delight by chuckles and giggles as they browse through the menu and something pops up unexpectedly on the screen. It not necessarily means that they have no interest in taking pictures. However, they would appreciate the possibilities to juice up and enrich the experience with humorous and playful interactions. The Gamer, as their name suggests, would enjoy gaming too, therefore be familiar with interfaces and interaction styles in gaming products.
- *The Player* does not have much interest in taking pictures, or exploring the camera. For them, playful social interaction with their peers has more value, and the camera or photography has a minor role in it. Social interaction and play is central in their experience, so much so that they may end up with no or just a few pictures. The camera can be relevant to the extent that it has significant value in play. Therefore, The Player would welcome products that can initiate and/or reinforce playful social interaction with their peers. Applications giving room to laughter to share with friends can also be appreciated by them.

Although these can inspire diverse design concepts, it is not suggested that every child would strictly be characterised by one of these four personas. Although a child-user can notably demonstrate the characteristics of The Adventurer, they can as well behave as The Player would in a brief social engagement. In a way, they show both diverse expectations and behaviours within the sample, and changing behaviours and interests of the same user. Therefore these personas can inspire different modes or applications of a camera, as much as different camera design concepts.

5.4.3 Implications for Usability

Although usability issues related to camera use was not the focus of the study (or this dissertation), observation findings reveal many usability-related issues. This section will summarise these insights, and a more detailed account and recommendations in comparison to Nielsen's (1995) usability heuristic that can be found in Appendix R. The key insights can be listed as follows:

- Although the children could be observed only for a brief duration, their product use behaviours apparently demonstrate that the interaction style afforded by the camera does not match with the interaction styles children are familiar with from their real life experiences. Children are often observed to attempt to use *gestural interaction*, mainly touching the screen for navigation in the menu or zooming, and shaking the camera in an attempt to avoid long steps to go back to the default mode. Together with the fact that all participants were independent tablet users, this shows that the interaction paradigm for children has already shifted from traditional button-menu mapping towards gestural interface, which can easily be adopted for camera interaction.
- The most significant problem affecting the photography quality is *image stabilisation*. This is partly due to limited fine motor capabilities, which is accentuated by difficulties in holding the camera properly and pushing the shutter button. Also, children seem to enjoy the zoom function and often use it even when it is not necessary, which also increases the image stabilisation problems.
- The use of iconography has no clear reference to the past experience of children, as it is evident in the way that they have difficulties in finding the function they are looking for (i.e. power on/off, zoom in/out, access to gallery), and usually ask for help. Although the use of gestural interface may partly eliminate or minimise this problem, when iconography is needed for tangible or digital interface, the design language can transfer from the interfaces children are already familiar with (i.e. tablets, game consoles, and computers).
- Another important aspect affecting the accessibility of the camera is the lack of a clear hierarchy among the control features. Some features are used more

frequently by children (i.e. shutter, zoom, gallery), hence the apparent visibility of such controls and simplification of the interface towards emphasizing the frequently used functions can contribute immensely to the efficiency of use.

- Finally, it is observed that when most children encounter a problem or interruption in the natural flow of interaction, their first reaction is to ask for help. They are also seen to often "narrate" their interaction step-by-step or give natural verbal responses (i.e. "Where is this button?" "How do I get out of here?" "I will turn on the flash now."), even though they were not asked to do so. This implies that such responses come intuitive to most children, hence the potential of voice interaction can be explored.

5.6 Implications of the Methodology

Following the two explorative studies, this chapter presented the main study investigating the potential of a mixed methodology aiming to elicit children's product-related subjective meanings and behaviours. In this sense, the data collection procedure showed great promise by unravelling their expectations and priorities, as well as the meaning emerge from the context of use.

The methodology was also useful in revealing differences among the sample in terms of attitudes and behaviours, informing and expanding the design space with diverse user perspectives and possible design directions. Additionally, age-based differences in constructions among children could also be explored, in terms of construct number and diversity. These issues give insights into further improvement or adaptation of the methodology into different research contexts, which are discussed in detail in the conclusions chapter.

The inferences gained from the field work, which was grounded on the literature and the gaps in the contemporary user research practices with children, informed the construction of a descriptive research model and two complementary techniques for inquiring children's product experiences from their perspectives. The next chapter will describe this model and the techniques in detail.

CHAPTER 6

THE EPO MODEL FOR THE EARLY EXPLORATION OF CHILDREN'S USER SPACE

6.1 The EPO Model: Elicitation, Prioritisation, Observation

In this section, the EPO model is presented as a framework for the early inquiry of the child-user's space to inform and expand the design possibilities. The EPO model is constructed on the theoretical foundations of models of user experience, psychology of personal constructs, and the requirements of the design activities, and refined in an evolving manner through knowledge gained from field research. The model is most useful before structuring a directed design brief, hence exploration of the user space can enrich the design possibilities by providing child-centred input into early design phases. In this regard, the model can contribute to the structuring of user research methodologies to investigate child-users' perspectives regarding their expectations from and interactions with products.

The EPO model consists of two major areas of inquiry ( ). The first part focuses on understanding children's concerns about and expectations from the product in question, whereas the second part commits to the exploration of behavioural factors in product use, both in individual and social level.

6.1.1 Part I: Concerns

The first part of the EPO model points out to the conceptual inquiry of the children's product-related meaning-making structures, expectations and priorities. Thus, this first component of the EPO model:

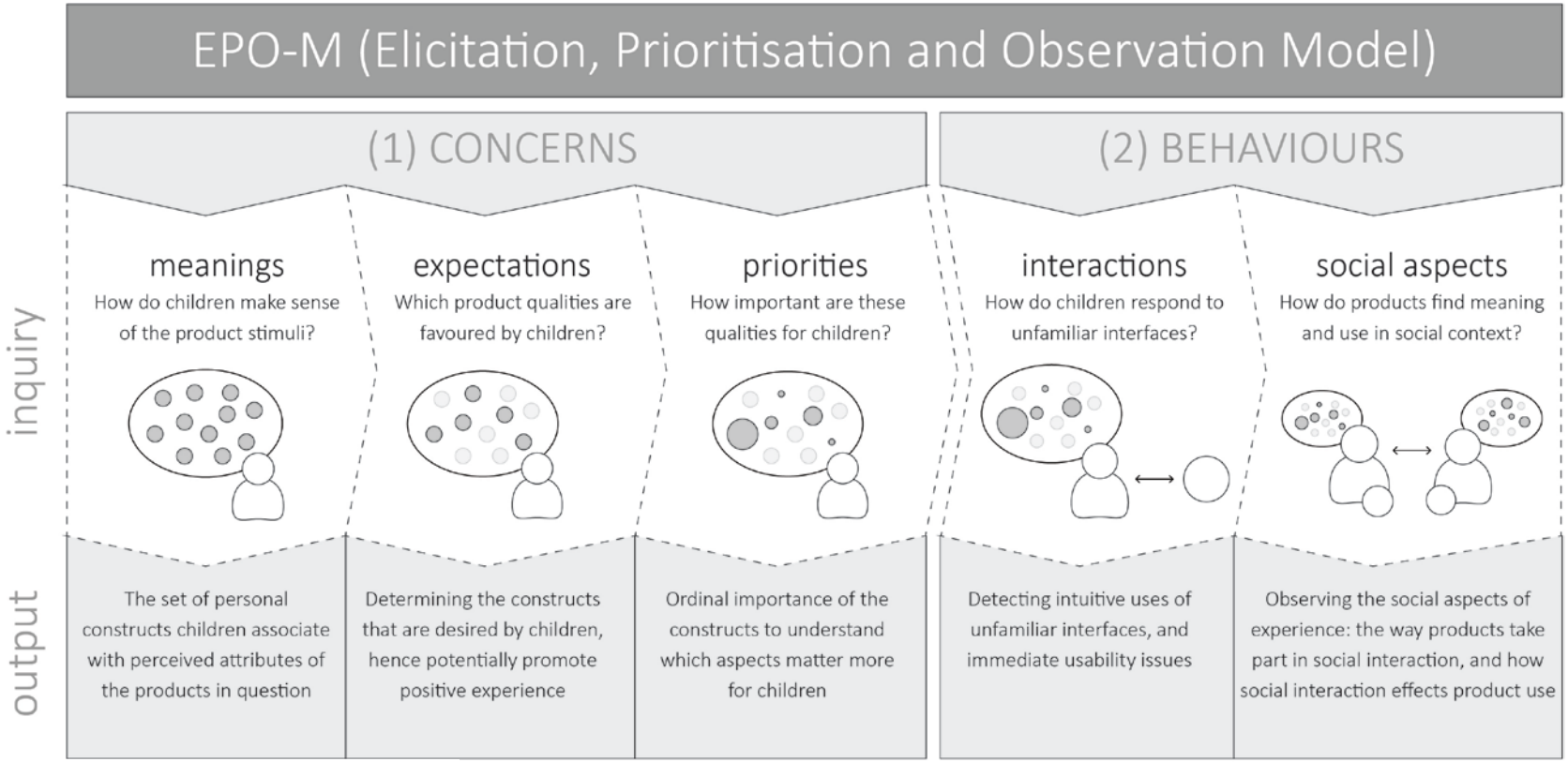

Figure 51. The EPO model

- Stems from the theoretical background framed by PCP, and methods to scrutinise personal construing systems,
- Focuses on the conceptual exploration of children's sense-making, by eliciting their expectations from and priorities in what products has to offer, in order to investigate the dimensions that potentially promote positive experience,
- Allows the researcher to analyse and communicate not only the plurality of children's expectations from products, but also the hierarchy among them.

For this reason, the conceptual inquiry seeks to answer the following questions:

- How do children make sense of the product stimuli?
- Which product qualities are favoured by children?
- How important are these qualities for children?

The outputs of the conceptual inquiry also correspond to the expected input of the user research for the design space as required by designers, so that they could benefit from the user information during design activities. For this purpose the first step of the EPO model corresponds to the requirements outlined in Töre Yargın's model in the following ways:

- Generates multidimensional user information, which is found useful in boosting empathy with the user through inspiration and guidance in design activities, by:
    - Exemplifying and concretising the conceptual reflections of user's perceptions with product features,
    - Revealing the relative importance among these concepts,
    - Representing user diversity.
- Focuses on increasing the persuasiveness of the user information which can be achieved by highlights from critical user comments, as well as quantifiable findings. Hence, helps designers have feedback from, and justify their decisions through findings of the user research, by:
    - Concretising findings referring to differing meanings children attribute to product features, and

    - Conceptualising and prioritising children's expectations from future products.

6.1.2 Part II: Behaviours

The UX literature refers to the physical and social context as important aspects influencing how products are experienced by users. Similarly, Töre Yargın's model illustrates that designers highly value user information retrieved from the natural context of use. Contextual factors in product use is a valuable source of information for designers, as it increases the credibility and persuasiveness of the research findings, leading to better guidance and justification in design activities. Additionally, scenes from actual use context is considered to be enriching information, reinforcing the multidimensionality and in-depthness of the findings, which are important aspects to support inspiration and empathy with the user.

For this purpose, the second part of the model aims to investigate the behavioural and social aspects of experience as follows:

- Explores the behavioural aspects of product experience through an inquiry into both one-to-one interaction between the product and the user, and the impact of the use context on product interaction,
- Investigates the child-product interaction by observing children's intuitive and natural responses to interfaces they may or may not be familiar before, as well as immediate usability issues that designers should take into consideration, although usability improvement is not one of the core concerns of the EPO model:
    - Unfamiliarity of the interface can be an asset to concentrate on how and where children try to access information and controls in an intuitive manner, as it will disrupt the "regular" product use. For this reason, a short period of immersion to a set of different interfaces can reveal valuable insights.
- Investigates how social aspects impact the product experience. This involves a scrutiny of both the ways products take part in social interaction, and how social environment affects product use.

The two legs of the EPO model present a complementary structure by integrating conceptual and contextual factors affecting children's product experience, in order to be able to draw a comprehensive picture of the child-user's space to support empathy and feedback for designers. To illustrate the implementation of the model in a research setting, two different techniques are presented in the following sections.

6.2 CEPT: Construct Elicitation and Prioritisation Technique

Construct Elicitation and Prioritisation Technique (CEPT) is devised to correspond to the conceptual inquiry suggested in the EPO model. The features of CEPT can be summarised as follows:

- Aims to provide structural and operational guidance for user researchers working with children in their early exploration of children's expectations and preferences regarding the aspects of experience to be met by the product in question,
- Is essentially an interview procedure adapted from the construct elicitation techniques available in the literature:
    - *Adapting for research with children:* Methodological recommendations for child-friendly construct elicitation protocols, as well as accumulative modifications through insights gathered from field studies are the sources consulted when developing the technique,
    - *Adapting for the requirements of design research:* Along with the traditional applications of construct elicitation techniques that function for eliciting meaning structures, CEPT also incorporates a step to prioritise which aspects matter more for children.
- Consists of two major procedures: elicitation of personal constructs, and prioritisation among them (Figure 52). In this sense, the technique proved to be promising in understanding child-user perspectives by portraying their conceptions of the product in question, and the aspects of experience that matter more for them:

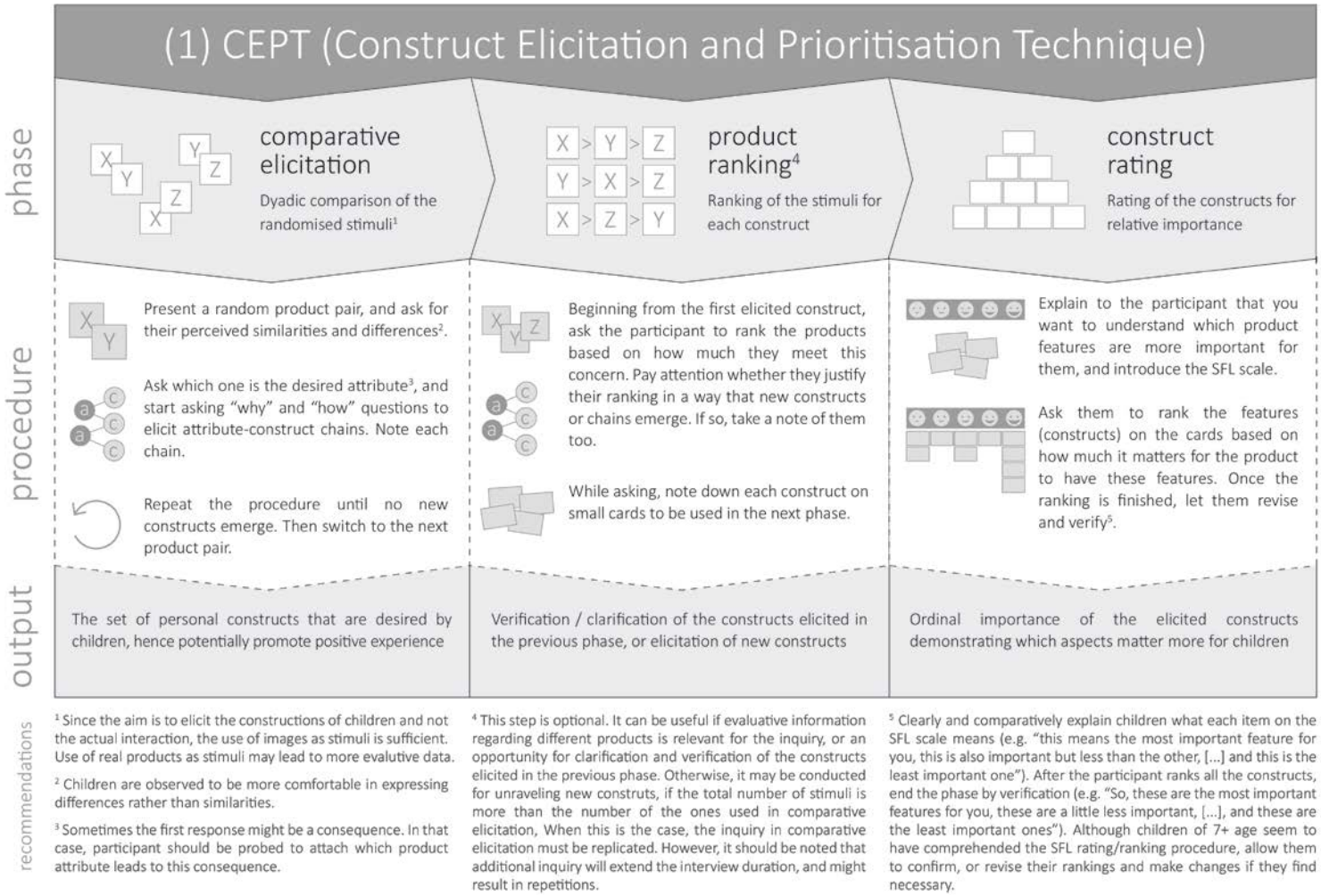

Figure 52. Construct Elicitation and Prioritisation Technique (CEPT)

- The first part of the technique relies on the comparative judgement of the concrete stimuli to elicit the set of constructs children have to make sense of the product attributes,
- In the second part, these constructs are rated for importance to gain an understanding about which aspects matter more for children.

6.2.1 Sampling

Although PCP suggests that there are no age restrictions to studying the construing systems of children, the specific procedure CEPT outlines does impose age limits. Based on the first-hand experience gained from two comparative elicitation studies, and the literature on intellectual development (Piaget, 2001), CEPT procedure is suggested to be suitable with children 7+ years of age. The pilot study conducted with children aged between 5 to 7 years (preschool and primary school) showed that schooled children could follow the procedure easier compared to preschool children. This observation is consistent with the developmental characteristics matching with the cognitive requirements of the procedure, as Piagetian stages of intellectual development mark 7-11 years as the "concrete operational stage", during which cognitive functions such as categorising concrete stimuli based on similarities and differences, and inductive thinking (the ability to make general inferences based on concrete stimuli) begin to develop.

- The age limit recommended is based on the level of the understandability of the comparative procedure:
  - It should be noted that each child is unique in terms of their development. The age-based characterisations are not universal. This means that some younger children may just as well find the procedure comprehensible, or vice versa.
- As demonstrated in previous chapter, the total number and diversity of the constructs may differ with age:
  - Interviews with younger children are more likely to result in fewer and less diverse constructs, as well as more repetitions.

    - If the research goals impose elicitation of as many and diverse constructs as possible, 9 years old and beyond can give more fruitful results.
- It should also be noted that the specific procedure recommended in CEPT requires a certain degree of literacy due to prioritisation through construct rating:
    - The regular age to start formal education in Turkey is 6. Hence the age limit recommended here falls approximately one year into formal schooling, which means most children at this age would already be literate. In the case of differences in the age to start formal education as well as the curriculum in different countries may require additional consideration of the literacy skills.

6.2.2 Materials

Before the interviews, the elements of comparison, that is the stimuli to be utilised in comparative elicitation, should be determined. This is one of the key tasks to be conducted by the researcher carefully, as the constructs elicited during the interviews depend highly on the stimuli presented to children. The concerns that should be taken into account when determining the elements include the relevance and representativeness of them, and the research goals unique to each study:

- *Relevance* means the selected products should be within a reasonable range so that it makes sense to compare against each other. For example, the constructs elicited from comparison of a compact camera with a professional one may not reveal expectations that are unexpected for the researcher. Also, the products should be relevant for children, which means they should be more or less familiar to the participants, so that they can be judged in a meaningful way based on past experience.
- *Representativeness* refers to the ability of the stimuli set to represent the variety among the product line. This means the products should be selected in a way to represent the diversity of the designs, yet remain within the relevant range.

- *Research goals* are also an important aspect when selecting products. If the study is directed towards a certain aspect of the experience (e.g. expressive dimensions), then the set of stimuli should represent a sensible variety in terms of this specific aspect (e.g. products with different expressive qualities), whereas other features can be kept similar as they are not the focus of the inquiry.

Another important matter is the fidelity of the stimuli. As the intended use of CEPT is to investigate how product meaning is constructed by children, hence the chains of logic they operationalise in making sense of the product features, the use of product image cards should be sufficient. The way visual stimuli is perceived and judged by child-users can establish a network of meaning structures, serving as a "mental vocabulary" that children refer to when interpreting the product features. During the field studies, children were occasionally observed to misinterpret the visual stimuli, such as assuming from the image that the product has a touch screen control when it doesn't. Such assumptions are part of their past experiences and how the visual stimuli overlaps with their mental imagery of the familiar products. The goal of CEPT is to elicit product meanings and not obtaining accurate product evaluations from children. In this sense, misinterpretations are not obstacles to the inquiry, as long as the meaning of the assumed feature is clarified and justified by the participant.

6.2.3 Comparative Elicitation

Comparative elicitation is essentially a procedure of deconstructing the products into their isolated attributes, and questioning whether or not these attributes are found desirable by children, and why. The procedure unfolds in the following order:

- The interview procedure begins with comparative elicitation, during which pairs of product stimuli are presented to children and asked for similarities and differences:
    - The experience gained from the field studies suggest that children can readily express the differences perceived from the visuals, whereas comparative similarities yield many ineffective statements, such as "they both have a screen", or "they are both mobile phones". For this

reason, it is recommended to focus mainly on questioning differences rather than similarities of the products.

- Once the participant expresses a perceived difference between the two stimuli (e.g. one is colourful, the other is white) the investigator should ask which is preferred by them, and why:
    - The importance of asking the preferred end is to be able to detect the product attribute for further questioning. Rather than adopting a problem-driven approach, concentrating on the positive constructs is a strategy developed to lay emphasis on the aspects that potentially promote positive experience, and reducing the interview duration by avoiding repetitions.
    - Children seem to have well comprehended this procedure, as they were observed to begin justifying their preferences without further probing.
- The key aspect of comparative elicitation is to question the consequences different product attributes lead to, which outlines the participant's construing of the product in question:
    - To achieve this, product attributes must be linked with the constructs as mentioned by the participant in order to form attribute-consequence chains (e.g. white colour -> looks high-tech -> for adults). This requires consistent probing into why the mentioned attribute or consequence is important for them.
    - If the difference initially expressed by the child is a consequence, e.g. "looks high-tech", then they should be probed to explain which attributes make the product look high-tech.
    - It should also be noted that a particular product attribute can be attached to multiple consequences by children, as much as a consequence might be perceived as a result of multiple attributes. In this case, all relevant chains should be noted so that analysis can yield a comprehensive map of overall construction of the product in question.

As the theoretical foundations of construct elicitation lie in PCP, and it is based on obtaining the subjective meaning structures of persons, the researcher will notice

incompatibilities between the constructions of different children, both in the personal meanings attached to product attributes, and in their expectations and preferences. For this reason, construct elicitation is also useful in exploring the variety of the perspectives to be transferred into the design space to expand the design possibilities, rather than seeking for one-fits-all design guidelines. It is likely to see patterns that are more generalizable across the sample, however one should refrain from reductionism imposed by over-generalisation of the findings. In this sense, variety of perspectives should be welcome as enrichment of common impressions, which is a potential source of diversification in design decisions to cater differing needs and expectations of children.

6.2.4 Product Ranking

Comparative elicitation can be supported by an optional step, namely product ranking. In this phase:

- The participant is asked to rank the stimuli based on how much they meet the requirements posed by each construct elicited in the first phase.
    - For example, if the child expressed “for my age” as a consequence before, now they are asked to rank the stimuli from the most to the least suitable to their age.
- It was observed that when the total number of the stimuli are more than the number of stimuli used in comparative elicitation, new constructs may emerge due to the existence of new information available to the participant, which was not taken into consideration before.
- Another output which can be gained from product ranking is an opportunity to enrich and clarify the attribute-consequence chains expressed during comparative elicitation.
    - For instance, “white colour -> looks high-tech” is a chain elicited from comparison of two products in the first phase. When the child is asked to rank the products based on how much they are perceived to be high-tech, they need to consider other product(s) as well in order to decide whether it looks more or less high-tech than the others. To make this

judgement, they need to take into account the attributes they perceive from the new stimuli. This means there are potential attribute-consequence chains to be elicited based on new stimuli, such as interpreting the fewer number of buttons as a sign of touch-screen control, which makes the product look more high-tech.

- It should also be noted that product ranking will extend the interview duration significantly by resulting in repetitions. If there are time limitations, or the researcher thinks the constructs elicited from comparative elicitation is sufficient enough, then product ranking phase can be skipped.

6.2.5 Prioritisation

Prioritisation of the constructs is one of the novelties of CEPT, which other construct elicitation techniques lack. Hierarchical representation of the findings is valued by designers as it increases the persuasiveness of the user information by providing guidance and justification in taking design decisions. Prioritisation procedure in CEPT takes place in the form of rating the constructs on a Smiley Face Likert (SFL) Scale, in the following order:

- For the rating procedure, the constructs written on small cards must be present. The interviewer can take advantage of the time in between product rankings for each construct to write them on cards:
    - If the product ranking phase is skipped, then time for transferring the constructs on cards must be allocated between comparative elicitation and construct rating. When that is the case, the interviewer can take this as an opportunity to remind the child of the constructs and get confirmation regarding their accuracy.
- It should be explained to the child that written on these cards are the qualities that they would like the product to have, and that some maybe more important for them than the others.
- Then the interviewer should introduce the SFL scale, and that they are asked to rank these cards according to how important they are for them:

    - The use of SFL scale is recommended to concretise the otherwise abstract rating procedure.
    - SFLs featuring a scale from slightly happy to very happy faces are more relevant, as all the constructs subjected to rating are expressed to be desirable by the participant. For this reason, the use of sad-to-happy faces, or any representation from negative-to-positive, can be confusing for the child.
- Before proceeding to the rating procedure, it should be explained to the child that one end of the scale represents the most important qualities, the other represents the least important ones, and that it is okay to put more than one card under any piece of the scale.
- At the end of the rating, the researcher can go through all the constructs by saying: "So, these are the most important qualities for you, these are also very important but a little less than these, […] and these are the least important ones. Is that correct?" This is an opportunity for confirmation, and allows the child to revise their decisions if necessary:
    - In a few occasions, the participant asked to change the placement of a card or two after reviewing the ratings.
    - The most important thing is to make sure that children do not feel being tested, insecure about their decisions, and want to make changes simply to satisfy the researcher.

6.3 Shared Discovery Technique

Shared Discovery is a technique corresponding to the second part of the EPO model, and recommended for investigating the contextual factors of children's product experience (Figure 53). It is essentially a compact observation technique in a naturalistic setting, which can be used in early exploration of child-product interaction, as well as the social aspects of the experience. In this regard, Shared Discovery consists of the following features:

- Simulates the real use context, yet provides a non-rigid structure to allow children to explore the products in a flexible way,

- Provides a setting for children to create opportunities to explore the products in a shared environment, both individually and collectively,
- Aims to make up for the limitations of traditional observation techniques, such as participant observation and passive observation, with a non-invasive setting, yet not losing any valuable moments for potential insights,
- Helps efficient collection of multi-faceted data in a short period of time.

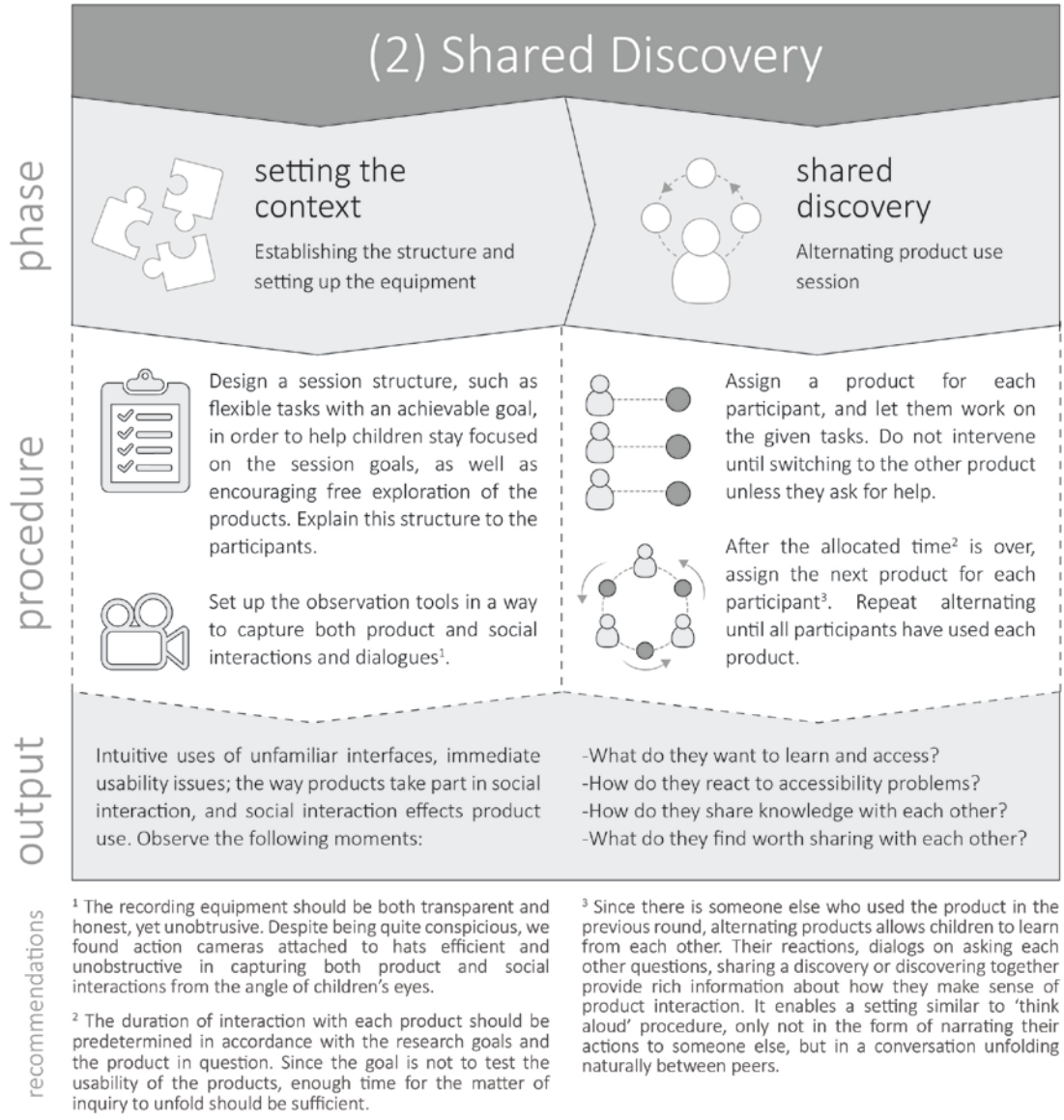

Figure 53. Shared Discovery Technique

6.3.1 Materials

The materials to be used in the observation sessions should be working products or prototypes. Technically, it is not necessary to employ the same products which are used in the CEPT, as the central goal of Shared Discovery is not to evaluate the products or compare the perceived judgements with the actual use, but to investigate the personal and social interactions with the products by immersing child-users to various interfaces in a short amount of time. In this sense, the variety of the product interfaces is a key aspect in material selection. If the products, images of which were utilised in CEPT provide such variety, they can be used in Shared Discovery as well.

6.3.2 Setting the Context

The observation setting is a critical aspect of the technique, as it defines the structure, quality and efficiency of the observation activities. The setting should be designed before the session, and children should be fully informed about the structure and the methods of collection. This phase includes both establishing the structure, and setting up the recording equipment.

- The session structure should steer children's concentration towards exploring the product functions which are expected to be observed later by the researchers, but also provide a partial flexibility for the children to explore what they desire:
    - Instead of giving a total freedom with no directions at all ("take this camera and use it"), or very strict directives ("find the picture gallery"), children should be given broad, open-ended tasks ("take 3 of each: portrait, texture, nature and architectural photographs"),
    - These predefined tasks should be explained to children. If any prior knowledge is required to attend and complete the session, an optional meeting for conveying the necessary information to the participants should be planned.
- Before the actual product use session, the observation equipment should be set up. The use of on-body action cameras is highly recommended for the following reasons:

- Although they are quite conspicuous, the use of head or vest-mounted action cameras do not obstruct the product or social interaction,
- It records the session from the user point-of-view, which makes it impossible to miss any actions or conversations of children,
- It can be used to explore both on-the-go and still interactions.

6.3.3 Shared Discovery

This part is the actual product use phase during which the observation material will be collected. It provides a naturalistic, semi-controlled context for small groups of children to explore and discover products both personally and collectively. Since it is a social environment, it is inevitable to lead to product-related conversations between children, which enriches the observation data as it resembles a think-aloud procedure, but unfolds more naturally. The procedure is easy to follow for the researcher:

- Assign different products to each participant, and note them on a sheet to check it later to make sure every child used different products. A checklist prepared prior to the session can be useful.
- Even though the researcher is present during the use session when the data is collected, they should not intervene with the product use. Do not give instructions to children unless they specifically ask for help. Let them try and succeed/fail first, ask questions to each other, and discuss. Their intuitive ways of trying to access a certain function, as well as conversations with each other, will unravel valuable insights.
- When the allocated time is over, alternate the products so that each child switches to the next one. Repeat this until each child uses each product.
- The duration of interaction with each product should be predetermined in accordance with the research goals and the product in question. Since the goal is not to test the usability of the products, enough time for the matter of inquiry to unfold should be sufficient.

6.4 Guides and Recommendations for Analysis

CEPT and Shared Discovery techniques are proposed to be utilised corresponding to the two legs of the EPO model. Hence, they are directed towards the expected outputs of child-user information presented in the model. Accordingly, the analysis of the data gathered with these techniques should satisfy the needs of the designers during design activities. For this purpose, this section presents guides and recommendations for the treatment of the data gathered with CEPT and Shared Discovery techniques.

CEPT, as the name suggests, concentrates on the elicitation and prioritisation of children's product-related constructs. When analysing the data collected through this conceptual inquiry, the following issues should be taken into consideration:

- If the researchers used an efficient method of noting/recording the attribute-consequence chains accurately and simultaneously, verbatim transcription of the audio recordings of the interviews may not be crucial. In this case, the audio recordings can be used to double-check the accuracy of the elicited chains.
    - For example, a well-thought record sheet can be used to record (i) the products that are being compared, (ii) the product which is being judged by the participant at that moment, (iii) the attribute the participant is talking about, and (iv) the consequences emerged from this feature.
    - A second researcher in the background can fully focus on noting, when the primary researcher is in charge of conducting the interview.
- Interviews allow elicitation of the personal constructs in the form of subjective judgements about the products. However, the analysis should also reflect multi-user findings evident among the sample. When doing this, it is crucial to avoid over-simplifications and non-realistic generalisations, in order not to lose the details and diversity of the data, which can provide valuable insights for designers. For sample data coding of the interviews, refer to Appendix O.
- Through iterative content analysis, recurring themes among the constructs should be determined to form abstracted dimensions reflecting the expectations expressed by the sample. When generating these dimensions, the authentic attribute-consequence chains should be protected to avoid over-simplification.

    - For example, the use of hierarchical maps for each dimension featuring the attribute-consequence chains will represent how this particular dimension is constructed by the sample, without losing the differing perspectives. For sample hierarchical maps, refer to Appendix Q.
- Similarly, construct rating data should be attached to each construct falling under a particular dimension.
    - For each dimension, both the frequency of the constructs showing by how many children this dimension is found desirable, and the average rating of importance for the constructs represented under this particular dimension, can be provided together.
    - The frequency and level of importance together will form a hierarchy among children's expectations and preferences, which can be interpreted by the designers. For sample visualization of prioritised findings, refer to Section 5.3.1.2.

Shared Discovery technique aims to detect how products find meaning in actual use, both individually and collectively. Hence, the video recordings collected from the observation sessions should be coded in a way to reveal moments pointing out to the below aspects, and Appendix P outlines sample coding of the observation data:

- The type of functions children try to access, and their ways to access them:
    - This will generate a pool of functions that children frequently want to access, which perhaps should be designed more visibly,
    - Where and how they seek for these functions, potentially revealing their impressions and expectations from the product interface.
- The problems they face when trying to access these functions, and their immediate, intuitive manners to solve these problems:
    - Do not focus on usability assessment. This is an opportunity to observe the genuinely natural behaviours of children when they face an accessibility problem. These tactics will guide the design of intuitive interaction modalities, which can be readily adopted by child-users.
- The types of product-related questions they ask each other, and the product-related issues they find worthy of sharing with each other:

    - Such moments will reveal what type of product functions children want to access, as well as what they find interesting, amusing or distressing in product interaction. These issues can be partly explored in one-on-one interaction with products, but the conversational communication between children will help them to be observed more accurately.
- The situations when products initiate social interaction between children:
    - Try to detect the moments when products lead to situations such as laughter, conflict, negotiation and alike social sharing between children. Such instances are potentially inspirational information for designers to develop products that enrich the experience by promoting meaningful social interaction.
- The situations when social interactions affect the way children interact with products:
    - This will help designers be aware of the social factors which potentially have an impact on child-product interaction.

6.5 Utilisation of the Model

The EPO model and the techniques is expected to be utilised in both academic and industrial settings (Figure 54). The requirements of these two context is naturally different than each other. The scholarly use of the model can be theoretical or methodological, whereas the industrial setting might require more practicality in terms of contribution to the design process.

The academic researchers can use the model in the following ways:

- Develop a comprehensive theoretical/actionable model of child-users' experience with a particular product
- Improve the model/techniques to be adaptable to explore products with varying interactive characteristics
- Compare with different methods/models to contribute to the field of user research methods with child-users.

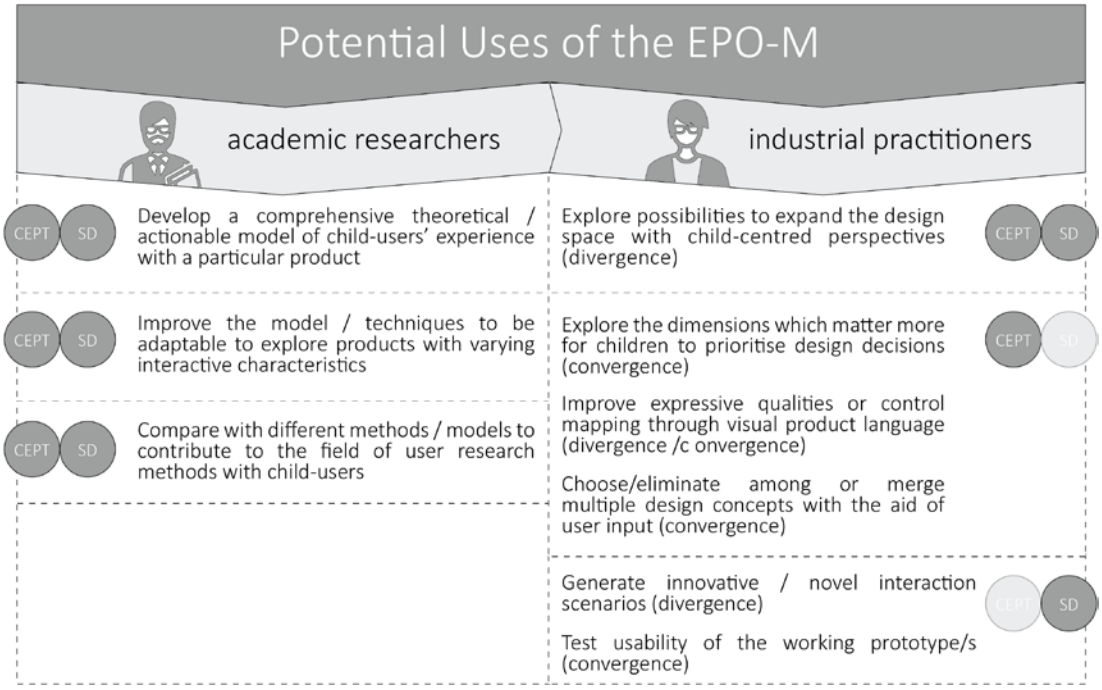

Figure 54. Utilisation of the model

The industrial practitioners can make use of the model more flexibly, and partially if needed. Although it is recommended to be useful in the predesign phases, it can as well be adopted for divergence or convergence of design depending on the phase:

- The model as a whole can be used to explore possibilities to expand the design space with child-centred perspectives (divergence).
- CEPT can be used to:
    - Explore the dimensions which matter more for children to prioritise design decisions (convergence),
    - Improve expressive qualities or control mapping through visual product language (divergence/convergence),
    - Choose/eliminate among or merge multiple design concepts with the aid of user input (convergence).
- Shared Discovery can be used to:
    - Generate innovative/novel interaction scenarios (divergence),
    - Test usability of the working prototype/s (convergence).

6.6 Limitations

The EPO model is only applicable when it is possible to provide stimuli to represent products, as it is based on eliciting and prioritising the product-related meanings, and observing product use. Hence, it may not be suitable for exploring the experience with future products which do not yet exist. In that case, creative/generative adaptations of the techniques are required in terms of providing tools for probing and observation, and new techniques of inquiry.

The techniques suggested within the EPO model also have certain constraints. CEPT poses the following limitations:

- The data collected with this technique will reflect perceived judgements regarding products, and not the ones coming from direct experience,
- The selection of materials highly affects the elicited data, hence should be decided meticulously,
- Although some studies using similar construct elicitation techniques (e.g. laddering) report on suitability of the technique to be used with younger preschool children, experiences from the studies reported in this dissertation imply that achieving high-order, value-laden constructs requires advanced probing skills:
    - Such construct elicitation techniques are originally developed by psychologists to be applied by researchers with clinical training. It can be challenging to pursue an in-depth inquiry for inexperienced design researchers. Hence, it may be more feasible to keep the procedure simple and well-structured.
- Due to the nature of the construct ranking procedure, application of the current version of the technique requires literacy of the participants. If the participants are not literate, this procedure must be adapted in a way that does not require any reading skills,
- Even though the prioritisation phase to some extent allows quantification of the findings, it does not provide statistically significant results. For this reason, instead of statistically viable findings, it should be regarded as a way of early

investigation of the user space to seek for insights and guidance in exploring design possibilities from the children's point of view.

The limitations posed by the Shared Discovery technique are as follows:

- The Shared Discovery technique prescribes a short duration of exploration time for each product. For this reason, it does not promise the detection of issues that might emerge in long-term product use.
- The application of the technique requires attachment of one camera, and assignment of one product per child. If this equipment is not readily available, it is not a cost-effective method of recording observational data.
    - This can be compensated by keeping the group size smaller, however, then the number of sessions must be increased, which may raise time-efficiency concerns.
- Attachment of one camera per child may also pose additional technical burden. The researcher/session facilitator should check the status of the multiple cameras in case of any disruptions in recording.

CHAPTER 7

CONCLUSIONS

The goal of this dissertation was to construct an operational model and guide for investigating holistic product experiences of child-users in order to inform and expand the early design process with child-centred perspectives. For this purpose, first a literature review and a systematic review were conducted on the methodological approaches to early involvement of children in the design phases. This was followed by an overview of the user experience models as a reference for conceptualising product experience of children. Following the gaps in the contemporary user research trends with children, a methodological exploration focusing on children's making sense of product experience was then complemented with contextual observations for a holistic inquiry. The resulting output is the EPO research model, and CEPT and Shared Discovery as two complementary techniques suggested to be utilised within the EPO framework.

This concluding chapter begins with looking back at and reflections on the research questions posed in the introductory chapter. After, implications and limitations of the study, as well as directions for further research are discussed.

7.1 Reflections on the Research Questions

In the first chapter, the following research questions were asked in order to frame the scope of the research:

1. What are the state-of-the-art methodological approaches to user research with children? (Chapter 2)

2. What are the critical dimensions affecting children's product experiences, and to what extent do contemporary early stage methods correspond to them? (Chapter 3)
3. In which ways can we elicit and integrate the various factors affecting children's product experience to present a holistic capture of the user space to inform the design process? (Chapters 4 & 5)

In the following sub-sections, these questions will be answered with reference to the research presented in relevant chapters and the inferences drawn from them.

7.1.1 Contemporary Methodological Approaches to User Research with Children

As outlined in Section 2.4, literature review shows that methodological approaches to early involvement of children evolve in two axes. First one frames and guides long-span participation of children from initial inquiries to prototyping and testing (informant, design partner, etc.). Second approach consists of early exploration of the user space through generative methods (contextmapping, design ethnography, low-tech prototyping) with no specific focus on the product. Both approaches dominantly focus on participatory methods and techniques, hence require either direct involvement of children in design activities, or of designers and developers in research activities.

Although the importance of early involvement of children is acknowledged, the systematic review in Section 2.5 shows that the dominant form of children's contributions still remain to be in the form of testing and evaluating the prototypes. A closer look at the early involvement methods reveal the fact that the most popular method in the early design phase is observation, which is followed by the use of participatory methods with an assumed role of informants or design participants for children. The use of participatory design methods with children are well explored in the field, with many recommended tools and techniques, as well as immense methodological discussions. However, despite such popularity, there are no specific guidelines let alone techniques described to observe child-users in the early design phases.

As the content analysis shows, design research with children mostly employ observation or participatory methods. For this reason, the focus of inquiry is mostly the product or system to be designed or the context of use and user practices, whereas attitudinal research yet remains to be explored. This points out to the fact that there is no systematic research on what children have to *say*, and focus is mostly on what they *do* or *make*. Also, these early methods mostly conduct user research only after the design brief to describe and narrow down the problem, rather than exploring the user space to expand and inspire the design possibilities.

Additionally, there appears to be an awareness of children's developmental characteristics in designing for and conducting user research with young users (Section 2.2). Although this awareness can be a useful theoretical ground when designing for children, such emphasis on the developmental capabilities (or limitations) of children misdirects the attention towards what children can or cannot do with products, rather than how themselves make sense of this experience. Also, emphasis on the developmental issues reinforce the adult/designer constructions of child-users in a generalising way, which can lead to overlooking diversities among them. In this direction, instead of paying much effort on adapting child-friendly research methods, more attention should be given to emphasise the expertise of children in their own lives in order to be able to challenge our adult conceptions about them, hence gain a better understanding of how they themselves conceptualise their experience. This issue is accentuated by the fact that much of the research has been in the domain of education, which prioritises institutional learning goals rather than the child perspectives, and children's contribution usually remain to be in the formal qualities of the design, rather than the content and the structure.

7.1.2 Critical Dimensions Affecting Children's Product Experiences

A holistic understanding about children's experiences requires a multifaceted inquiry into various factors that would be relevant to how children interact with products. As outlined in Chapter 3, in order to have a better comprehension of the product experience, and inspire the design of products that potentially lead to meaningful experiences, it is vital to consider the personal, social and material aspects of the user

experience. This implies both conceptual and contextual inquiries, the former being on how children make sense of the product features, their likes and preferences, and the latter is on the in situ factors such as how products find meaning and are used in context.

Exploring the conceptual factors requires the use of explicit, self-report methods and techniques of inquiry to have an understanding about how certain features are perceived and assessed by children. Such exploration allows us to comprehend the mental imagery of child-users regarding the products in question, their concerns, preferences and expectations from these products, and have a chance to compare it against and challenge our adult-designer models of child-users. On the other hand, contextual exploration can be made through observations or longitudinal self-documentation techniques such as diaries and cultural probes, in order to inquire the contextual factors within which the product to-be-designed will be used.

When investigated and interpreted through this lens, current design research practices with children presented in Chapter 2 show a general trend that avoids asking direct questions to children and seeking for explicit responses regarding their concerns and expectations in the pre-design phase, especially with younger children, even though they are said to be considered as reliable and able informants of their lives. This gap in the literature was also the starting point of the methodological inquiry of this dissertation

7.1.3 Eliciting and Integrating the Factors Affecting Children's Product Experience

The issues and concerns raised in the experiential models and designers' needs point out that we should examine both conceptual and contextual aspects for a holistic investigation of the experience. Considering the gap in the literature, the point of departure was how to elicit conceptual, design-relevant information from children. The accumulative insights gathered from three different field studies can be summarised as below:

- Personal Construct Psychology (PCP) provides a valid theoretical foundation for a meaning-driven approach for inquiring how children make sense of the product experience. Hence, research techniques based on PCP are fruitful in understanding children's sense-making of the product stimuli in a design-relevant way (Sections 4.1, 4.2 and 4.3).
- Children can better comprehend and cooperate in structured construct elicitation procedures when concretised with visual stimuli, in comparison to open-ended and generative procedures (Section 4.4),
- A comparative construct elicitation procedure can reveal which product attributes are favoured and why, and which aspects of experience are desired by child-users to be embodied in and supported by the future products (Section 4.4, Chapter 5),
- These elicited concerns and expectations can be prioritised and transformed into design requirements format to support design activities (Chapter 5),
- Having background PCP, which focuses on investigating subjective judgement and construing, construct elicitation also allows detection of different perspectives and expectations among children, potentially leading to diverse product concepts (Section 5.4).

In order to be able to integrate the complementary contextual factors of experience into conceptual aspects, a two-part inquiry is needed. Contextual factors can be scrutinised through observations in naturalistic settings. The following inferences regarding the exploration of contextual aspects of children's product experience can be made based on insights from the main field study (Chapter 5):

- Observations during product use sessions in a naturalistic setting and with a flexible structure yields design-relevant information by helping comprehension of how products find meaning in context,
- An empathetic observation reflecting children's product interactions from their eyes can reveal not only potential usability problems, but also children's natural responses to them, which can be an inspirational source for the design of intuitive interfaces and interactions,

- On the contrary to traditional usability testing methods, creating a social environment for observation in a naturalistic setting, even if it is for a brief and limited duration of time, sheds light on the social aspects of product experience.

From this point of view, the EPO model was constructed to inform and guide design researchers in exploring children's multifaceted product experiences. Also, CEPT and Shared Discovery techniques are suggested to inquire the issues in the EPO model (Chapter 6).

7.2 Implications of the Study

The study describes a research model with expected outcomes from a user study with children. When developing the model, diverse factors affecting children's product experiences based on experiential models, as well as the needs of the designers in design activities were taken into consideration. The implications of the model and the recommended techniques have the following implications:

- The EPO model can guide construction of research methodologies aiming to explore how children use and make sense of products in a holistic way. Such a methodology will most likely reflect the requirements of the early design activities, and can be applied for investigating children's experiences and perspectives regarding a wide range of products.
- CEPT and Shared Discovery techniques correspond to the inquiries indicated by the two steps of the EPO model. However, they can just as well be applied separately within different methodological frames:
    - CEPT can be useful in any research context which aims to explore how certain products are perceived and made sense of by children, and to understand their expectations and priorities from future products.
    - Shared Discovery, on the other hand, can provide insights into product related behaviours, and the impact of social and physical context on the ways children interact with products.
- The model and the techniques can be useful when there is no specific design brief available, and user research can guide taking major design directions. This is owed to the potential of the model to support expansion of the design

space with data-driven strategies to diversify early design concepts through a child-centred lens based on differences in child-user perspectives, as well as to detect and prioritise the design requirements in a way to lead meaningful experiences for child-users.

7.3 Limitations of the Study

The study poses the following limitations:

- The final version of the methodology was employed in a single study. Although the findings show that the methodology is promising in fulfilling the predefined goals, the replication of the procedure in different research contexts can ensure better adaptability.
- The sample of the study consists of children from middle class families, parents of whom hold university or higher educational degrees. Hence, the sample is not representative of the population.
- The interviews were conducted and the observation sessions were facilitated by a single researcher. Even though the methodology is devised in a way that can be conducted by one researcher, it is possible that the presence of a second researcher could have yielded more productive results.
- Data was collected in a limited duration of time in each study. In a longitudinal research, additional dimensions affecting children's product experiences could have been observed.
- For varying reasons, the field studies investigated children's experiences with different products. If the evolving methodology was used to explore the experience with the same product category, it could have yielded controlled study findings, and it would have been possible to focus solely on the comparative assessment of the effect of data collection procedure.
- All three field studies conducted, explored children's experience with an industrial product with tangible interaction, and for the studies exploring the experience with personal electronics (mobile phones and cameras), the main focus of the investigation was not the digital interface. For this reason, the methodological recommendations may not be fully extended to HCI research.

7.4 Directions for Further Research

Moving from the gap in the contemporary research agenda on children's product experiences, the focus of this dissertation was to develop a guide model of inquiry to respond to the requirements of the early design activities by capturing and presenting a holistic picture of children's expectations from products, as well as their product-related behaviours. For this purpose, the EPO model, a two-step inquiry into product experience through a child-centric lens, was developed based on theory and practice. Also, CEPT and Shared Discovery techniques are suggested sample techniques of inquiry for the two steps of the EPO model.

Future research can be directed towards verification, expansion or adaptation of the model and the techniques. First of all, one of the core aims of the model is to generate user information to support early design activities of the designers of children's products. Hence, designers' assessment of the findings and insights produced from research taking the EPO model as the basis of the methodology will contribute to the improvement of the model, as well as modifications on the techniques.

Second potential direction for further research can be taken towards expanding the phase of application of the research. The research model and the techniques described in this dissertation aim to support early exploration of child-users' space in the predesign phase. However, it is possible to explore their potentials at different phases of the product development process, at points where user insights can be useful in taking design directions. Such investigation will oblige adaptation of the tools and techniques in accordance with the requirements of the specific design phase, and perhaps will lead to alterations of the proposed techniques or new ones.

The research presented in this dissertation concentrates on a compact procedure of exploration of children's product experience by recommending one individual interview and one group observation session. The third path of investigation may focus on inquiring the issues which may rise in long-term product use, presumably through a longitudinal data collection procedure. In that case, the EPO model can provide the general frame for defining the expected outputs, whereas the tools and techniques of data collection should be modified for a longitudinal inquiry.

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APPENDIX A

SYSTEMATIC REVIEW PROCESS

1. Framework of analysis

Before the review of the studies, a framework consisting of the classification of the relevant dimensions was developed in order to support a structured analysis. For this purpose, an iterative methodology was adopted, as described in the following sub-sections.

1.1 Collection and initial classification of constructs

First, literature review was conducted on categorisations of user research to elicit constructs on various dimensions in design practice and research. Since construction of such analysis framework is not the central inquiry of this dissertation, the following sources and an additional literature survey constitute the basis of this investigation:

- Blythe et al. (2007): In this paper, authors present a framework for analysing user experience studies. They conduct grid analysis, citation analysis and content analysis to utilize their framework for analysing the papers submitted to the COST294-MAUSE affiliated workshop. The authors brainstorm several dimensions of research concerns and focuses in user experience studies in general, coming up with 14 dichotomous constructs under 5 categories (p. 1).
- *Töre Yargın* (2013): In her doctoral dissertation, the author compiles and categorizes different types of user research from the literature. A total of 13 dimension scales under 8 categories emerge (p. 21). These categories were expanded and referred to the original sources in the collection.

- Apart from these, 6 more dimensions were derived from the literature and added to the list of constructs. All constructs were then thematically categorised without any prior elimination. The preliminary categorisation of the collected constructs is presented in Table 12.

Table 12. Initial classification of constructs related to design practice and research

Category		Constructs			Reference
APPROACH/ THEORY		Reductive / Measuring	Holistic		*Blythe et al., 2007*
		Elemental	Gestalt		*Blythe et al., 2007*
		Problem-Driven	Possibility-Driven		*Desmet and Hassenzahl, 2012**
		Cognitive	Phenomenological / Pragmatic		*Blythe et al., 2007*
DESIGN PRACTICE	Purpose / Design Input	Measure	Inspire		*Blythe et al., 2007*
		Aim for Specified Ux	Create Circumstances to Allow Interesting Uxs		*Blythe et al., 2007*
		Testing & Evaluation	Front-End Analysis		*Wickens at al., 2004*
		Evaluation	Development / Design		*Blythe et al., 2007*
		Improvement	Innovation		*Chayutsahakij and Poggenpohl, 2002**
		Evaluation	Definition	Discovery	*Squires, 2002*
	Application / Domain	Personal	Social		*Blythe et al., 2007*
		Mono-Modal User Interfaces	Multi-Modal User Interfaces		*Blythe et al., 2007*
		Work Based	Leisure Based		*Blythe et al., 2007*
		Pragmatic	Hedonic		*Hassenzahl, 2004**
		Doing	Being		*Blythe et al., 2007*
RESEARCH	User Input	Say / Think	Do / Use	Know / Feel / Dream	*Visser et al., 2005**
		Consultant	Representative	Consensus	*Carmel et al., 1993*
		Explicit Knowledge	Observable Knowledge	Tacit / Latent Knowledge	*Visser et al., 2005**
	Research Perspective	Procedural	Conceptual		*Melican, 2000*
		Analytical / Formal	Descriptive / Informal		*Blythe et al., 2007*
	Research Purpose	Summative	Formative		*Rosson and Caroll, 2002; Bevan, 2008**
		Evaluative	Generative		*Visser et al., 2005*
		Evaluative	Generative	Explorative	*Hannington, 2007**
	Research Method	Traditional	Adaptive	Innovative	*Hannington, 2003*
		Experimental	Empirical	Theoretical	*Strickler, 1999*
		Clinical	Applied	Basic	*Buchanan, 2001*
		Understanding (What?)	Methods (How?)		*Blythe et al., 2007*
		Social Science	Humanities		*Blythe et al., 2007*
		Direct / Undisguised	Indirect / Disguised		*Malhotra, 2007*
	Research Output	Quantitative	Qualitative		*Blythe et al., 2007*
		Raw	Abstract		*Melican, 2000*
		Example Cases	General Knowledge		*Blythe et al., 2007*
		Causal	Descriptive	Exploratory	*Malhotra, 2007*

* Shows constructs gathered from additional literature survey.

Both studies categorize the constructs based on several dimensions such as purpose, method, domain, origins of methods, etc. However, since these two papers' categorisations are based on different goals, it was observed that some similar dimensions were grouped under different categories (i.e. evaluative vs. generative dichotomy was labelled as *phases of the design process* by Töre Yargın, whereas evaluation vs. development/design was labelled as *purpose* by Blythe et al.). Instead of using the categorisations proposed by the authors, the constructs were subjected to re-grouping. Since these constructs are mainly related to user research in general, maintaining diversity was important to adapt them into the specific domain of user research with children, the process of which is explained further in the following sections.

Approach/Theory refers to the general attitude in the purpose, process and outcome of the research and practice. *Design practice* includes constructs related to the design activities, such as design phase, aim, expected outcome, and domain of application. *Research*, on the other hand, involves the aim and type of the research, its contribution to the field and design practice, as well as the extent and types of input provided by the users.

1.2 Categorization, testing and refinement of the constructs

The aim of this step was to define and organise emerging categories and sub-categories in a way to prevent repetitions without losing the diversity of the concepts, and tailor them in accordance with the requirements of the analysis of design and research practices with children. For this purpose, elicited constructs were subjected to a secondary classification and abstraction. Since this categorisation is based on user research in relation to design practice in general, there emerged the necessity to test its applicability in design research with children. For this purpose, 2015 full paper proceedings of the Interaction Design and Children (IDC) conference were reviewed. Of all the 24 full papers published, 20 of them reported on both user research with children, and its implications on the design process. In order to be able to investigate both user research and how it is utilized in design, these 20 papers were included in testing in order to assess the applicability and generalizability of the constructs and

categorisations in the preliminary framework. The coding procedure was based on the predefined constructs in the framework.

Based on the insights of the testing, the categorisation and organisation of the constructs were modified. *Table 13* shows the modified final categorisation. The categories in this framework should not be treated separately, but rather they reflect the mutual contribution to each other. For instance, the type of research has an input to the decisions taken in design practice, as much as the aimed purposes of the design output effects the decisions taken in research design.

Table 13. Final categorisation of the constructs

DESIGN			
Phase of application	Testing	Idea Generation	Pre-design
Input for design process	Measure	Improve/Iterate	Inspire/Innovate
Domain of design outcome	Learning	Edutainment	Leisure
USER			
Degree of participation	Tester	Informant	Design participant
Means of participation	Explicit know.	Observable know.	Tacit know.
RESEARCH			
Data collection & analysis	Quantitative	Mixed	Qualitative
Expected data outcome	Causal/Procedural	Descriptive	Explorative/Conceptual
Scope of research outcome	Case-specific	Domain	Theory/Method

Phase of Application. The first subcategory regarding the design process refers to the phase of design in which user research is conducted. Children can be involved at various stages of design, all of which would result in different inputs for the design output. User research can be conducted at the *pre-design* phase, or the "fuzzy front-end" of design, preceding idea generation, and in some occasions, even design brief. Children can be informants or design partners, having a chance to influence major design decisions regarding both the structure and the content.

When user research is conducted during *idea generation* phase, the purpose is typically to evaluate early design concepts to re-define the following design decisions. In our categorization, this construct refers to a rather flexible phase compared to *testing*. Although testing of hi-fi prototypes can also result in iterations of the designed solution, the changes are usually minor and made due to usability issues. However, in

the idea generation phase, children can test and inform through lo-fi prototypes, concepts, and multiple iterations of the same design, or they can be partners in the design of certain modules of the system, such as content generation.

Input for Design Process. This subcategory refers to what sort of input user research provide for the design. In other words, it is about the purpose of the involvement of children. One purpose of the user research may be to *measure* the impact of the designed solution. This is typically conducted as summative evaluation, during which the impact of the technology, such as for learning or skills acquisition, is measured based on pre-defined criteria. In such studies, most of the time no explicit intention for improvement or iteration is suggested. As expected, being involved for this purpose, children are given a rather passive or indirect role, such as through administered pre/post-tests or activity log files.

User input might also contribute to *improve/iterate* the product by evaluation and user feedback to define a path for improvement or new design possibilities. Such input would be useful in either idea generation or testing phases. Children may evaluate the prototypes with different levels of fidelity, and their input is expected to be incorporated in further design iterations. Another purpose of user research is to *inspire* novel products through *innovative* designs. Inspirational input is most likely to be provided from user research in the pre/early design phase, when there is no specific product concept has been suggested by the developing team yet. Although innovation not necessarily stems from the user (i.e. technology-driven), our description applies when user input is the major source of innovation.

Domain of Design Outcome. This category stemmed from 'work based' vs. 'leisure based' and 'pragmatic' vs. 'hedonic' dichotomies, and modified according to the emergent terminology used by the IDC community. *Learning* means the design solution focuses solely on children's academic learning or skills development, mainly in an educational setting such as classroom and museum; but sometimes also at places not necessarily marked as educational settings, such as home or outdoors. When the domain of the design outcome is learning, there are usually other stakeholders involved, including teachers, pedagogues, and parents.

We use *edutainment* when the design outcome aims to gamify learning experiences of children by integrating entertainment with education. This construct is easy to confuse with learning, as significant number of educational technologies utilise gamification strategy to make it more appealing to children. We draw the line by looking for explicit statements of both gamification and learning aspects in the studies. *Leisure*, the final construct under this subcategory, focuses on extracurricular product experience of children, with no pre-defined learning goal. Games, or products aiming to improve well-being of children, are examples to this domain.

Degree of Participation. For this subcategory regarding the user input, Druin's (2002) classification was taken as basis. One interpretation of 'relationship to technology' in her framework can be that it refers to the level of fidelity of the design medium; which is related to the phase in which user research is conducted, the kind of input expected to be gained through users, as well as means of user participation. In the *tester* role, as the name suggests, children are asked to test the prototypes and give feedback for further improvement. Or, they are even more passive subjects who use the prototypes, so that the impact of design is measured through standardised tests.

The definition of *informant* here is different than imposed by "informant design". Children may assume informant role during idea generation by giving feedback on multiple or lo-fi prototypes and concepts. They can also inform the developing team to define design requirements in pre-design phase. In the latter, the role sometimes may be similar to that of *user*, as in ethnographic methods where children can be observed when using and/or reflecting on existing products. In this sense, the user role in the framework only partially corresponds to the informant role, since children's input inform the design of future products. In *design participant* role, children are either equal partners in a design team, or asked to co-design certain modules or contents of the system via generative methods during pre-design or idea-generation phases.

Means of Participation. This subcategory refers to with what type of knowledge children contribute to the design process. Means of participation is strongly connected to the role assumed by children, as well as data collection methods. *Explicit knowledge*

can be gathered through methods and techniques that require direct and open articulation. Children can be asked for opinions and feedback through structured or open-ended interviews and surveys at various steps of design, or the impact of designed technology can be measured through administered pre/post-tests.

Observable, or implicit knowledge, is the type of user knowledge that is hard to explicitly articulate, and can be unsurfaced in an operational setting. For example, in ethnographic studies, implicit knowledge embedded in practice (i.e. observation) is often triangulated with explicit knowledge (i.e. interviews) for a holistic picture of the experience. *Tacit knowledge* and latent needs, on the other hand, are suggested to be surfaced 'in the making' through generative and participatory methods (Visser et al., 2005).

Data Collection and Analysis. Studies that aim to measure the impact of the designed technology usually employs structured means of data collection and analysis, such as standardised tests, questionnaires, or activity log files, which results in procedural data and *quantitative* measures. *Qualitative* means of data collection and analysis are likely to stem from content analysis of observational material and interviews. Using *mixed* techniques is another strategy, which enables triangulation of both qualitative and quantitative data.

Expected Data Outcome. This subcategory is about the characteristics of the data gathered as an input for the design process. *Causal/procedural* data highlights step-by-step, cause-effect relationships, such as activity flows, or usage scenarios. For example, user studies focusing on usability improvement from a cognitivist approach would fall under this construct. *Descriptive* data outcome aims to describe several variables playing role in children's user experience, possibly informing design requirements and strategies. Although it sounds to fit in pre-design research, it is also possible to come up with such requirements somewhere in the middle to focus on improving a certain function or module of the system, or describe and propose these requirements for future studies as a result of testing an existing product.

Explorative/conceptual output is not necessarily directly associated with the product or system in question. It might provide us a general understanding on the subject of

inquiry, such as children's attitude towards bullying. Naturally, such an outcome would apply to a greater extent. Explorative/ conceptual inquiries might be easy to confuse with descriptive ones, as they also do a description of sorts. However, descriptive inquiry tends to narrow down the problem area, while explorative inquiry expands it to unravel various opportunities and areas to further focus on.

Scope of Research Outcome. Scope is related with to what extent the output of the user research is generalizable, and it has a strong connection to the expected data outcome. *Case-specific* studies focus on generating data to be utilised specifically in the ongoing project. Although it is possible to infer more generalizable results from these studies to inform a broader range of future projects, it is expected that these inferences be drawn from multiple cases or supported from models and frameworks existing in the literature to generate *domain* knowledge. For example, drawing conclusions about shared aspects, strategies etc., these can practically and theoretically guide future research in the same domain (i.e. math learning, multi-touch interaction, etc.).

The broadest scope defined is *theory/method,* the extent of which either can be generalizable, or allows cross-domain application. As an example; Druin suggests that in the role of the users and testers, children might contribute to researchers develop an educational theory, while direct and extensive contribution (informants and design partners) results in better usability within the case in question. Alternatively, if the focus is on developing a new or improving an existing method, hence the output focus is the method itself and not the product per se, it is also possible to say that this method can be utilised in different studies across various domains.

2. Methodology

The analysis framework was utilised in a systematic review of the seven years of the IDC full paper proceedings published from 2010 to 2016. Due to the structure of the framework, only the papers explicitly reporting a user study which informs a design process, even if it is in planning phase, were included in the review. Of all the 158 papers published during these years, 127 of them fits in this inclusion criteria, 20 of which fully report two different user studies at different phases of design. Since the

research methods, user role and goals for contribution to design differs in multiple user studies reported in a single paper, these studies were analysed separately. In total, 147 studies in 127 papers were included in the final analysis.

3. Analysis

The review is fundamentally a content analysis procedure, which consists of (1) elimination of papers which doesn't fit in the inclusion criteria, (2) coding of each paper based on the constructs predefined in the framework, (3) and analysis to come up with independent frequencies of each construct. Since the constructs for each category are not always stated explicitly in the papers, each paper was carefully read to match the content with the predefined definitions of the constructs. During coding procedure, the papers which do not fit in the inclusion criteria were also identified and excluded. The author of the dissertation reviewed the whole data set, while an external researcher independently coded approximately 10% of the data (11 papers, 14 studies). The coding schemes of both researchers were compared and the interrater reliability was 79%. After one round of discussions on the disagreements, agreement rate was up to 89.75%.

4. Findings

Of all the 127 papers, 20 of them (15.75%) report multiple user studies. Independent frequencies for each construct are presented based on the number of studies in a bar chart in Figure 55.

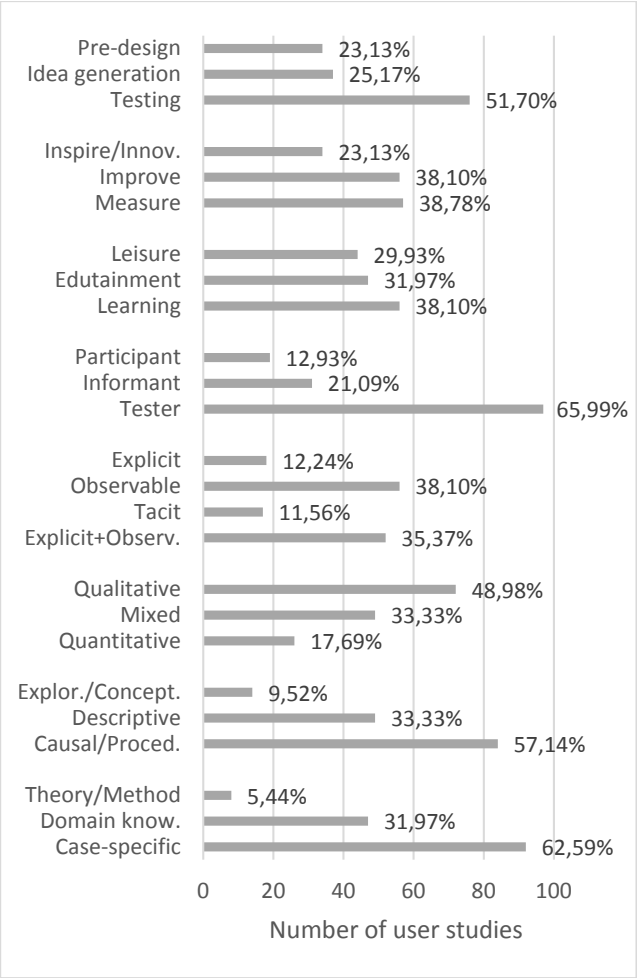


Figure 55. Independent frequencies for each construct based on studies

Phase of application. The results show that studies involving direct contribution of children mostly tend to do so in the *testing* (51,70%) phase of the design process. This is consistent with (Yarosh et al., 2011), who reviewed the IDC papers of the previous years. Involvement of children in *pre-design* (23,13%) or *idea generation* (25,17%) phases show a similar rate.

Input for design process. Children's input is usually utilised for *improvement* of the product or system (38,10%), or *measuring* the impact of it (38,78) such as its ability to support a learning outcome. Only 23,13% of the studies consult to the contribution of children for *inspiring* innovative and novel design concepts.

Domain of design outcome. Less than one-third (29.93%) of the studies report developing systems for *leisure*, meaning with no predefined learning goals. Aiming to develop a product or system for *learning* purposes 38,10% is the most common trend, which is followed by *edutainment* systems (31,97%).

Degree of participation. The dominant form of participation of children is as *testers* (65,99%). The reason for this percentage being larger than the rate of involvement in the testing phase of design (51,70%) is that children can also be involved as testers of design concepts or lo-fi prototypes during idea generation as well. 21,09% of the studies casted an *informant* role for children, whereas design *participant* role is 12,93%.

Means of participation. The type of knowledge children contribute to the design process is mostly *observable* (38,10%), while mere *explicit* (12,24%) or *tacit* (11,56%) knowledge is rarely a form of participation. When consulted to explicit means of participation of children, it is usually accompanied by observations (35,37%).

Data collection & analysis. *Qualitative* methods of data collection and analysis (48,98%) is quite common in studying with children. In 33,33% of the studies, *mixed* methods were used. However, the use of mere *quantitative* methods is considerably low (17,69%).

Expected data outcome. More than half of the studies generate *causal/procedural* data (57,15%) focusing on one-to-one interaction flow of the child with the system or product in question. One-third (33,33%) of them results in *descriptive* data which informs requirements for design or improvement. 9,52% of the studies aim to *explore* relevant concepts and potential points of intervention.

Scope of research outcome. Vast majority of the studies result in *case-specific* knowledge (62,59%) usable for the project in question. Almost one-third (31,97%) contribute to *domain knowledge* which can be usable in a relatively broader term, whereas only 5,44% of the results of the studies contribute to a *theory or method*.

APPENDIX B

LIST OF REVIEWED PAPERS

Table 14. List of reviewed papers

Paper	Authors	Methods used	Focus of inquiry
1	(Bonsignore et al., 2016)	Co-design (Cooperative inquiry)	Product-focused
2	(Fisher, Yefimova, & Yafi, 2016)	Co-design (Generative)	Context-focused
3	(Rhodes & Walsh, 2016)	Observation (Lab / Controlled)	Practice-focused
		Interview (Not specified)	Practice-focused
		Co-design (Lo-fi prototyping)	Product-focused
4	(Gourlet, Eveillard, & Dervieux, 2016)	Observation (Field / Natural)	Context-focused Practice-focused
5	(Mora-Guiard, Crowell, Pares, & Heaton, 2016)	Co-design (Lo-fi prototyping)	Product-focused
6	(McRoberts, Bonsignore, Peyton, & Yarosh, 2016)	Archive (Child-generated YouTube videos)	Practice-focused
7	(Anthony, Stofer, Luc, & Wobbrock, 2016)	Observation (Field / Natural)	Practice-focused
8	(Leite & Lehman, 2016)	Observation (Lab / Controlled)	Practice-focused
		Survey (Fun toolkit)	Attitude-focused
9	(Chu, Saenz, & Quek, 2016)	Observation (Field / Natural)	Practice-based
		Survey (Standardised)	Practice-based
10	(Alessandrini, Loux, Serra, & Murray, 2016)	Observation (Field / Natural)	Context-focused Practice-focused
11	(Sobel, O'Leary, & Kientz, 2015)	Observation (Field / Natural)	Context-focused Practice-focused
		Co-design (Lo-fi prototyping)	Practice-focused
12	(Hiniker et al., 2015)	Observation (Lab / Controlled)	Practice-focused
13	(Webster et al., 2015)	Co-design (Generative)	Product-focused

Table 14. List of reviewed papers (continued)

Paper	Authors	Methods used	Focus of inquiry
14	(Petersen, Rasmussen, & Jakobsen, 2015)	Observation (Field / Natural)	Context-focused Practice-focused
		Artefact analysis (Children's constructions with interactive materials)	Practice-focused
15	(Bartoli, Garzotto, Gelsomini, Oliveto, & Valoriani, 2014)	Observation (Field / Natural)	Context-focused Practice-focused
16	(Lindberg, Wärnestål, Nygren, & Svedberg, 2014)	Co-design (Lo-fi prototyping)	Context-focused Product-focused
17	(Emanuel & Stanton Fraser, 2014)	Co-design (Lo-fi prototyping)	Product-focused
		Interview (Semi-structured)	Attitude-focused
		Survey (Open-ended)	Attitude-focused
18	(Hamidi, Saenz, & Baljko, 2014)	Co-design (Lo-fi prototyping)	Product-focused
19	(Leong & Horn, 2014)	Observation (Field / Natural)	Context-focused Practice-focused
20	(Yip et al., 2014)	Observation (Field / Natural)	Practice-focused
		Interview (Not specified)	Practice-focused
		Co-design (Cooperative inquiry)	Product-focused
21	(Rubegni & Landoni, 2014)	Observation (Field / Natural)	Context-focused Practice-focused
		Interview (Focus group)	Attitude-focused
22	(Durrant et al., 2013)	Observation (Field / Natural)	Context-focused Practice-focused
23	(Meckin & Bryan-Kinns, 2013)	Observation (Field / Natural)	Context-focused Practice-focused
24	(Celis et al., 2013)	Interview (UX laddering)	Attitude-focused
25	(Anthony, Brown, Nias, & Tate, 2013)	Observation (Lab / Controlled)	Practice-focused
26	(Smith et al., 2013)	Co-design (Ecological inquiry)	Context-focused Practice-focused
27	(Yip et al., 2013)	Co-design (Cooperative inquiry)	Product-focused
28	(Jensen, Burleson, & Sadauskas, 2012)	Observation (Field / Natural)	Context-focused Practice-focused
29	(Iversen & Smith, 2012)	Co-design (Collaborative workshops)	Product-focused Practice-focused
30	(Desjardins & Wakkary, 2011)	Interview (Drawing-telling)	Context-focused Attitude-focused
31	(Wang, Zhang, & Wang, 2011)	Observation (Field / Natural)	Context-focused Practice-focused
		Interview (Not specified)	Practice-focused

Table 14. List of reviewed papers (continued)

Paper	Authors	Methods used	Focus of inquiry
32	(Arteaga, Kudeki, Woodworth, & Kurniawan, 2010)	Survey (Standardised)	Attitude-focused
		Interview (Focus group)	Attitude-focused
33	(Mazzone, Iivari, Tikkanen, Read, & Beale, 2010)	Co-design (Lo-fi prototyping)	Product-focused

APPENDIX C

INFORMATIONAL NEEDS OF DESIGNERS

Table 15. Informational needs of designers (adapted from Töre Yargın, 2013)

Strategy & impact (goal)	Designer's needs (why)	Quality (how)
Multidimensionality Obtaining and delivering multidimensional data: *Empathy* *Inspiration* *Guidance*	Information regarding original design requirements that are not foreseen by the design team -> can lead to more generative results	Reflect diversity of the sample by pointing out information collected from different types of users
	Multidimensional thinking: Providing all relevant factors regarding product qualities and user's perceptions	User's perceptions are verbalized with abstract concepts by the user and they need to be clarified by referring to attributes of concrete product examples that causes user's perception (i.e. Infographics showing relative importance of the factors)
	Observe multiple perspectives and consider different variables that have effects on user actions	Video recordings of the users' actions from different perspectives
In-depthness Maintaining in-depthness: *Empathy* *Inspiration*	Understanding & interpreting underlying reasons of user behaviour and evaluations	Raw data in the form of organized transcriptions and video recordings are considered as in-depth data that the designer can investigate while searching for underlying reasons for problems and needs
	Avoiding superficiality	Supporting quantitative findings with their explanations and referring users' expressions or actions or providing images from the context of use and research setting

Table 15. Informational needs of designers (adapted from Töre Yargın, 2013) (continued)

Strategy & impact (goal)	Designer's needs (why)	Quality (how)
Credibility Providing credible information that the design team can rely on: *Having feedback* *Guidance* *Justification*	Obtaining reliable and valid info - understanding actual needs and problems *Credibility of the methodology: Setting	Natural setting with disguised manner is found more credible compared to laboratory setting
	Obtaining reliable and valid info - understanding actual needs and problems *Credibility of the methodology: Procedure	Presence of stimuli in the form of actual products
	Obtaining reliable and valid info & Ability to access the credibility of info -Having own interpretations, understanding users' actual problems and needs and getting to know user's behaviours in-depthly by assessing whether there are discrepancies between user's statements and their behaviour	Raw materials in the form of transcripts and video recordings should be provided so that the designer can review them to be able to assess the credibility of the information if s/he wants
Persuasiveness Providing persuasive data to convince designers and other team members: *Having feedback* *Guidance* *Justification*	Ability to persuade (himself/herself) on design decisions	Backing up the findings by providing video recordings regarding critical comments and actions
	Supporting researcher's interpretations with raw data, receiving clear and convincing feedback	Filtered raw data highlighting critical comments of users by giving quotations and video recordings
	Receiving clear and convincing feedback, persuading other stakeholders especially managers	Quantitative and generalizable evidence

APPENDIX D

PARENTAL CONSENT FOR EXPLORATIVE STUDY 1 (TURKISH VERSION)

Bu anket çalışması, Orta Doğu Teknik Üniversitesi Endüstri Ürünleri Tasarımı Bölümü'nde yürütülen "Anaokulu çocuklarıyla yaratıcı tasarım araştırması" konulu proje kapsamında yapılmaktadır. Projenin amacı, anaokulu çocuklarının çeşitli yaratıcı tekniklere yönelik tercihlerine dair bilgi elde etmektir. Bu anket çalışmasının amacı, proje oturum çalışmasına katılacak çocuğun yaratıcı tekniklere yönelik bilgi ve becerilerini araştırmaktır. Anket çalışması ortalama 5 dakika sürecek olup, katılımcı açısından herhangi bir tehlike oluşturmamaktadır.

Bu formu imzalayarak yapılacak görüşme konusunda size verilen bilgiyi anladığınızı ve görüşme yapmayı kabul ettiğinizi belirtmiş oluyorsunuz. Formu imzalamış olmanız yasal haklarınızdan vazgeçtiğiniz anlamına gelmemektedir. Bu oturum çalışmasının kayıtları ve sonuçları yalnızca bilimsel amaçlı yayın ve sunuşlarda kullanılacak, anket ya da oturum katılımcısının kişisel bilgileri başka kişilerle kesinlikle paylaşılmayacaktır.

Çocuğum.....'nin yaratıcı tekniklerle ilgili bilgi ve becerilerini araştırmaya yönelik olan bu anket çalışmasına katılmayı gönüllü olarak kabul ediyorum.

Katılımcının:		*Araştırmacının:*	
Adı Soyadı	:.....	Adı Soyadı	:.....
Tarih	:.....	Tarih	:.....
İmza	:	Imza	:

APPENDIX E

POSTERS USED IN EXPLORATIVE STUDY 1

Figure 56. Slide poster used in explorative study 1

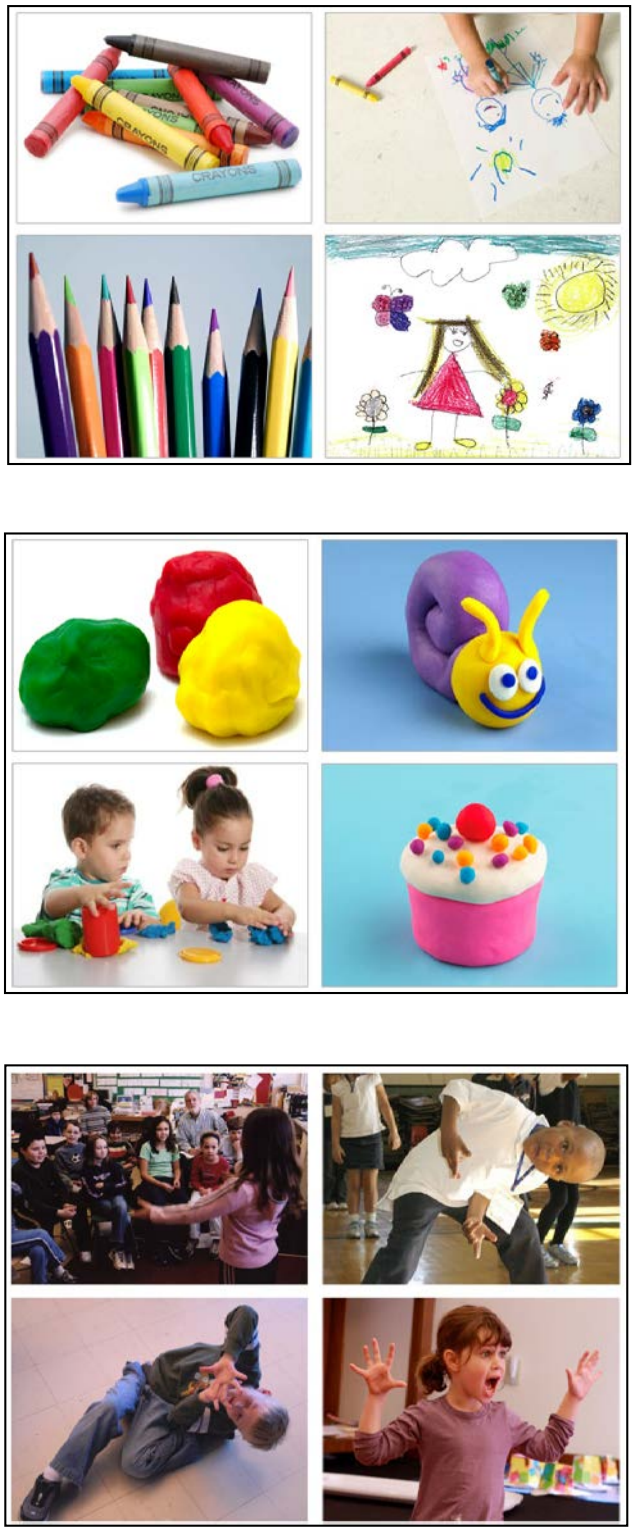


Figure 57. Technique posters used in explorative study 1 (drawing, clay modelling, drama)

APPENDIX F

BACKGROUND QUESTIONNAIRE IN EXPLORATIVE STUDY 1

1. Çocuk aşağıdaki yaratıcı teknikleri daha önce kullandı mı? *Has the child experienced the following generative techniques before?*

Resim/Çizim: *Drawing*	Evet ○ *Yes*	Hayır ○ *No*
Oyun hamuru şekillendirme *Clay modelling*	Evet ○ *Yes*	Hayır ○ *No*
Öykü anlatma/Drama *Storytelling/Roleplaying*	Evet ○ *Yes*	Hayır ○ *No*

2. Çocuğun bu yaratıcı teknikler için kullandığı/bildiği isimler nelerdir? *What is the familiar terminology for the child for these techniques?*

Resim/Çizim: *Drawing*	
Oyun hamuru şekillendirme *Clay modelling*	
Öykü anlatma/Drama *Storytelling/Roleplaying*	

3. Çocuğun bu yaratıcı tekniklere olan ilgi ve becerisini nasıl değerlendirirsiniz? *How would you evaluate the child's interest and mastery in these techniques?*

	İLGİ *INTEREST*			BECERİ *MASTERY*		
Resim/Çizim *Drawing*	1	2	3	1	2	3
Oyun hamuru şekillendirme *Clay modelling*	1	2	3	1	2	3
Öykü anlatma/Drama *Storytelling/Roleplaying*	1	2	3	1	2	3
	Az *Low*	Orta *Med.*	Çok *High*	Az *Low*	Orta *Med.*	Çok *High*

APPENDIX G

CROSS-IMPACT MATRIX

CAUSAL (impact)		EFFECTED (dependency)																		
		accessibility	aesthetic appeal	age appropriateness	audibility	durability	ease of use	familiarity	fun	gamability	multifunctionality	novelty	personification	portability	product expression	readibility	understandibility	visibility	writability	TOTAL
	accessibility	7		1			41		2	13	9	3				3			2	81
	aesthetic appeal		46	1					1			2								50
	age appropriateness			1																1
	audibility			2	26		1													29
	durability		1			16													1	18
	ease of use	1		2		2	31			25	2	1				4			24	92
	familiarity	2	15	2	5	2	11	47	1	9	4	4		1	1		5		2	111
	fun			3					4											7
	gamability			3				1	2	12										18
	multifunctionality	1		3	1			5	2	1	21	8								42
	novelty		4		2				1	3	7	9								26
	personification		15	4				10	1				2		1					33
	portability		1	3		1	1	1						54						61
	product expression		19	9		1		19	3			5		2	1					59
	readability	4	2	3			5	2		5		1				45	1		2	70
	understandability	6	2	2	1		18	3		6	1	2					3		3	47
	visibility	57					19	2		1	6						3	1	22	111
	writability	1				1	13		3	3									4	25
	TOTAL	72	59	38	9	7	109	43	16	66	29	26	0	3	2	7	9	0	56	

Figure 58. Cross-impact matrix

APPENDIX H

CROSS-IMPACT CHART

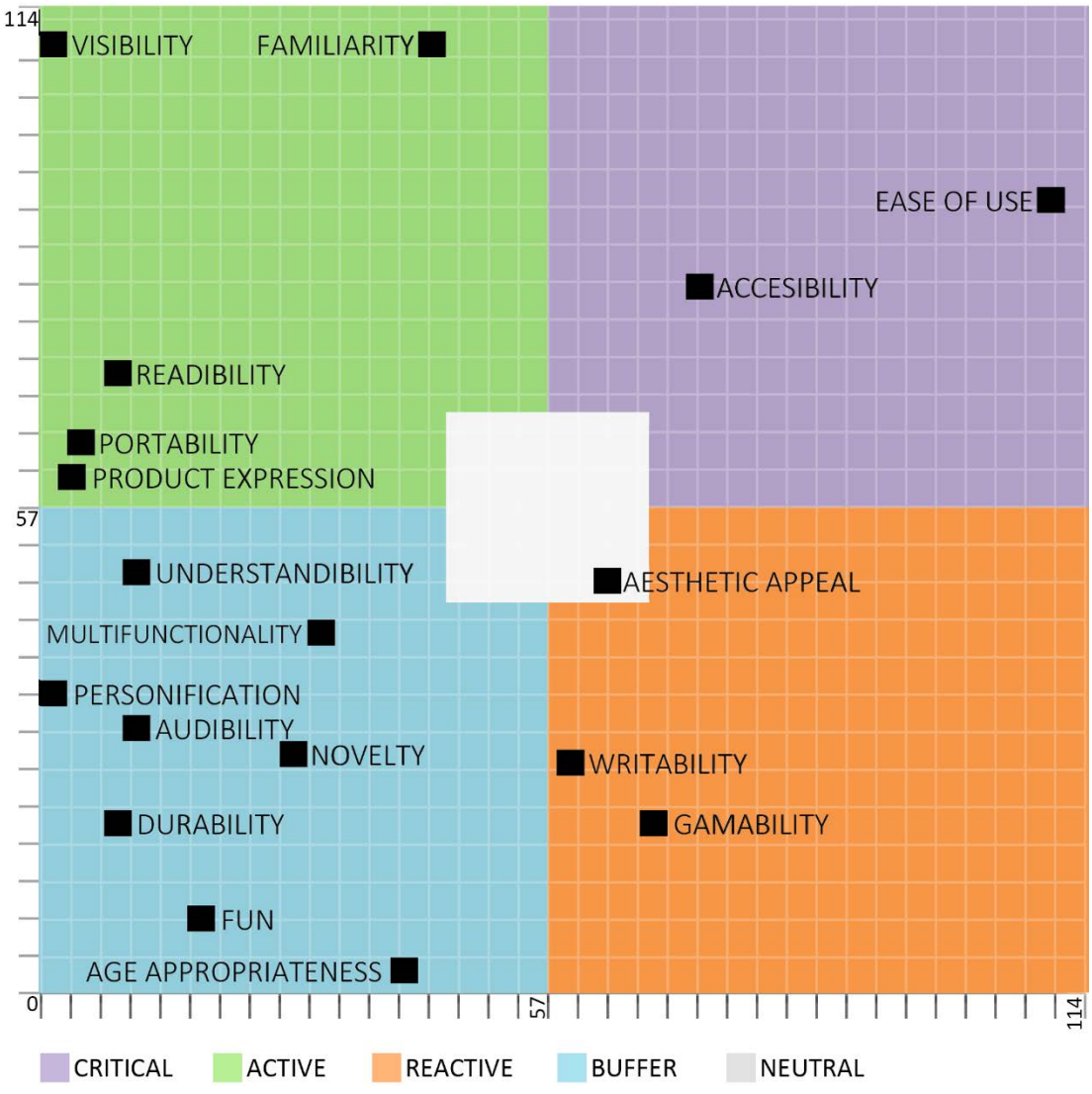


Figure 59. Cross-impact chart

APPENDIX I

ATTRIBUTE-DIMENSION IMPACT MATRIX

		ATTRIBUTE												
		application	body color	body form	body material	body size	control color	control layout	control number	control size	control type	screen color	screen size	TOTAL
CONSEQUENCE	accessibility	30	0	0	0	2	2	22	13	1	62	1	16	149
	aesthetic appeal	7	28	28	6	3	2	1	1	0	5	22	6	109
	age appropriateness	7	4	7	0	6	0	0	2	1	6	0	3	36
	audibility	1	0	27	0	0	0	0	1	0	1	0	3	33
	durability	1	0	6	8	1	0	3	1	0	4	0	0	24
	ease of use	13	0	2	0	2	3	22	51	10	74	1	16	194
	familiarity	8	8	42	3	5	1	1	17	2	32	2	2	123
	fun	5	1	2	1	1	2	0	4	0	5	0	0	21
	gamability	12	0	0	0	0	0	3	14	1	37	2	8	77
	multifunctionality	30	0	0	1	4	0	0	18	0	5	1	8	67
	novelty	10	1	2	6	2	0	0	5	0	10	1	1	38
	personification	0	0	32	1	0	0	0	0	0	0	0	0	33
	portability	0	0	35	2	25	0	1	0	0	0	0	0	63
	product expression	0	8	21	10	3	0	1	1	0	6	9	0	59
	readability	0	1	0	0	0	2	0	0	1	1	14	45	64
	understandability	3	0	3	0	0	1	1	20	0	23	1	0	52
	visibility	23	0	0	0	1	5	12	21	0	37	0	0	99
	writability	1	0	0	0	0	1	1	38	4	26	0	7	78
	TOTAL	151	51	207	38	55	19	68	207	20	334	54	115	**1319**

Figure 60. Attribute-dimension impact matrix

APPENDIX J

COMPARISON OF MOBILE PHONES AND CAMERAS

Table 16. Assessment of product categories

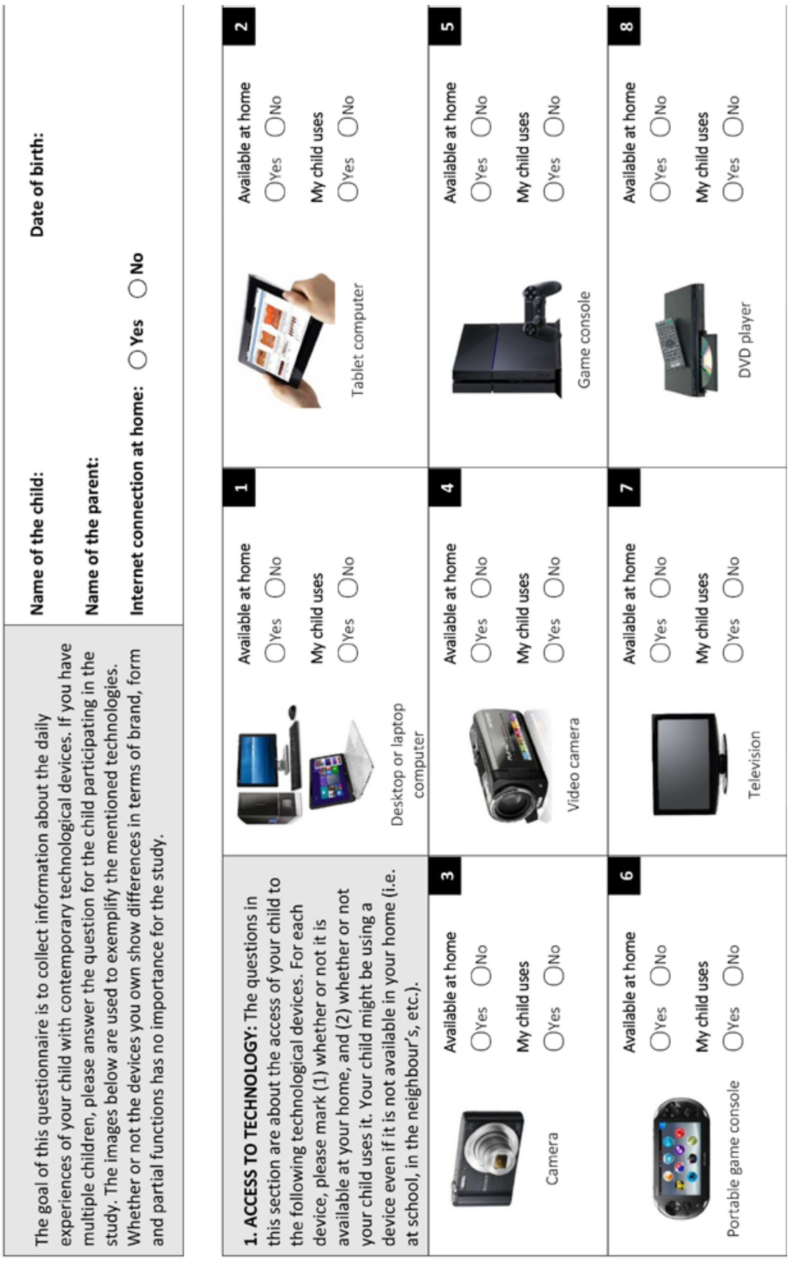
DIMENSION	MOBILE PHONE (+)	CAMERA (+)
Multidimensionality: *Providing all relevant factors regarding product qualities and user's perceptions*	Although it is a product primarily designed for personal use, it is also visible, because of its use in public space. Being a product that is favoured both in terms of its technical specifications and its social significance helped exploring both pragmatic and hedonic aspects of meaning.	Cameras are also products of personal use in public space, which is expected to reveal both pragmatic and hedonic aspects of meaning.
Multidimensionality: *Information regarding original design requirements that are not foreseen by the design team*	Although the real products could not be obtained, there are various alternatives in the market which are designed specifically for children's use. This provided the opportunity to explore and detect the mismatches between the adult and child perspectives (i.e. reduced function, "child-friendly" form and interface)	The cameras designed for children follow a design strategy similar to the mobile phones: reduced technical functions, and "child-friendly" looks.
Credibility: "Obtaining reliable and valid info - understanding actual needs and problems"	The children were not the owners/holders of the products, or any other mobile phones for that matter. However, being either observers or "part-time" users, they have experience to some extent, which they could reflect on during interviews.	Although they may not always be behind the camera, they are familiar with the concept of photography in a social context and they are not required to have technical expertise.
In-depthness: "Understanding & interpreting underlying reasons of user behaviour and evaluations"	Mobile phones support multiple functions, which prevents us from narrowing down the scope and focus on a particular experience. This resulted in expansion of the comments in a comprehensive way, while limiting the in-depthness of the investigation.	When limited to "image capturing", it will be possible to focus on a limited set of functions for an in-depth investigation.
Multidimensionality: "Providing all relevant factors regarding product qualities and user's perceptions"	In the upcoming contextual exploration session, users may potentially focus on the software qualities [due to the high number of functions supported by the product], which would shift the scope of the study.	Both digital and tangible interactions are significant. Existing products differ not only in terms of technical specifications, but also physical interaction and form.

Table 16. Assessment of product categories (continued)

DIMENSION	MOBILE PHONE (+)	CAMERA (+)
Credibility: "Obtaining reliable and valid info - understanding actual needs and problems"	The products designed for children's use are not available in local market. Even if they could be obtained, they would not fully function since they are sold with pre-paid contract that is available only in the sold country, which means no GSM service. This would lead to technical limitations in actual use during a potential contextual exploration session.	Does not hold the mentioned technical limitations. They can fully function regardless of country of origin and use.
-	For the same reasons specified above, there is no Turkish language support. (This limitation is valid for most technological products designed for children due to the lack of a significant local market, firms rarely offer Turkish language support.)	Although some children's cameras provide Turkish menu support, most do not. However, software support is a less significant issue when limited with image capturing experience, since the functionalities are not much varied as in mobile phone usage, the textual information is has less significance, and most interactions are also tangibly mapped.
-	Controversy and bias: Parents don't want their kids to own phones at this age, which makes it a product of desire for children, marking a "rite of passage". This shows a bias toward full-spectrum phones, which is supported by both ranking and interview data (they don't see children's phones as "real" phones, in some cases they say they are "for kids" but it is all the more reason for them to not favour these products).	Although they may be more familiar with the products designed for adults, compared the mobile phones, cameras are socially/politically more neutral, hence may not hold the bias that is most evident in mobile phones.

APPENDIX K

CHILDREN’S DAILY INTERACTION WITH TECHNOLOGY QUESTIONNAIRE (ENGLISH VERSION)



QUESTIONNAIRE ON CHILDREN’S DAILY INTERACTION WITH TECHNOLOGY

The goal of this questionnaire is to collect information about the daily experiences of your child with contemporary technological devices. If you have multiple children, please answer the question for the child participating in the study. The images below are used to exemplify the mentioned technologies. Whether or not the devices you own show differences in terms of brand, form and partial functions has no importance for the study.

Name of the child: **Date of birth:**

Name of the parent:

Internet connection at home: ◯ **Yes** ◯ **No**

1. ACCESS TO TECHNOLOGY: The questions in this section are about the access of your child to the following technological devices. For each device, please mark (1) whether or not it is available at your home, and (2) whether or not your child uses it. Your child might be using a device even if it is not available in your home (i.e. at school, in the neighbour’s, etc.).

No.	Device	Available at home	My child uses
1	Desktop or laptop computer	◯Yes ◯No	◯Yes ◯No
2	Tablet computer	◯Yes ◯No	◯Yes ◯No
3	Camera	◯Yes ◯No	◯Yes ◯No
4	Video camera	◯Yes ◯No	◯Yes ◯No
5	Game console	◯Yes ◯No	◯Yes ◯No
6	Portable game console	◯Yes ◯No	◯Yes ◯No
7	Television	◯Yes ◯No	◯Yes ◯No
8	DVD player	◯Yes ◯No	◯Yes ◯No

 Mobile phone (GSM)	Available at home ◯Yes ◯No My child uses ◯Yes ◯No	9
 Mobile phone (smart)	Available at home ◯Yes ◯No My child uses ◯Yes ◯No	10
 Smart watch	Available at home ◯Yes ◯No My child uses ◯Yes ◯No	11
 Activity tracker	Available at home ◯Yes ◯No My child uses ◯Yes ◯No	12
OTHER (belirtiniz)	Available at home ◯Yes ◯No My child uses ◯Yes ◯No	13
OTHER (belirtiniz)	Available at home ◯Yes ◯No My child uses ◯Yes ◯No	14

2- INTERACTION WITH TECHNOLOGY: The questions in this section ask the nature of interaction your child has with the listed technological devices. For each device, please mark (1) the purpose of the interaction, and (2) with whom they use this device. The questions for the devices your child does not use, can be left unanswered.

	NAME OF THE DEVICE	PURPOSE OF INTERACTION	USES... Independently	With family	With friends
1	Desktop or laptop computer		◯	◯	◯
2	Tablet computer		◯	◯	◯
3	Camera		◯	◯	◯
4	Video camera		◯	◯	◯
5	Game console		◯	◯	◯
6	Portable game console		◯	◯	◯

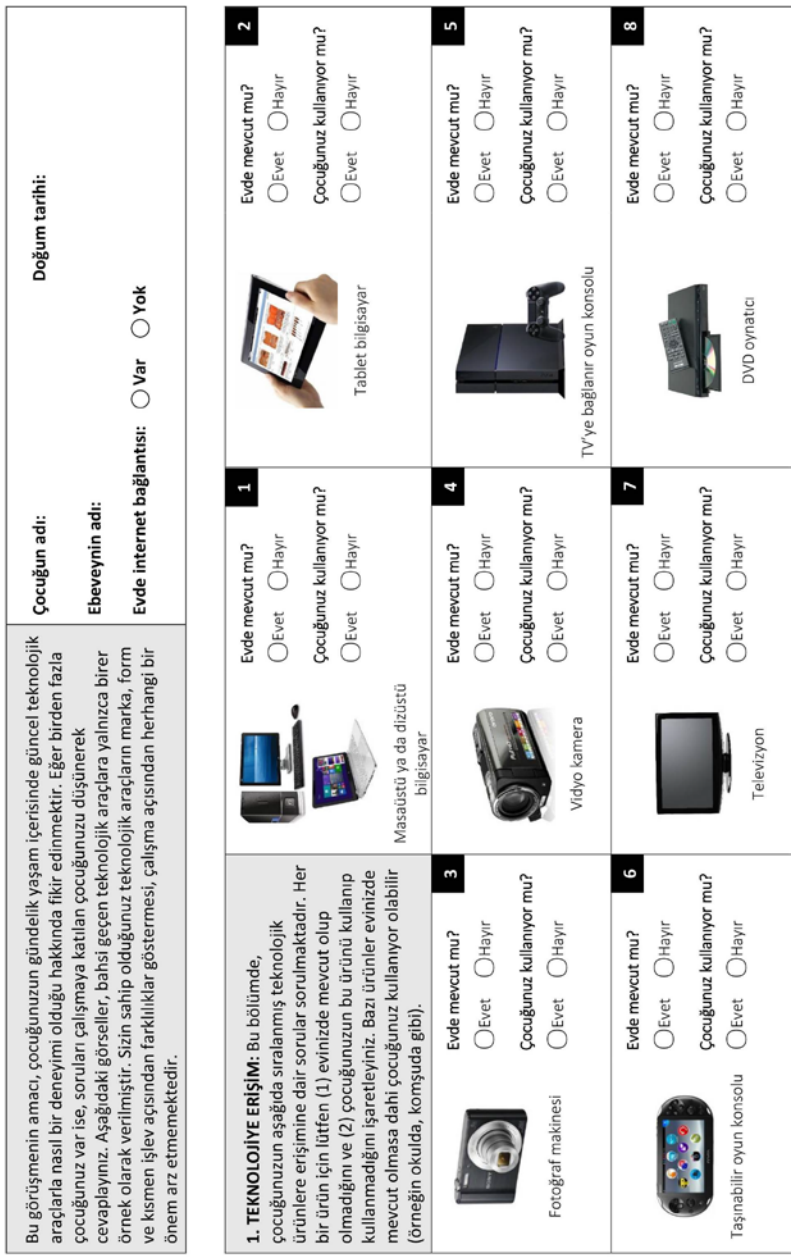
2. sorunun devamı...

NAME OF THE DEVICE		PURPOSE OF INTERACTION?	USES...		
			Independently	With family	With friends
7	Television		○	○	○
8	DVD player		○	○	○
9	Mobile phone (GSM)		○	○	○
10	Mobile phone (smart)		○	○	○
11	Smart watch		○	○	○
12	Activity tracker		○	○	○
13	Other:		○	○	○
14	Other:		○	○	○

3- What are the possible places, situations and activities for your child to take pictures? You can think of indoors and outdoors family activities during weekends and holidays, or the activities your child has attended / can attend with or without your company. If you can think of places and situations they took pictures before, you can also include them (e.g. Picnic, museum, family visits, playing outside, field trips…)	

APPENDIX L

CHILDREN'S DAILY INTERACTION WITH TECHNOLOGY QUESTIONNAIRE (TURKISH VERSION)



ÇOCUĞUN TEKNOLOJİYLE GÜNDELİK ETKİLEŞİMİ ANKETİ

Bu görüşmenin amacı, çocuğunuzun gündelik yaşam içerisinde güncel teknolojik araçlarla nasıl bir deneyimi olduğu hakkında fikir edinmektir. Eğer birden fazla çocuğunuz var ise, soruları çalışmaya katılan çocuğunuzu düşünerek cevaplayınız. Aşağıdaki görseller, bahsi geçen teknolojik araçlara yalnızca birer örnek olarak verilmiştir. Sizin sahip olduğunuz teknolojik araçların marka, form ve kısmen işlev açısından farklılıklar göstermesi, çalışma açısından herhangi bir önem arz etmemektedir.

Çocuğun adı: Doğum tarihi:

Ebeveynin adı:

Evde internet bağlantısı: ◯ Var ◯ Yok

1. TEKNOLOJİYE ERİŞİM: Bu bölümde, çocuğunuzun aşağıda sıralanmış teknolojik ürünlere erişimine dair sorular sorulmaktadır. Her bir ürün için lütfen (1) evinizde mevcut olup olmadığını ve (2) çocuğunuzun bu ürünü kullanıp kullanmadığını işaretleyiniz. Bazı ürünler evinizde mevcut olmasa dahi çocuğunuz kullanıyor olabilir (örneğin okulda, komşuda gibi).

1 — Masaüstü ya da dizüstü bilgisayar
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

2 — Tablet bilgisayar
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

3 — Fotoğraf makinesi
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

4 — Vidyo kamera
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

5 — TV'ye bağlanır oyun konsolu
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

6 — Taşınabilir oyun konsolu
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

7 — Televizyon
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

8 — DVD oynatıcı
Evde mevcut mu? ◯Evet ◯Hayır
Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

 Telefon (GSM)	**9** Evde mevcut mu? ◯Evet ◯Hayır Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır	 Telefon (akıllı)	**10** Evde mevcut mu? ◯Evet ◯Hayır Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır	 Akıllı kol saati	**11** Evde mevcut mu? ◯Evet ◯Hayır Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır
 Fiziksel aktivite takip eden cihazlar	**12** Evde mevcut mu? ◯Evet ◯Hayır Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır	DİĞER (belirtiniz)	**13** Evde mevcut mu? ◯Evet ◯Hayır Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır	DİĞER (belirtiniz)	**14** Evde mevcut mu? ◯Evet ◯Hayır Çocuğunuz kullanıyor mu? ◯Evet ◯Hayır

2- TEKNOLOJİYLE ETKİLEŞİM: Bu bölümde, çocuğunuzun aşağıda sıralanmış teknolojik ürünlerle olan etkileşim biçimine dair sorular sorulmaktadır. Her bir ürün için lütfen çocuğunuzun bu ürünü (1) ne amaçla kullandığını doldurunuz ve (2) kiminle kullandığını işaretleyiniz. Çocuğunuzun kullanmadığı ürünlerle ilgili soruları lütfen boş bırakınız.

	ÜRÜNÜN ADI	NE AMAÇLA KULLANIYOR?	KİMİNLE KULLANIYOR?		
			Tek başına	Aile bireyleriyle	Arkadaşlarıyla
1	Masaüstü ya da dizüstü bilgisayar		◯	◯	◯
2	Tablet bilgisayar		◯	◯	◯
3	Fotoğraf makinesi		◯	◯	◯
4	Vidyo kamera		◯	◯	◯
5	TV'ye bağlanır oyun konsolu		◯	◯	◯
6	Taşınabilir oyun konsolu		◯	◯	◯

2. sorunun devamı...

ÜRÜNÜN ADI		NE AMAÇLA KULLANIYOR?	KİMİNLE KULLANIYOR?		
			Tek başına	Aile bireyleriyle	Arkadaşlarıyla
7	Televizyon		○	○	○
8	DVD oynatıcı		○	○	○
9	Telefon (GSM)		○	○	○
10	Telefon (akıllı)		○	○	○
11	Akıllı kol saati		○	○	○
12	Fiziksel aktivite takip eden cihazlar		○	○	○
13	Diğer:		○	○	○
14	Diğer:		○	○	○

3- Çocuğunuzun fotoğraf makinesi kullanabileceği olası yerler, durumlar veya etkinlikler nelerdir? Yardımcı olması için hafta sonları ya da tatillerde ailece yaptığınız iç ve dış mekan etkinlikleri, ya da sizin refakatiniz olmadan katıldığı/katılabileceği etkinlikleri düşünebilirsiniz. Eğer hatırınızda daha önce fotoğraf çektiği durumlar yerler varsa onlar da örnek olabilir. (*ör. Piknik, müze, aile ziyaretleri, dışarıda oynamak, okul gezileri...*)	

APPENDIX M

PARENTAL CONSENT FORM (IN TURKISH)

Bu çalışma Orta Doğu Teknik Üniversitesi Endüstri Ürünleri Tasarımı Bölümü'nde, doktora çalışmalarını sürdürmekte olan Araş. Gör. Sedef Süner tarafından yürütülmektedir. Çalışmanın amacı, çocukların kullanabileceği bir fotoğraf makinesinin tasarım özelliklerine dair bilgi edinmektir. Çalışma aşağıdaki aşamalardan oluşmaktadır:

1- Atölye öncesi görüşme: Bu aşamada, çocuklarla birebir olarak fotoğraf makineleri hakkında yaklaşık 20 dakika sohbet edilecektir. Farklı fotoğraf makinesi resimlerinin birbiriyle karşılaştırılması yoluyla çocukların fotoğraf makinelerine dair beklentileri anlaşılacaktır.

2- Atölye: Atölye çalışması iki bölümden oluşmaktadır. İlk bölümde çocuklara fotoğrafçılık üzerine başlangıç düzeyinde temel bilgi ve becerilerin kazandırılması, bakış açısı geliştirilmesi ve merak uyandırılması amaçlanmaktadır. İkinci bölümde ise bu bilgi ve becerilerin uygulamalı olarak deneyimlenmesi sağlanacaktır. Bu yaş grubunun kullanımına uygun farklı fotoğraf makineleri araştırmacı tarafından sağlanacak ve çocuklarca dönüşümlü olarak kullanılabilecektir. Aynı zamanda araştırmacı çocukların fotoğraf makinesi kullanımını gözlemleme imkanı bulacaktır. Atölyenin yaklaşık 2-2.5 saat sürmesi planlanmaktadır.

Bu çalışma, çocuğunuz açısından herhangi bir risk içermemektedir. Daha sonra araştırmacı tarafından tekrar incelenebilmesi için oturumların görüntü ve ses kaydı alınacaktır. Araştırma sonuçları yalnızca bilimsel amaçlı yayın ve sunuşlarda kullanılacak, sizin ya da çocuğunuzun kişisel bilgileri başka kişilerle kesinlikle paylaşılmayacaktır. İstediğiniz takdirde aşağıda verilmiş olan iletişim bilgilerinden araştırmacıya ulaşarak çalışma hakkında daha fazla bilgi alabilirsiniz.

Bu oturum çalışmasına katılımın koşullarını ve tamamen gönüllülük esasına dayandığını anladım ve oğlum/kızım.....'nin yapılacak bu oturum çalışmasına katılımına izin veriyorum.

Adı Soyadı : .....

Tarih : .....

İmza :

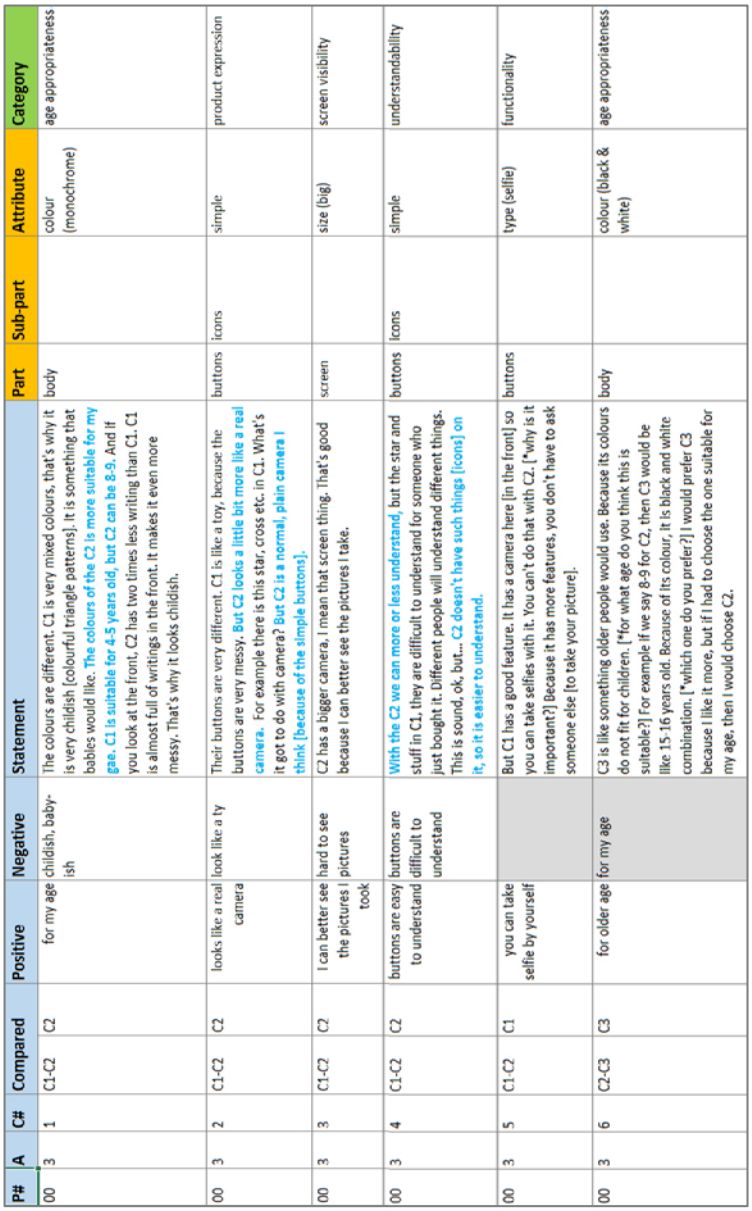
APPENDIX N

INFORMATIVE LEAFLET FOR CHILD CONSENT

Figure 61. Informative leaflet for child consent

APPENDIX O

SAMPLE CODING OF THE INTERVIEW DATA



P#	A	C#	Compared	Positive	Negative	Statement	Part	Sub-part	Attribute	Category
00	3	1	C1-C2	C2	for my age	childish, baby-ish	The colours are different. C1 is very mixed colours, that's why it is very childish [colourful triangle patterns]. It is something that babies would like. The colours of the C2 is more suitable for my gae. C1 is suitable for 4-5 years old, but C2 can be 8-9. And if you look at the front, C2 has two times less writing than C1. C1 is almost full of writings in the front. It makes it even more messy. That's why it looks childish.	body		colour (monochrome)	age appropriateness
00	3	2	C1-C2	C2	looks like a real camera	look like a ty	Their buttons are very different. C1 is like a toy, because the buttons are very messy. But C2 looks a little bit more like a real camera. For example there is this star, cross etc. in C1. What's it got to do with camera? But C2 is a normal, plain camera I think [because of the simple buttons].	buttons	icons	simple	product expression
00	3	3	C1-C2	C2	I can better see the pictures I took	hard to see pictures	C2 has a bigger camera. I mean that screen thing. That's good because I can better see the pictures I take.	screen		size (big)	screen visibility
00	3	4	C1-C2	C2	buttons are easy to understand	buttons are difficult to understand	With the C2 we can more or less understand, but the star and stuff in C1, they are difficult to understand for someone who just bought it. Different people will understand different things. This is sound, ok, but... C2 doesn't have such things [icons] on it, so it is easier to understand.	buttons	icons	simple	understandability
00	3	5	C1-C2	C1	you can take selfie by yourself		But C1 has a good feature. It has a camera here [in the front] so you can take selfies with it. You can't do that with C2. [*why is it important?] Because it has more features, you don't have to ask someone else [to take your picture].	buttons		type (selfie)	functionality
00	3	6	C2-C3	C3	for older age	for my age	C3 is like something older people would use. Because its colours do not fit for children. [*for what age do you think this is suitable?] For example if we say 8-9 for C2, then C3 would be like 15-16 years old. Because of its colour, it is black and white combination. [*which one do you prefer?] I would prefer C3 because I like it more, but if I had to choose the one suitable for my age, then I would choose C2.	body		colour (black & white)	age appropriateness

Figure 62. Sample coding of the interview data

APPENDIX P

SAMPLE CODING OF THE OBSERVATION DATA

W#	P#	Vid#	Camera	Time	Summary info	Code
5	12	1	C2	15:00	He gets closer to the subject, and zooms in at the same time. While I am accidentally caught in the frame, he says "oops" and shakes the camera to geet rid of the preview. Then he tries again and says "I got the whole thing".	Shaking
5	12	2	C3	10:00	Over-zooms in his friend's face and takes his picture. They chek out the picture and start laughing together. Continues to show the picture to other kids and they all laugh: "Hahaha he has a mouctache!".	Over-zoom
5	17	1	C2	12:05	As she takes a new picture, the screen automatically shows the control menu for a brief moment. She tries to touch the icons on the menu when it does that.	Touch (menu)
1	10	5	C1	01:40	He attempts to touch the screen to access something, but it doesn't work. His fingers hoover around the buttons but he doesn't know which one to push, so he gives up.	Touch (menu)
1	9	2	C2	00:20	She adjusts the frame and wants to push the shutter button, but pushes the movie-shutter button instead, and she doesn't realise [both buttons are almost identical]. Later she attempts to take another picture, but she can't because the camera is video ecording at that moment. She pushes the movie-shutter button thinking that she took a picture, but she actually ended the movie-record.	Accessibility (buttons)
1	9	2	C2	03:50	False feedback - She couldn't have taken much photos, except a few. In some instances even before the focus sound she sees the control menu appearing on the screen, which she interprets as photo taken.	Feedback
2	15	2	C1	16:00	She wants to take a picture of the coat of her friend but he runs away. She starts chasing him and while they are both laughing.	Laughter
3	18	2	C2	03:20	"I need flash!" - although I showed him twice before how to access the flash controls from the menu, he approaches me for help again.	Accessibility (menu)
3	18	2	C3	09:10	The screen shows black right after taking a picture indicating that the image is processing. He doesn't undersand this and moves on, so the picture comes out shaky.	Feedback
3	5	2	C1	12:40	He gets lost in the menu: "Oiiy where did you go!" he says. As a solution, he restarts the camera. After he turns on again, he starts checking out the filters. Apparently that's what he was looking for before. He checks them out for a while.	Accessibility (menu)
3	5	3	C3	00:10	"I will record a video" - The minute he lays hand on the camera, he looks for the movie-shutter button. He can't find it and accidentally gets into the image gallery. He doesn't know how to get out. He restarts the camera to go back to the default mode.	Accessibility (menu)
4	24	1	C3	05:50	She shakes the camera to get rid of the image preview and go back to image capturing mode.	Shaking
0	0	1	C2	06:00	"And how do you get closer with this one?" - as he asks, he also makes the spread gecture on the screen in an attempt to zoom in the subject.	Touch (zoom)

Figure 63. Sample coding of the observation data

APPENDIX Q

DIMENSION MAPS

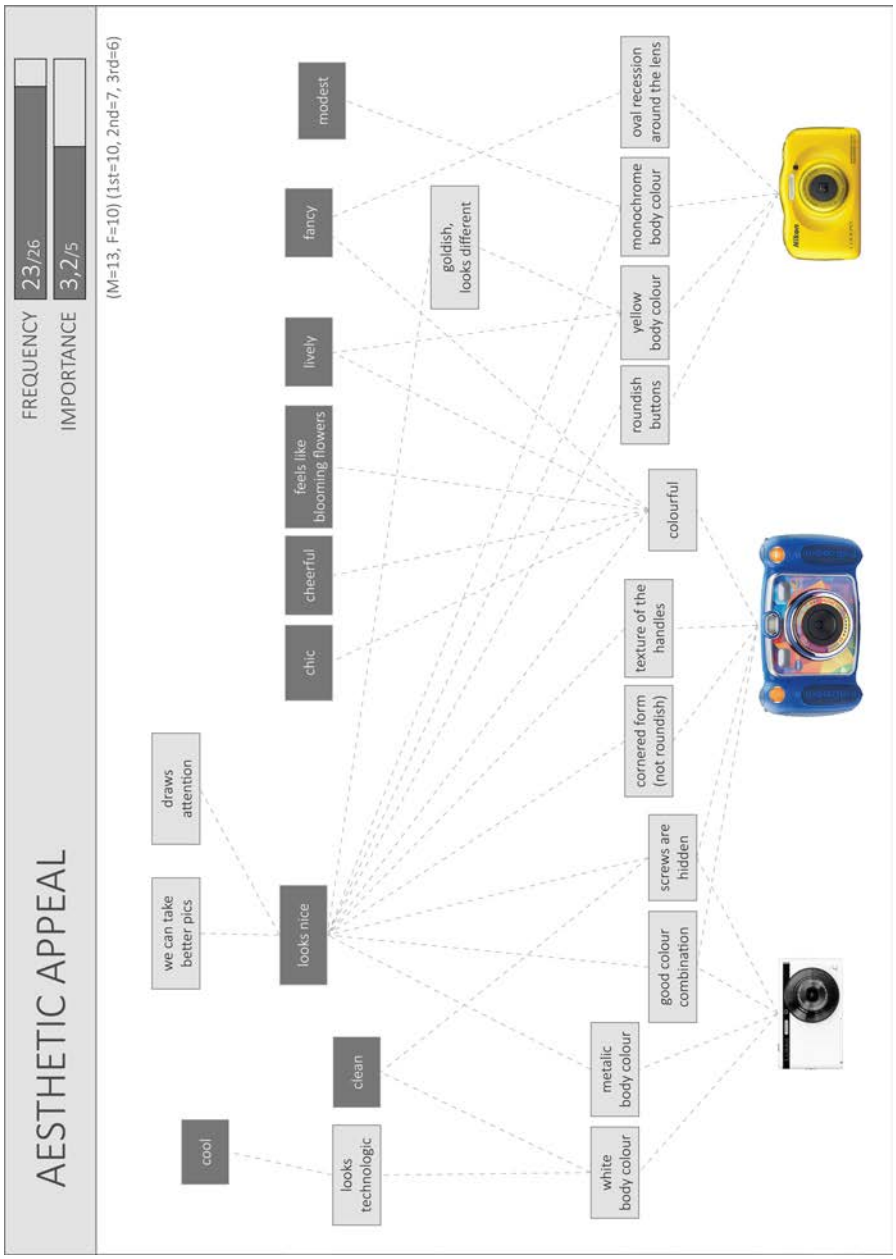


Figure 64. Aesthetic appeal

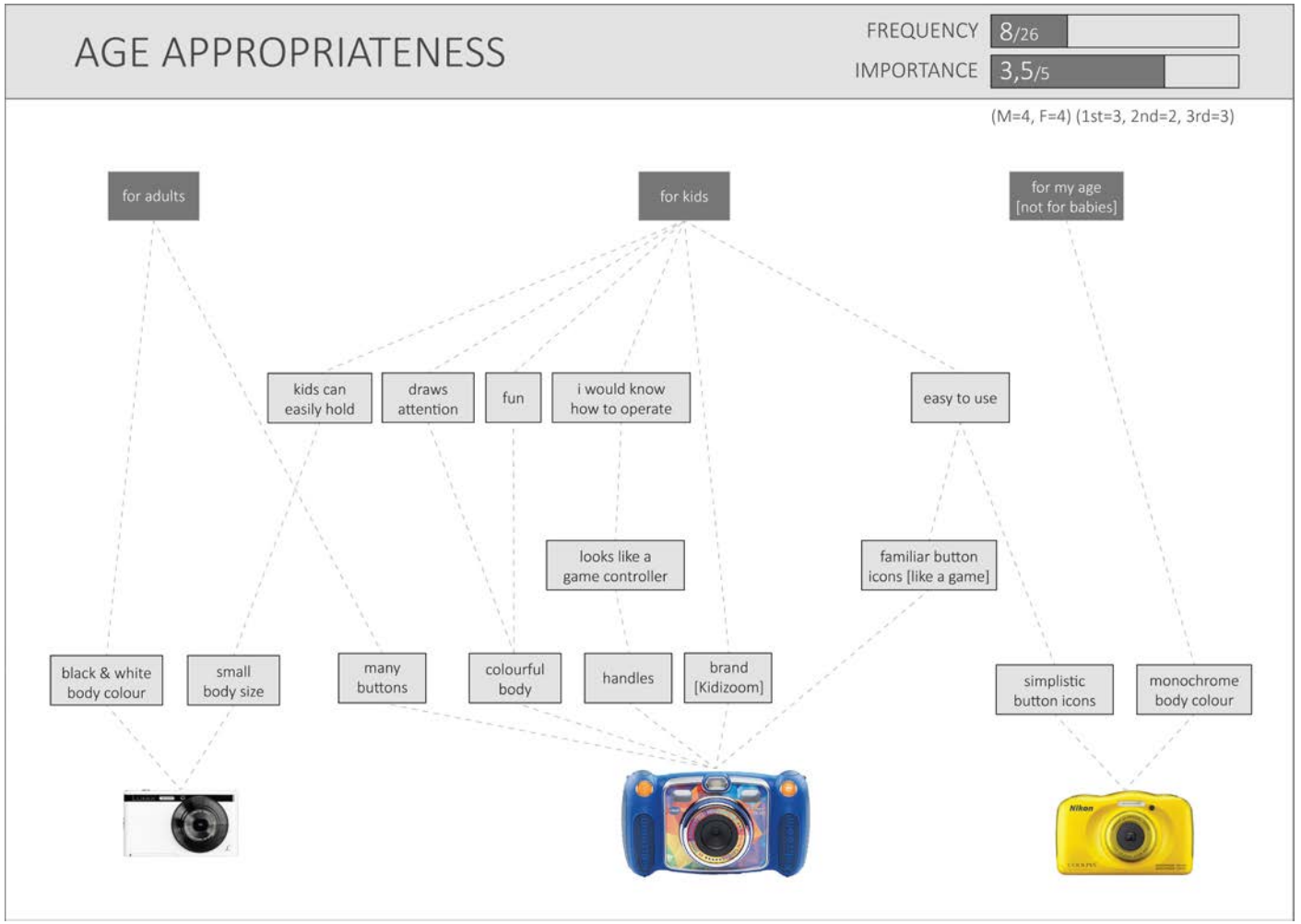


Figure 65. Age appropriateness

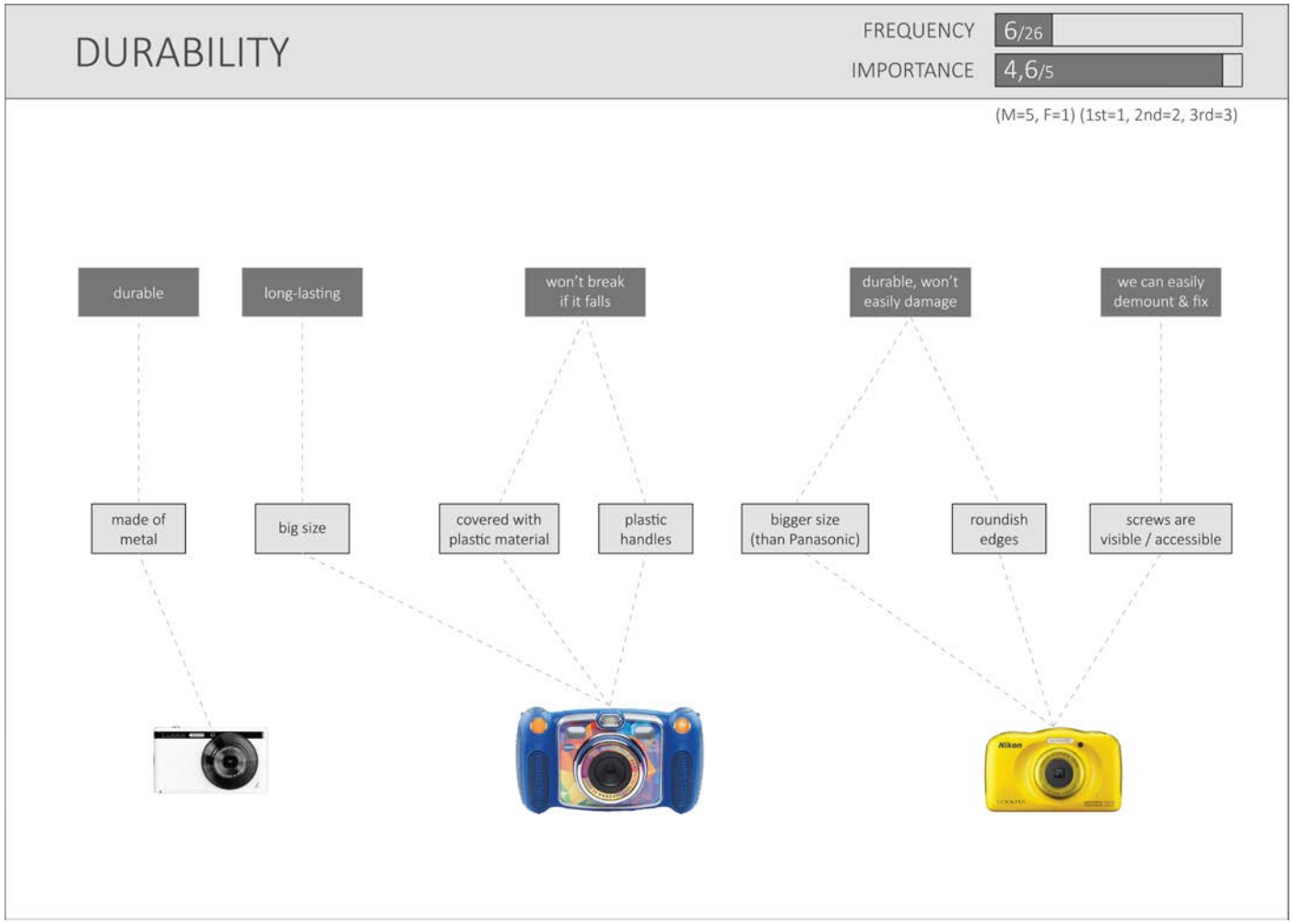


Figure 66. Durability

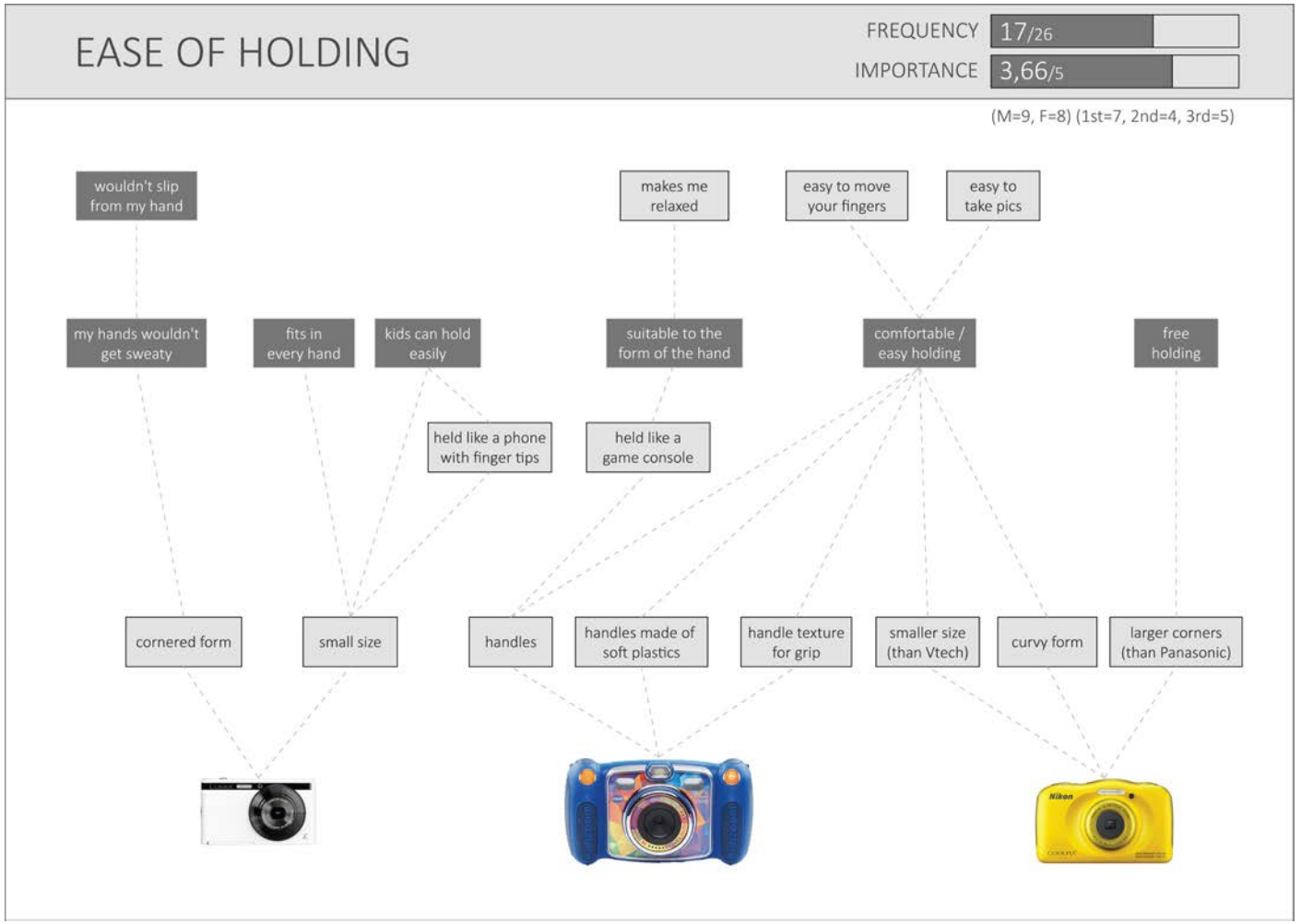


Figure 67. Ease of holding

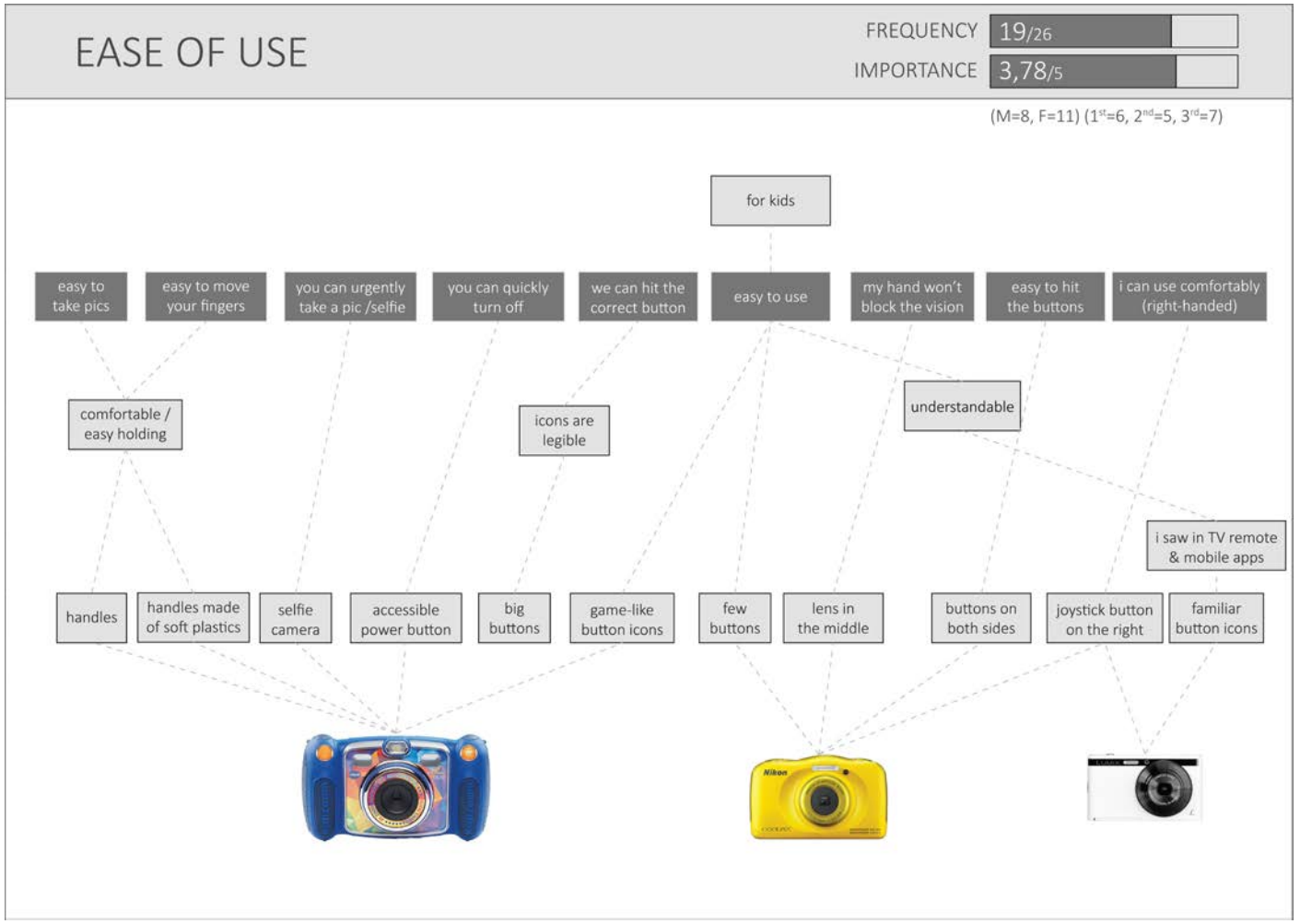


Figure 68. Ease of use

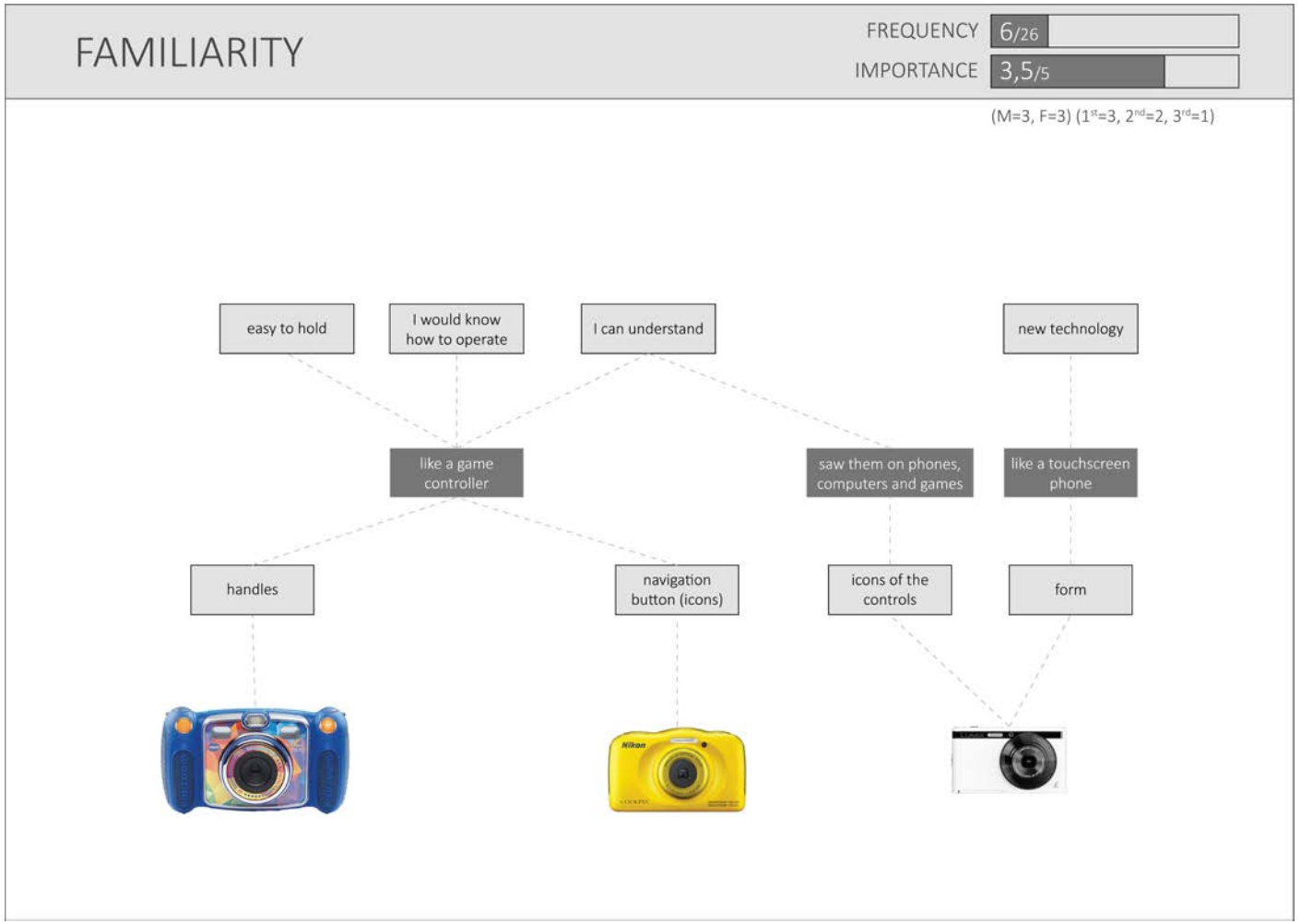


Figure 69. Familiarity

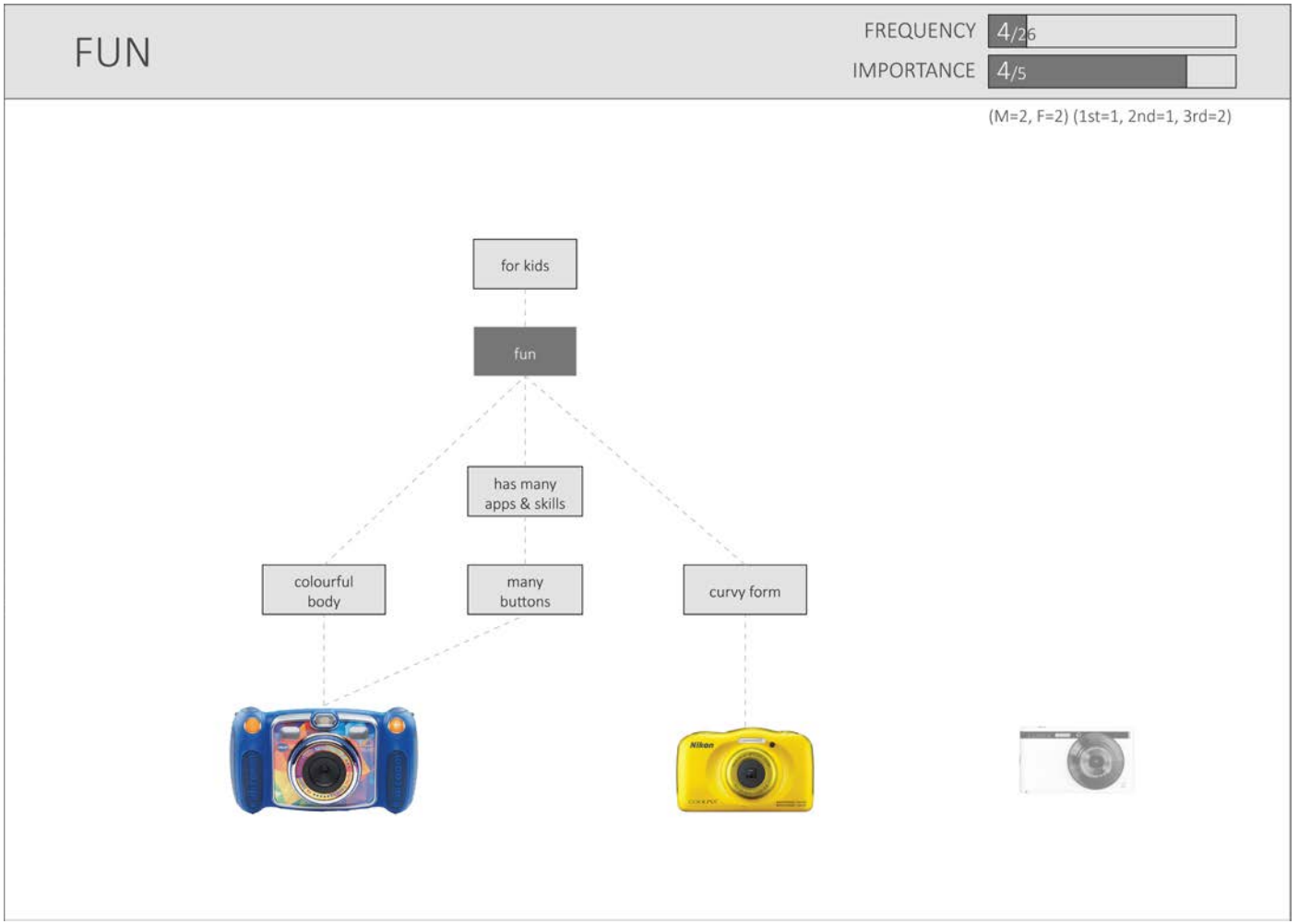


Figure 70. Fun

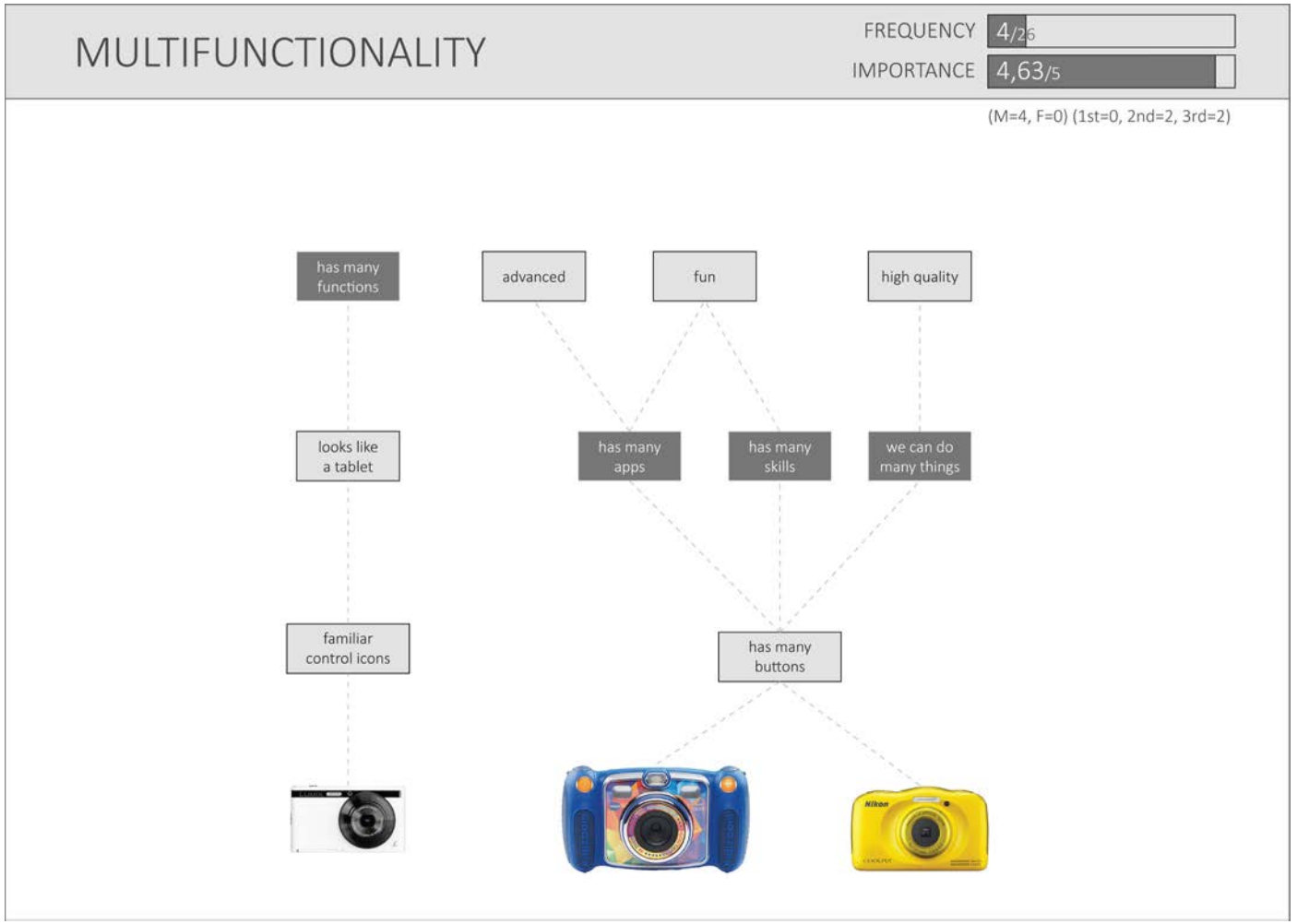


Figure 71. Multifunctionality

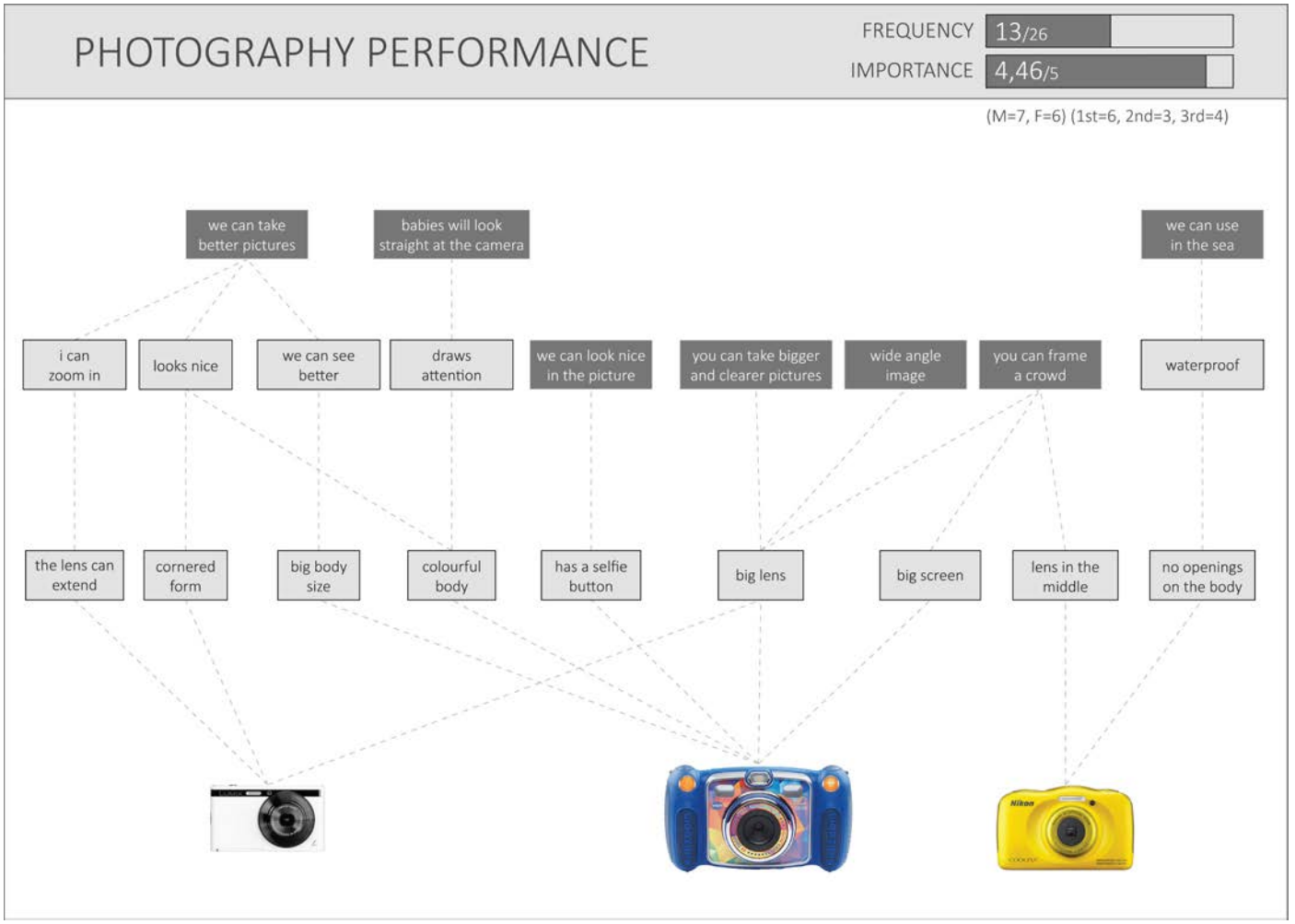


Figure 72. Photography performance

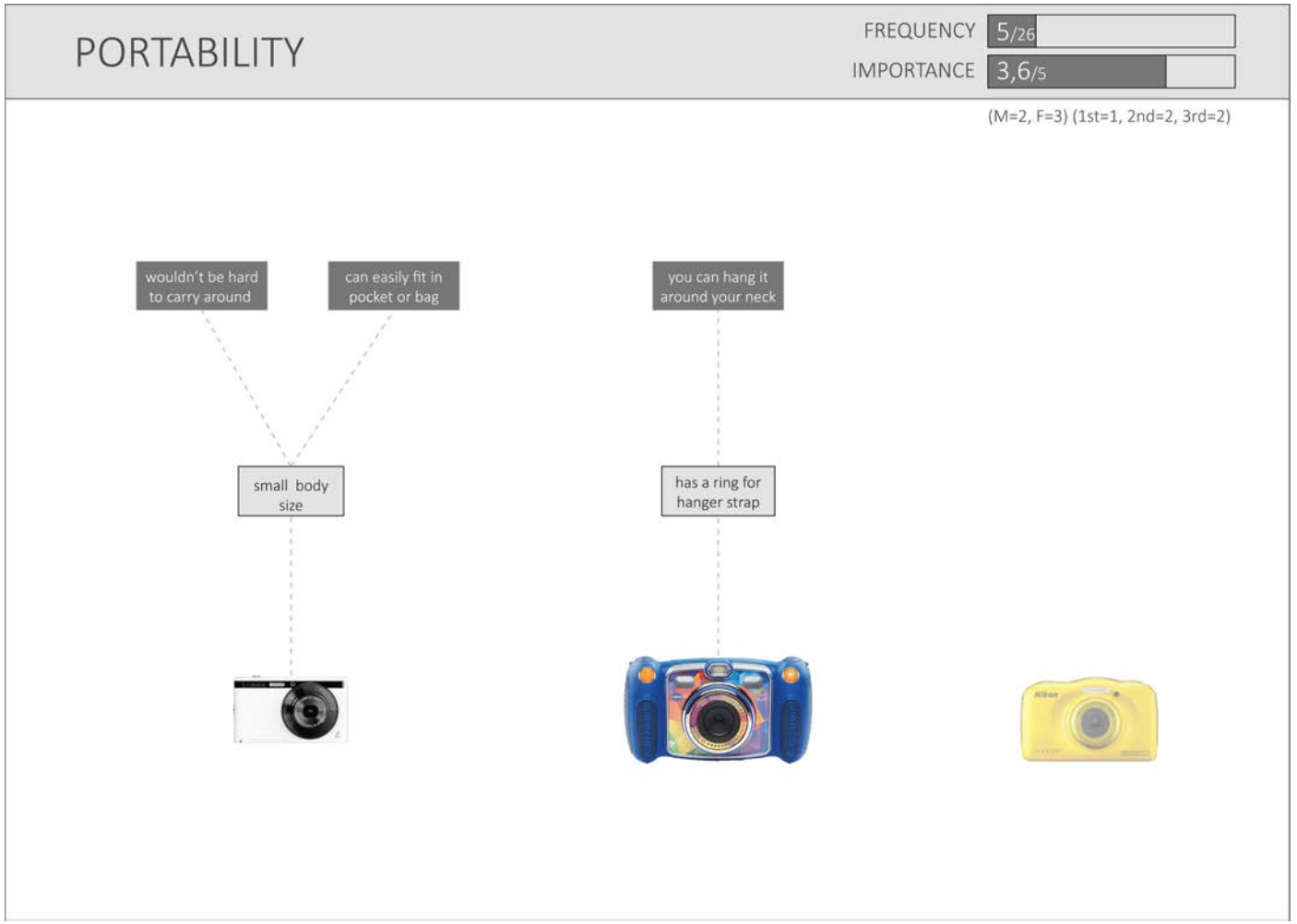


Figure 73. Portability

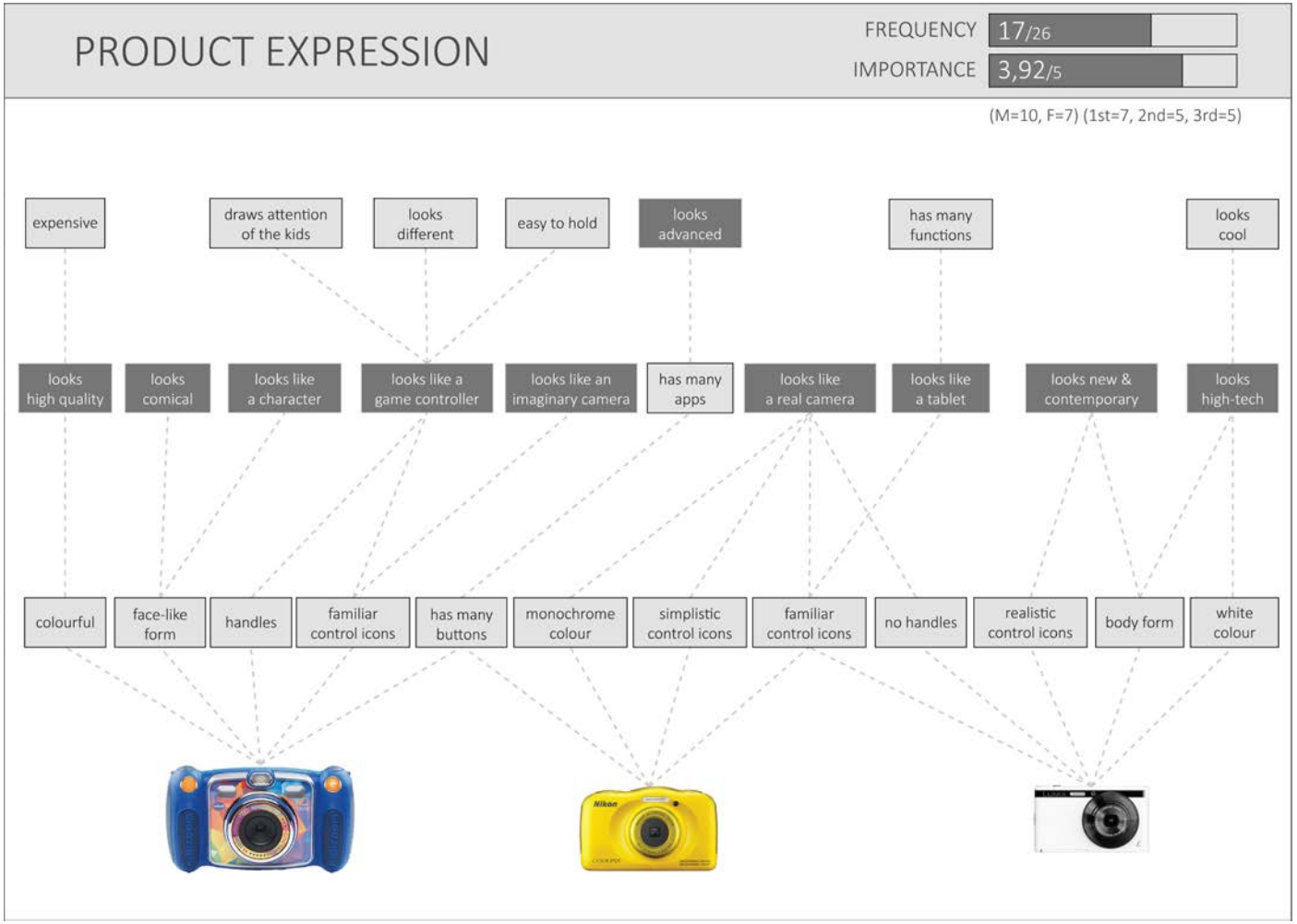


Figure 74. Product expression

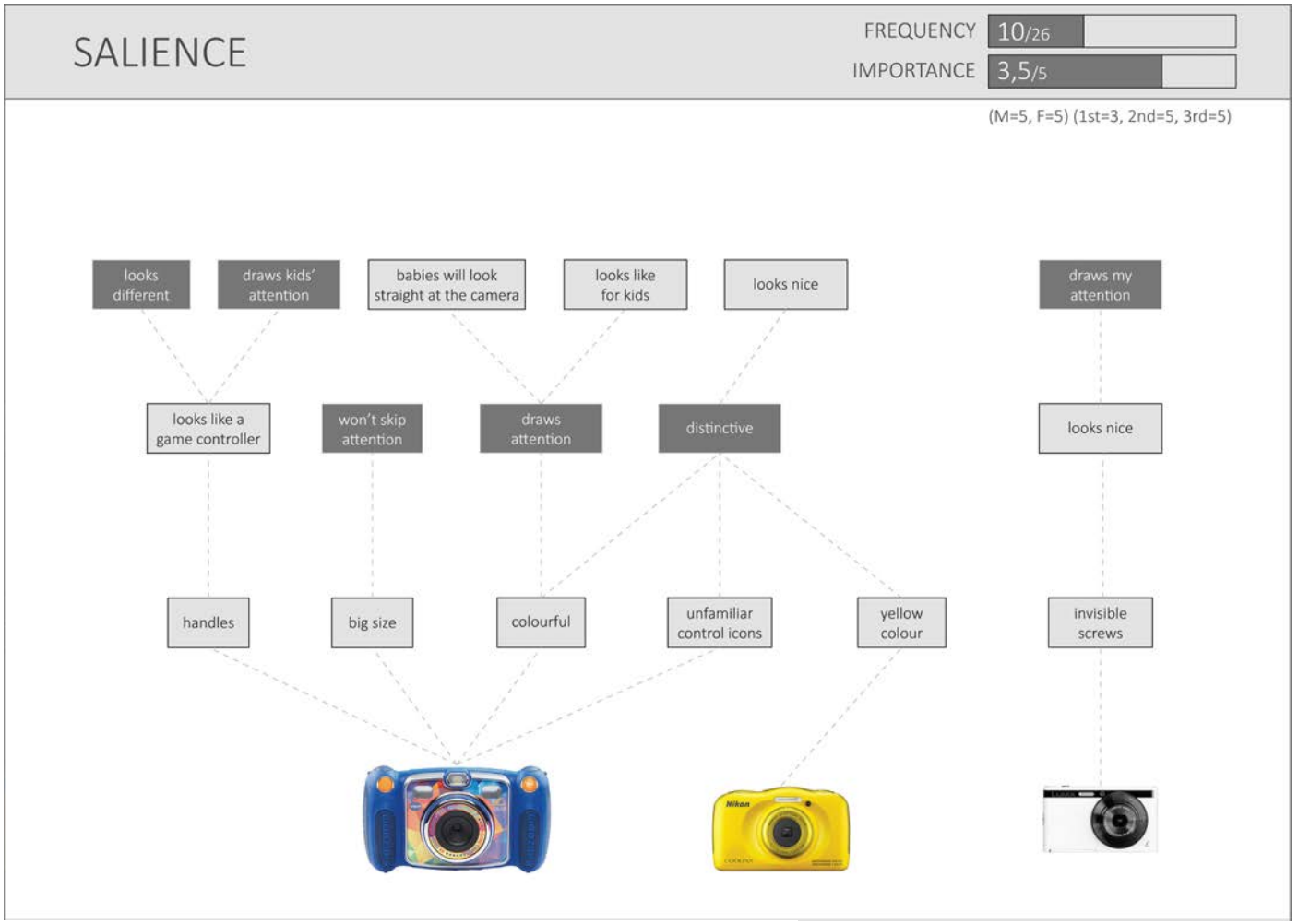


Figure 75. Salience

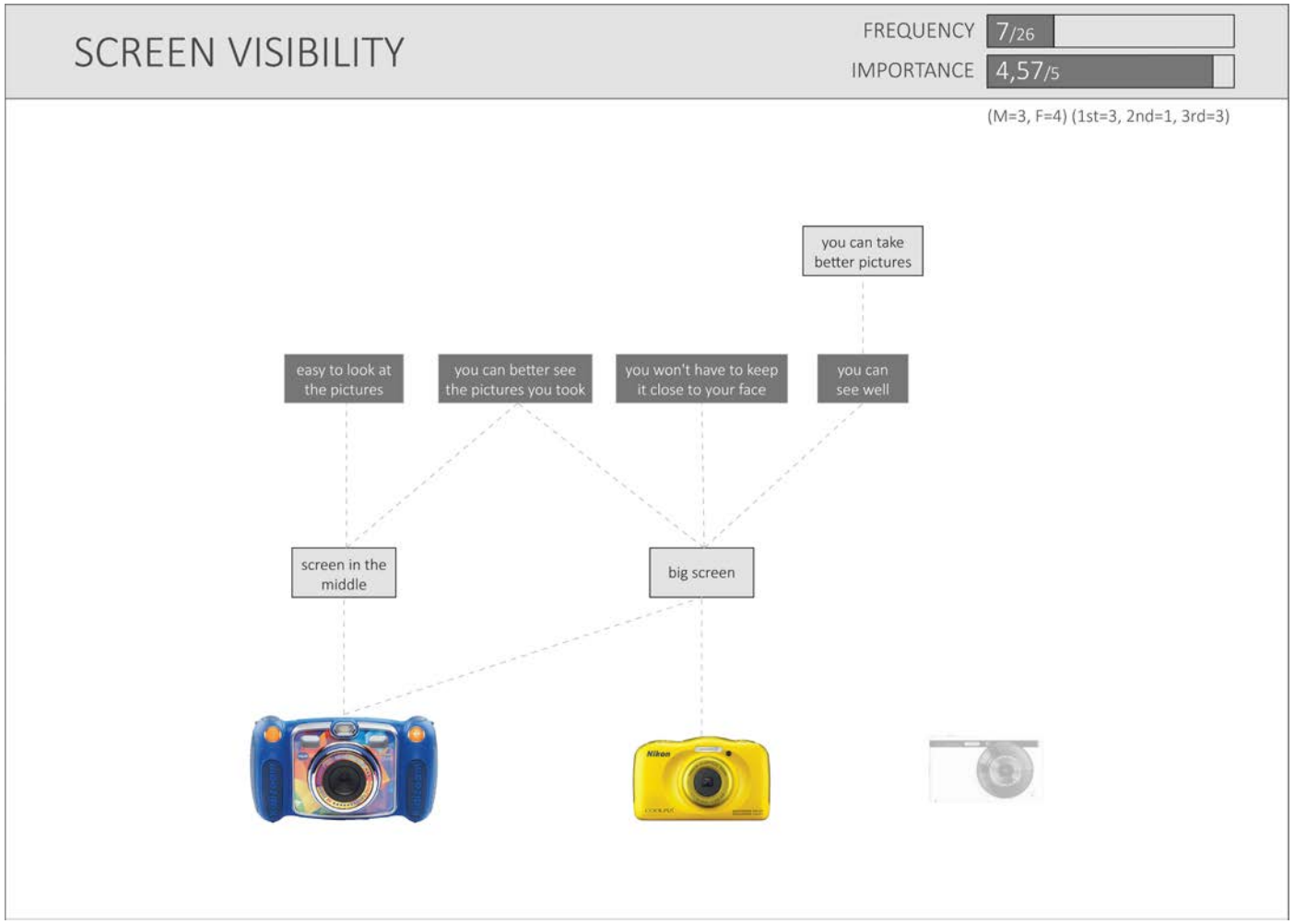


Figure 76. Screen visibility

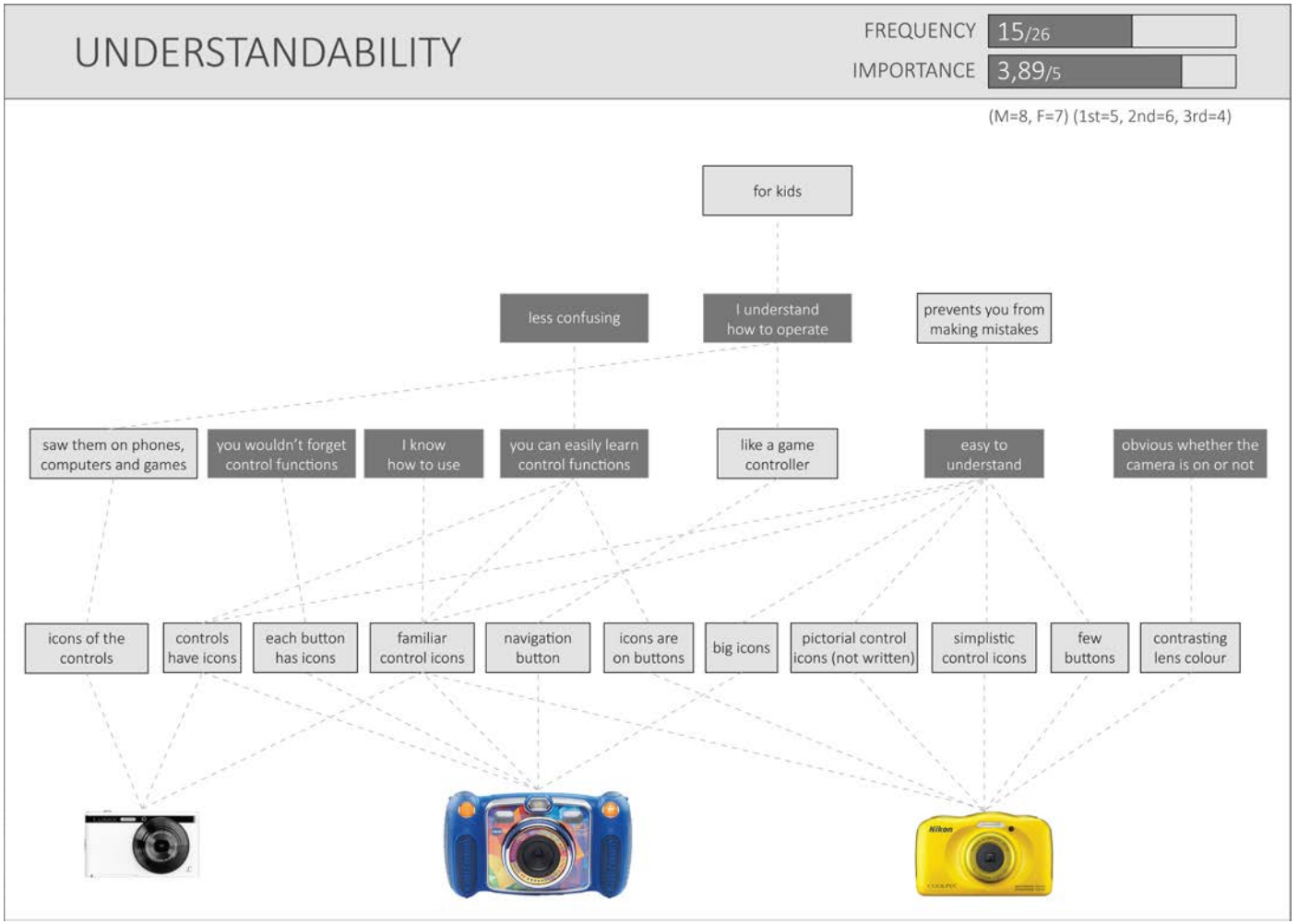


Figure 77. Understandability

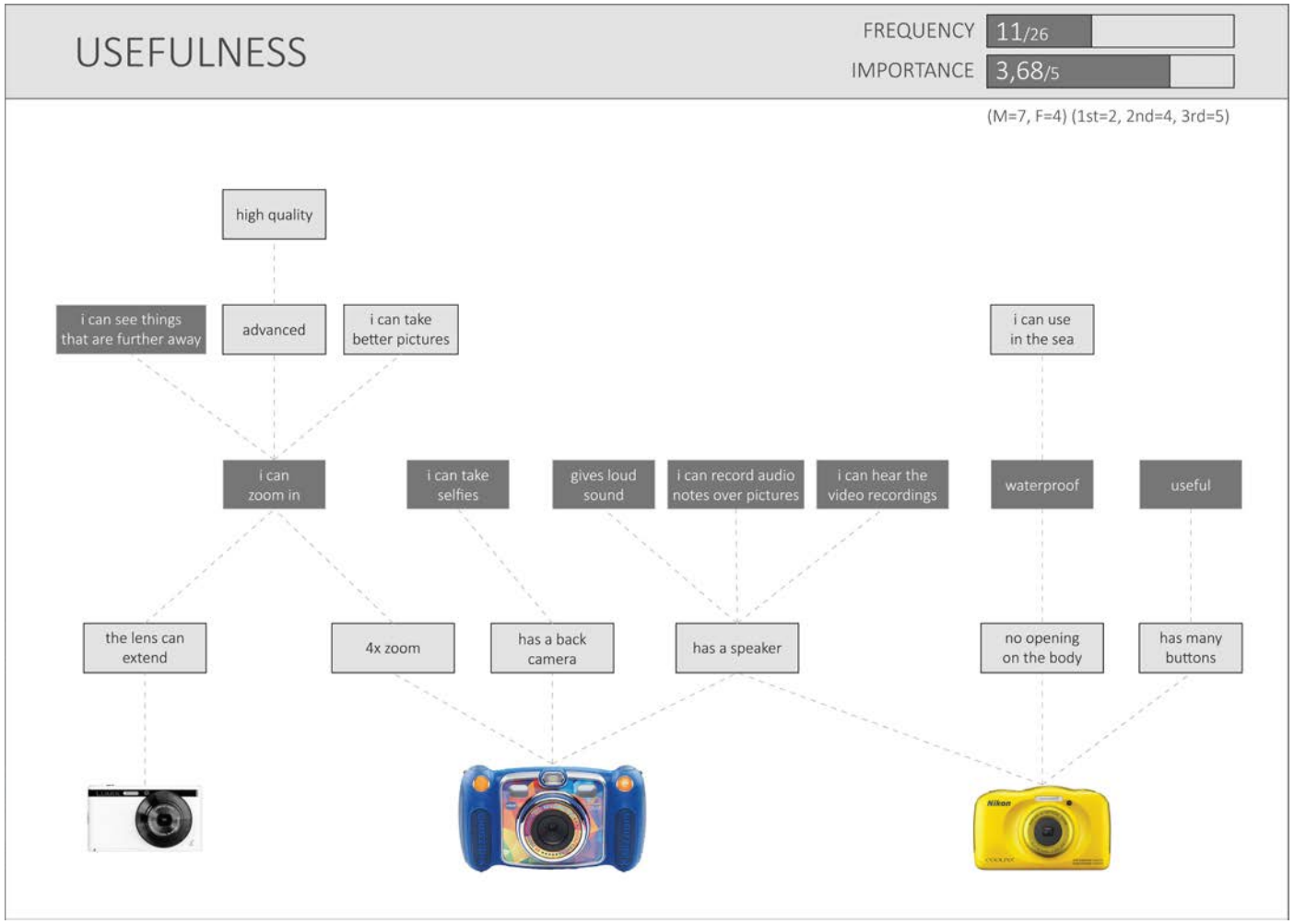


Figure 78. Usefulness

APPENDIX R

USABILITY ASSESSMENT BASED ON NIE LSEN HEURISTICS

Table 17. Usability assessment based on Nielsen Heuristics

Heuristics	Observation	Recommendation
1. Visibility of system status: The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.	*Feedback indicating the image is being process is not clear for children, hence they prematurely take down the camera which sometimes results in shaky pictures *Sometimes children accidentally start video recording instead of taking a picture. Not realising the movie record continues, they try to go on taking pictures.	Provide clearer audio-visual feedback that speaks to children (or explore others forms of feedback, such as tactile).
2. Match between system and the real world: The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order	*Icons and menu language is not understandable by children	Do not expect children to be familiar with adult photography terminology & iconography. Present information in a literal language and within context, and avoid abstract concepts that requires previous knowledge. (For example: do not assume children are familiar with a certain icon -- "magnifying glass" is a good reference for the zoom function for adults; but are we sure children saw any actual magnifying glasses before, or that they are familiar with the concept?)
3. User control and freedom: Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.	*Children are frequently observed to get lost in the menu whether while seeking for a specific function, or after accidentally pushing a button. Their reactions to solve the problem include: - Shaking the camera - Restart the camera, or - Ask for help from a friend or the adult, to get out of the preview or menu, and get back to image capturing mode.	Allow conspicuous and intuitive strategies to exit back to previous mode & back to default. This will help them to be more courageous in exploring camera functions. Primary function of a camera is to capture image. Additional functions to improve image quality or fun experience are important too, but in the end, they will always want to go back to image capturing mode.

Table 17 (continued). Usability assessment based on Nielsen Heuristics

Heuristics	Observation	Recommendation
4. Consistency and standards: Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.	*Children often seem to try gestural interaction (tap, swipe, spread, shake), which they are more familiar with than button-menu mapping.	Allow intuitive control by investigating and transferring experience and familiar interaction modalities from other technological products they are surrounded with (tablets, smart phones, game consoles...).
5. Error prevention: Even better than good error messages is a careful design which prevents a problem from occurring in the first place.	*Most common problems: Shaky pictures, mistaking the focus feedback for shutter, pushing wrong buttons	Make sure to have provided clear and unobtrusive feedback/instructions and hierarchy of information in the interface to prevent common mistakes before happening.
6. Recognition rather than recall: Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.	*Even after explicitly shown how to access a specific function, children sometimes forget how and ask for help again. *Similarly, they first try touch screen interaction, ask for help when it doesn't work, they are shown the buttons to the desired control, but next time their first intuitive reaction is to touch the screen again.	Provide alternative paths to access a certain function, enable intuitive interactions, and prioritise the information presented to children by making key controls more conspicuous than others.
7. Flexibility and efficiency of use: Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.	*Children are diverse in their previous experience with and expectations from cameras. The ability and willingness to explore camera functions is not the same for each participant. *While some children show no attempt to investigate what the camera has to offer, others do so, though the interface is so complicated and lacks a hierarchical structure that they get lost in the menu, get frustrated, and eventually ask for help.	Keep in mind different types of users with diverse backgrounds. Simplify the interface by emphasizing key functions, and cascade advanced functions to be available to unfold in case the user is ready to explore.
8. Aesthetic and minimalist design: Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.	*Both tangible (buttons with icons) and digital (menu) interfaces are too complicated for children's use, and lack a hierarchical order. Most frequently used functions are: shutter button, preview, zoom, flash and delete. Most children failed to independently detect almost all of them.	Simplify the tangible and digital interface by prioritising and cascading (see 6 & 7).

Table 17 (continued). Usability assessment based on Nielsen Heuristics

Heuristics	Observation	Recommendation
9. Help users recognize, diagnose, and recover from errors: Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.	*Feedback indicating the image has been focused is misinterpreted by many children that the image has been captured. *Limited physical control over grasping is amplified with poor feedback (see 1), resulting in many shaky pictures, which is not detectable from the preview on the small screen.	Design the system in a way to detect situations such as failing to capture the image or stabilisation problems, and let the child know about it. Otherwise they may end up with no "good" pictures at all.
10. Help and documentation: Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.	*Children often ask for help from a friend or the adult when they get lost in the menu or seeking for a specific function. Sometimes they simply think aloud when they are looking for the function, without addressing to a specific person (e.g. "How do I get out of here?"). Asking for help in spoken language comes natural to them.	Explore the potential of personified virtual or voice assistance, which resembles real life help-seeking experience of children.

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