# DESIGN FOR INFANTS IS NOT DESIGN FOR CHILDREN: ON THE QUEST OF TOOLS TO MODEL A METHOD TO DESIGN FOR INFANTS

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## Abstract

Child Centred Design focuses on understanding children's contextual and experiential factors for design. However, the conventional user-designer interaction could not support the specific situation of designing for infants. This is due to infants are not verbal or self-reflective. Approaches addressing users largely dependent on caregivers could support the case of design for infants, considering the wide knowledge caretakers may hold about their care-receivers. This paper addresses a literature survey of tools for designing for children, aiming to provide theoretical support for the formalisation of a method for designing for infants. The study followed a systematic approach data abstraction and analysis. The study shows that the current CCD domain has a focus on co-design tools with intergenerational teams, addressing children older than 6 years old. There were no findings addressing the case of infants. However, it was found that frameworks intended to design for autistic children might support the case of design for infants, as they involve actively caretakers. Finally, this study proposes a selection of methods and tools that might be relevant when designing for infants.

**Keywords**: child centred design, design for infants, User centred design, Design methodology, User experience

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# 1 INTRODUCTION

This paper addresses a literature survey of tools[1] for designing for children (0-13 years old) but focusing on and assessment of their suitability for the case of design for infants, i.e., children under the age of 1, who are not verbal and are dependent on caregivers This study belongs to a larger project, which aims to formalize a method [2] for designing for infants to be used in a Dutch company[3] designing baby strollers. This study aims to provide theoretical support for the formalization of the mentioned method. Below we will discuss the most relevant gaps identified in the authors' current practice in the field of design for infants.

## 1.1 Design methodology and the conventional user-designer interaction.

Design methodology[4] supports design work by providing structure, as an arrangement of steps to guide designers from the identification of the user's needs to a final desired product. User Centered Design (UCD) methods focus on "understanding users' activities, providing comprehension of the customers, their environment, the tasks they currently perform, and the tasks they anticipate performing in the future" (Vredenburg, Isensee, et al, 2002). UCD has evolved to develop specific tools according to the typology of users such as design for the elderly, design for disabled people and design for children; the latter often referred as "Child Centered Design" (CCD). However, "many designers are not used to learning about and designing for small specific user groups…" (van Rijn, 2012), alike infants. Due to infants are entirely dependent on caregivers and are not able to verbalize their thoughts, the conventional user-designer interaction does not fully support the specific design situation. Social sciences knowledge about child's development has provided support when it comes to designing for infants, by informing designers about children's milestones in every life-stage. Below, we discuss the role of social sciences in the practice of design for infants.

## 1.2 The complexity of social sciences knowledge and its practicality within design practice.

Social sciences and human factors are integrated within UCD practice by translating knowledge about the user into insights that designers can understand and apply (Sanders, 2002). In the case of infants, social sciences display what we came to call an *overload of information* about the child's development. A great amount of theories, models, principles and evidences are available to explain the physiology, cognition, behavior and children's affect through their detailed stages of development. For example, as Baltes (1987) mentions, only the field of developmental psychology diverges in branches such us research areas, theories and/or theorists of psychological development, and life stages of psychological development. Each of these branches diverges in turn. In addition, the development of the child is influenced to a great extent by parenting, which in turn, "…is determined by characteristics of the parent, of the child, and of contextual subsystems of social support" (Belsky, 1984). This wide and complex universe of knowledge requires time and dedication to be accessed and grasped by designers during design practice. Therefore we believe there is a need of design tools to bridge this gap. Emergent design practice strives for wellbeing. Below we discuss the relevance that designing for infants may have in this field.

## 1.3 Design for infants and the emergent quest of design for wholesome lifestyles.

Tennant et al. (2007) assert that "there is an increased interest in exploring the potential of technology and design to support wellbeing". Recent approaches such as "Positive Design" have evolved as guidelines for the quest of designing wholesome lifestyles. This is, designing products that enhance people's physical health, contribute to sustainability, and encourage subjective well-being (well-being defined as positive mental health, and therefore not only the absence of mental illness, but also the presence of positive psychological functioning". (Thiem, Balaam, et al, 2012)). "Positive Design is an

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[1] *Tool:* the activities that support the development of a particular step during the design process.
[2] *Design method/procedure/Technique:* the consecutive arrangement of tools intended to guide each of the stages of the design process, from the start denoted as the "problem definition", up to the end, i.e., an actual product.
[3] Joolz, http://my-joolz.com/joolz/
[4] *Methodology:* referred as the science and study of method and procedure.

umbrella term for design research and intention in which explicit attention is paid to the effects of design on the subjective well-being of individuals and communities" (Desmet & Pohlmeyer, 2013). We believe that UCD procedures that actively involve end users and in this case, infants and caretakers, could have great impact on the way designers approach the design process, the resulted designed products and the way they are experienced by users in order to enhance their well-being. Results of prior exploratory studies of the authors in the field of design for infants led to relevant conclusions for the setup of the current study (Monsalve & Maya, 2012). Most important findings are discussed below.

### 1.4 Design for infants as a user-centred task.

Prior exploratory studies of the authors in the field of design for infants (Monsalve & Maya, 2012) led to the awareness of the little information available in the field of design for infants; furthermore, it led to the identification of two renowned authors in the domain of design for and with children: Mathieu Gielen[5], and Alison Druin[6] as starting points for further work. Moreover, these studies aimed to identify possible criteria for assessing existing tools to support the specific cases of design for infants. As hypothesis, the authors consider that design for infants is a user-centered task, however possibly implying higher complexity than other user-centered tasks; this is due to the possibly faulty support of the conventional user-designer interaction to the specific design situation centered on infants (see 1.2). Therefore, the following criteria are proposed in order to assess the tools on their suitability to the case of design for infants (See 5, RQ2 and RQ3): *a*. tools supporting researchers on identifying the experiential and contextual factors affecting the particular design situation involving infants, and *b.* tools supporting designers on translating above findings into real products (Monsalve & Maya, 2012). Below we present in detail the objectives of this study.

## 2 OBJECTIVES

The goal of the research is to assess existing tools for designing for children focusing on those to design for infants available in secondary sources. By identifying the advantages and limitations of the existing tools for designing for children, the authors aim to propose recommendations for modeling a method intended to design *for infants*. In this manner, the following section (3) aims to describe the method followed in the study. Section 4 describes the results of the study and discusses the answers to the research questions proposed below. Finally section 5 describes the conclusions and proposes future work. Below, the specific objectives of this study are described as the research questions.

### 2.1 Research questions

The RQ addressed in this study are presented below.

**RQ1: What are the existing tools about?**

- RQ1.1: Which phase of the design process do they approach?
- RQ1.2: What are the steps undertaken? What are the inputs and the outputs?
- RQ1.3 What kind of models, psychological, procedural or from another typology do these tools rely on?

**RQ2: How the existing tools are supporting designers, researchers and users during the design process?**

- RQ2.1: How do these tools support designers and researchers on identifying the experiential and contextual factors that affect the design situation?
- RQ2.2: How do these tools support designers and researchers on translating the findings into real products?

[5] Mathieu Gielen is a designer of products for children's play, lecturer and researcher in TU Delft

[6] Allison Druin is Professor in the University of Maryland's College of Information Studies. Her research has focused on developing new technologies for children with children as design partners.

**RQ3: What are the limitations of the existing tools for designing for children, when applied in the case of designing for infants?**

# 3 METHOD

The systematic approach employed in this study is described below.

## 3.1 Search process

The search process was manual. It started with the consultation of the most recent publications of the previously identified authors (See 1.4: Gielen, Druin), and was expanded to the consultation of their cited references. Furthermore, digital libraries and search engines were used for collecting information. With the aim of scanning the field of design for children broadly, regardless of children's age, design philosophy or typology of product, a set of keywords from a generic nature was selected: *User Centered Design (UCD), Child Centered Design, design for children, design methods for children, design for play*. The search process finalized when the authors considered that a saturation point was reached; this is, when no new relevant information was encountered.

### *3.1.1 Inclusion criteria*

Due to the awareness about the scarcity of information available, the impact factor for assessing the quality of the publications was low. The publications selected made part of book chapters, journals, conference proceedings and/or technical report. In addition, publications belonging to connected fields such as psychology, ergonomics, among others were also selected.

# 4 RESULTS

## 4.1 Results of the search process

The result of the search process was a collection of a total of 117 publications. The scan of these publications lead to the identification of 5 categories. Even though all categories classify within Child Centered Design, some of them were taken as separate groups due to the high amount of publications, and the specialization of the topic. These categories are: "3. Human Computer Interaction (HCI) for children"; "5. Design for difficult to reach users", which concerns nonverbal users and/or largely dependent on caregivers such us autistic children; finally, "6. Design for play" expands to all users who involve in playful activities. Finally, a second filtering process, selecting publications with highest impact factor lead to a total of 96 publications to be checked in detail (See Table 1).

*Table 1. Results of search process: amount and categorization of publications*

| Category | | Subcategory | | No. |
|---|---|---|---|---|
| 1 | Children's development | 1.1 | Cognitive, psychological and physiological development | 10 |
| | | 1.2 | Parenting and children's development. | 5 |
| | | 1.3 | Preverbal Children. | 8 |
| 2 | HCI for children | 3.1 | Co-design with children | 19 |
| | | 3.2 | Informant design with children | 5 |
| | | 3.3 | Learner centered design (for children) | 7 |
| 3 | Child Centered Design | 4.1 | Design for children | 17 |
| | | 4.2 | Contextmapping and generative techniques adapted for children | 6 |
| 4 | Design for difficult to reach users (nonverbal) | | | 5 |
| 5 | Design for play | | | 14 |
| Total | | | | 96 |

## 4.2 Data extraction

The data extraction focused tabulating the information in the following 7 columns: 1. Name of the method/tool; 2. General description of the method/tool; 3. Goal of the method/tool; 4. Children's age

ranges approached in the method/tool; 5. Phases of the design process approached in the design method/tool; 6. Steps undertaken in the method/tool; 6. Input and output of the method/tool and 7. Model or theory supporting the method/tool.

### 4.3 Data analysis

The data was analyzed applying the KJ Method (Scupin, 1997). This procedure requires the presence of a team as means for themes grouping, validation and consensus; however this part of the study was followed by only one of the authors. Nevertheless, it is important to highlight that other methods also intended for data examination such as Thematic Analysis (Braun & Clarke, 2006) require only one person. Therefore, we believe that the results of this procedure are anyway reliable. The data analysis started by familiarizing with the data of the table; the research questions were approached and annotations were made on sticky notes. The sticky notes were placed on the wall and grouped by similarity. A total of 3 groups representing trends in the information resulted of this analysis, named as following (see section 5, trends): *trend 1: intergenerational teams and the role of children in the design process; Trend 2: The roles of caretakers in the design process and Trend 3:The typology of products aimed to design*.
The data analysis conveyed the identification of a total of 9 methods for designing for children, and 23 different tools, which were registered as explained in 3.3. In order to shorten the amount of information this paper includes the simplified versions of the results registration, displaying the methods and/or tools considered relevant for modeling a method for designing for infants according to the criteria explained in 1.4. Table 2 displays a simplified version of 7 selected tools. Table 3 registers the key points of 3 selected methods.

## 5 DISCUSSION

In this section we discuss the research questions based on the author's hypothesis and criteria as explained in 1.4.

**RQ1: What the existing tools/methods for designing for children/infants are about?** The majority of the methods (6/9) belong to the domain of HCI; two (2/9) methods belong to the domain of design for autistic children. One (1/9) method found concerns Contextmapping techniques (See Table 3) adapted for the case of children. Furthermore, the majority of the tools (20/24) are enclosed within the domain of co-design/Participatory Design (PD). In addition, the majority of these tools (14/24) relate to children in the 6-13 years old as design partners (See table 2). Most of the tools found concern an adaptation of PD tools to the specific case of children. Some of these adaptations consist on reducing the complexity of the activities, as well as the length and amusing approach to ensure children stay engaged.
*RQ1.1: Which phase of the design process do they approach?* Most of the tools (20/24) approach the early phases of the design process: research, problem clarification, gathering inspiration. A significant amount of the tools approaches also the idea generation phase (12/24).
*RQ1.2: What are the inputs and the outputs? What are the steps undertaken?* The steps vary significantly according to the type of tool (See Table 2). Inputs to the tools addressing the phase of researching the design situation and idea generation consists mostly on *a.* an intergenerational (IG) design team; *b*. explanation of the design assignment; *c.* a set of research/idea generation activities and *d.* papers with layouts and other art supplies. The outputs of the tools consist mostly on *a*. insights from the design situation represented in drawings, notes, storyboards, low-tech prototypes or words and *b.* Early ideas/concepts represented in drawings, mock-ups and other artifacts through low-tech prototyping.
*RQ1.3 What kind of models, do these tools rely on?* Tools rely on procedural models and some of them on psychological models. Procedural models indicate a step-by-step approaches for the search for information/inspiration about the user; psychological models bring insights about the motivation and behaviour of the related subjects. These psychological models vary among cognitive, developmental and learning theories, e.g. Bonded Design (See Table 3) relies on the model of Zone of Proximal Development (Vigotsky, 1987).

**RQ2: How the existing tools/methods intended for designing for children are supporting designers, researchers and users in the design process?** The tools found provide not only frameworks, but also theoretical support to carry on a design assignment related with children.
*RQ2.1: How do these tools support designers and researchers on identifying the experiential and contextual factors that affect the design situation?* No tools were found guiding the search for contextual and experiential factors in the specific case of infants. Activities such as observation in the real context may reveal important details of the design situation that designers could not grasp otherwise. We believe that these observation activities may be as helpful for the case of design for infants. In addition, activities aiming to access children's thoughts and feelings involving simple tasks alike low-tech prototyping may be a practical and engaging way for caretakers and designers to collaborate in the design process when it comes to infants. In particular, Contextmapping and generative techniques support in detail above process. Practices such as involving caretakers during the design process are found in domains were target groups are largely dependent on caregivers. In this study, references alike were found in the field of design for disabled children e.g., the framework developed by van Rijn (2012) for learning from encounters with autistic children and caretakers.
As explained in 4.3, the data extraction and analysis resulted in the following 3 groups representing trends in the information found:
*Trend 1: Intergenerational teams, and the role of children in the design process.* Most of the tools require an intergenerational team: adult designers and/or researchers and children participants. The tools addressing the collaboration of children in the design process involved them as users, testers, informants, and design partners (Druin, 2012). There is a clear tendency of involving children as informants and design partners. Adults perform activities related to the preparation and conclusions of each phase.
*Trend 2: The roles of caretakers in the design process.* Caretakers can be considered fundamental when it comes to design for and/or with children, or specifically for the case of designing for infants; caretakers could take roles such us enablers, mediators, informants, users and co-designers (van Rijn, Visser, et al 2011); however they are not actively involved in the design process of the tools surveyed. This can be explained by the fact that children older than 6 years old are verbal and self-reflective enough to discuss what they are thinking (Druin, 2012). Only the tools intended to design for autistic children involved actively caretakers.
*Theme 3: The typology of products aimed to design.* Literature refers to studies where the type of products to be designed mostly concern educational technology and HCI. The design of technology can be seen from the perspective of designing technical systems and thus, products in general can be seen as such.

*Table 2. Simplified version of the tools considered suitable for designing for infants*

| | Name of tool | Age | Description | Phase of the design process | Input | Output | Reference |
|---|---|---|---|---|---|---|---|
| 1 | Generative techniques: cultural probes and generative sessions | 6 to 12 | Tasks and materials that help deeper reflection and diverse forms of expression: maps to indicate locations, notebooks to record thoughts as diaries, journals among others. | Clarifying the problem. Gathering inspiration for idea generation. | Diverse tasks and materials (maps, diaries, various craft materials) | Diverse artefacts expressing user's thoughts and ideas. | (Gielen 2011) (Wyeth & Diercke, 2006) |
| 2 | Contextual inquiry | 6 to 12 | One-on-one field interviews where both adults and children observe, take notes, and interact with child users in the users own environment. | Clarifying the problem. | User, IG team, context, inquiry. | Filled in questionnaires, notes on user's feedback. | (Druin, 1999) |
| 3 | Sticky note critiquing/frequency analysis | 6 to 12 | An intergenerational team critiques an existing piece of technology using sticky note pads with records of their likes and other relevant categories according to the case. | Research phase-clarifying the problem. | Representation of a product, IG team, and sticky notes. | Notes on the analysis of the piece of technology | (Druin, 1999) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | Technology immersion | 6 to 12 | Children access and use a wide variety of existing technologies over a sustained period of time with researchers observing children's activity patterns in an unconstrained setting. | Research phase- clarifying the problem. Validation phase. | Group of children as testers, IG team, existing technologies | Notes on the group analysis of the tester's usage of technology . | (Druin, 1999) |
| 5 | Child personas | NS | Tool that aims to create "fictional children", as detailed written conceptions of the eventual users. | Clarifying the problem. Gathering inspiration for idea generation. | IG team, users in their own context, inquiries. | Detailed written conceptions of eventual child users | (Antle, 2008) |
| 6 | Focus groups, Large Group Discussions Using Whiteboard, | 7 to 11 | Tools that aim to obtain children's feedback during diverse phases of the design process in an iterative way. Groups come together to discuss situations. White boards are used for quick frequency analysis. | Clarifying the problem, idea generation, idea evaluation. | IG team, various art supplies, white board. | Diverse artefacts, notes on the group analysis, and outcomes reflection. | (Gibson, 2007) |
| 7 | I-Spy | 7 to 11 | Tool from the Bluebells method aimed d to gather contextual information. Designers observe children in their context. The children are left to explore the problem space and behave in a natural way. | Clarifying the problem. | Group of children as testers, IG team, annotation tools. | Annotations about observations. | Rebecca, Mazzone, et al, 2006) |

*RQ2.2: How do these tools/methods support designers and researchers on translating the findings into a suitable product embodiment?* Various brainstorming tools support designers and children participants on coming up with ideas for product interactions and interfaces of their preference, e.g. Hide & Seek, and blind's men bluff from the bluebells method ("design method that balances child-centred design with expert design in a progressive approach iterating between 4 techniques" (Mazzone, et al, 2006)). However, no tools were found approaching specifically the embodiment of products for children. In addition, iterative usability tests may support the embodiment process. Tools such as technology immersion inviting children to intensively test concepts, and posterior focus groups/sessions following sticky note critiquing and discussions, may enhance the progressive evolution of a product's usability and aesthetics (See Table 2). In the case of design for infants, once more we believe that these types of tools may have to be adapted to the case of collaboration with caretakers.

**RQ3: What are the limitations of the current tools/methods for designing for children, when applied in the case of designing for infants?** Little reference was found about tools for designing specifically for infants. We believe that the tools found in the CCD field rely mostly on the children's spoken feedback and therefore, would not fully support the case of design for infants. Considering the phases in the design process where direct contact with users is required, adaptations need to be addressed to support the case of design for infants. For example, activities such as observation, where researchers may need to understand physiological and behavioural manifestations of infants could require extensive support not only from caregivers, but also from the knowledge found in the social sciences.

*Table 3: Simplified version of the methods considered suitable for designing for infants*

| Name of the method | Age | Description | Goal | Steps | Input | Output | Model/Theory | Reference |
|---|---|---|---|---|---|---|---|---|
| **1.** Context-mapping techniques (adapted ) | 7 to 16 | Form of generative research with children, aiming at creating context awareness by eliciting emotional responses from participants. | To create context awareness, gain empathy and identify user's world of experience to inform and inspire the design team. | 1. Preparation: the target of the study is formulated. A planning is made, participants are selected and the choice for specific research methods is made.<br>2. Sensitizing: self-reflection assignments are sent to participants prior to the session (s) as means of preparation.<br>3. Generative session: participants are brought together to carry out generative assignments in which they create artifacts. By explaining their artifacts to the group, they can express their thoughts, feelings and ideas.<br>4. Analysis: researchers meet to discuss and explore the results of the previous activities.<br>5. Communication: Visualizations are made to present the patterns that have been identified through the analysis.<br>6. Next steps: idea generation, creation of concepts, prototypes and tests, manufacture, implementation | Research team, participants, set of activities and various craft materials. | Rich user data represented in *infographics, scenarios, personas, storyboards* among others. | The Model of experience domain. (Sleeswijk Visser, et al, 2005)<br>Levels of understanding of the user experience (Sleeswijk Visser, et al, 2005) | (Gielen M. , 2008) |
| 2. Framework for learning from encounters with autistic children and caregivers. | Not specified | Framework to guide designers on learning from encounters with non-verbal or hardly speaking children with autism. | To build creative understanding about users in order to feed idea generation and concept development. | 1. Discovery and 2. Familiarization are phases to prepare for interaction.<br>3. Immerse: Participate in n interactions with children, without actively experimenting.<br>4. Observe: To subjectively collect data about users in observation.<br>5. Connect: To explicitly recall similar prior experiences in their own lives.<br>6. Reflect: To interpret the experiences they take from encounters in reflection.<br>7. Detach: To move towards theorization, shift from child as subject to child as object.<br>8. Theorize: To analyze interpretations from reflection together with external findings.<br>9. Apply: Develop ideas and concepts into prototypes.<br>10. Try out: To approach the children with the design proposal as prototype. | A design assignment, researchers, caregivers and children in their own environment. | Creative understanding, validated concepts/ prototypes. | The DIKW model describes how designers build creative understanding from encounters over time. (Ackoff, 1989) | (van Rijn, 2012) |
| 3. Bonded design | 11 to 12 | Children participate for a short intensive time in the process. | To bond the knowledge of adults and children. | 1. Needs assessment: study by survey or by questionnaire a user sample.<br>2. Evaluation of existing technology: identify strengths and weaknesses<br>3. Intergenerational discussion.<br>4. Brainstorm: Establish evaluation criteria, idea generation, and documenting.<br>5. Prototyping: iteratively used in order to produce a final low-tech prototype<br>6. Building a consensus: by matching options to pre-determined criteria,<br>7. Low tech prototype as end result. | Design team, activities, various craft materials. | Ideas, concepts, low tech prototype . | Zone of Proximal Development (Vigotsky, 1987) | (Large & Nesset) (Vigotsky, 1987) |

## 6 CONCLUSIONS

This paper aims to present the results of a survey of tools for designing for children and to build a theoretical basis for modeling a method for designing for *infants*. The study shows dominance of co-design tools with intergenerational teams, addressing children older than 6 years old, within the HCI and design of new technology domains, and a tendency to involving children as design partners. We believe that procedures that actively involve end users and in this case, infants and caretakers, could have a great impact on product design. UCD approaches addressing users largely dependent on caregivers could support the case of design for infants. The framework developed by van Rijn (2012) for learning from encounters with autistic children and caretakers (See table 3) was found as a suitable match and/or starting point for a potential adaptation to the case of design for infants. We consider two main opportunities to adapt this framework. The first one lays on the design of tools to support designers on identifying tacit and latent needs of both infants and caretakers based on direct contact. Frameworks such as Contextmapping (Gielen 2011) relying on generative techniques could support the above. The second consists on the design of tools that bridge the gap between the information overload from social sciences with the actual design practice. This is, tools that support designers accessing and applying this information throughout the entire design process but in particular, in the observation phases.

On the other hand, the involvement of users in the design process may be conditioned by the resources, timeframes available and design philosophies. Tools such as Child Personas (Antle, 2008) could support this challenge by building "fictional infant profiles" in early phases, which designers can return to in consequent stages. Furthermore, adaptations to the Distributed Co-Design method (Walsh, 2010) could provide communication platforms to connect design teams, caretakers and infants in different locations (See table 3). Finally, approaches such as Bonded Design (Large & Nesset), which propose a short but intensive interaction with users, could provide guidance on discerning the most suitable moments to have direct contact with users (See Table 3).

For culminating the task of modeling a method for designing for infants, future work may include further theoretical studies such as: the study of the practice of methods/tools for designing for children/infants in the industry; the study of tools to support phases of the design process which require direct contact with caretakers and infants: observation, idea generation, validation; studies concerning the design of tools that convey knowledge of the social sciences regarding developmental stages of infants, applicable for design practice; studies concerning the role of *Positive Design* in the practice of designing for infants. Moreover, future work includes also empirical studies concerning drafting, modeling, testing, iterating and validating tools /methods for designing for infants integrated in 3 different running projects at Joolz (the company in concern, see 1). These projects are subject to different design conditions such as type of product to be designed (playing/non playing items). In this manner, the empirical studies aim to gain generic conclusions about the suitability of the tools/methods in varied cases and provide a practical framework for modeling the method in question.

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