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Evaluation of an Affordance-Based Requirements Generation Tool for Speech And Language Therapeutic Toys

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Abstract

Task clarification poses various challenges to designers as they need to understand the different needs of users before translating the requirements into specifications and aptly conceiving product concepts in the subsequent design stage. This paper presents a descriptive study for the evaluation of a framework and its implementation as a computer-based prototype tool, proposed to assist designers in generating and understanding affordance-based requirements for speech and language therapeutic toys. Results show that early design support is beneficial to both experienced and novice designers.

Keywords: early design phase, design tools, evaluation, affordance-based requirements, therapeutic toys

1. Introduction

It is estimated that 7% of the entire population possesses a considerable deficit in language ability which cannot be attributed to any causative health factor (Leonard, 2014). For developmental language disorder (DLD), which is a type of language impairment, treatment in the form of language intervention is most of the times successful, if the diagnosis is done in the early childhood. However, due to the various limitations that mainstream toys have when adapted for therapy, speech and language pathologists (SLPs) end up using several resources to cater for the needs of different clients. Therapeutic toys are specifically designed toy products intended to support the work of clinicians, by which they can establish a relationship with young children and in turn, motivate children towards the therapeutic effort. Designers' own knowledge and experience is limited to address the needs for such niche products, or they may find it difficult to transfer their skills across different design domains (Fikar et al., 2018). Additionally, the exhaustiveness of their research is often restricted by the accessibility to key field experts, the number of details on the design brief and their understanding of the customers' needs. In view of this context, the aim of this study is to evaluate a prototype tool that supports designers in the early design phase for speech and language therapeutic toys (SALTT). The users of such artefacts are SLPs, children attending therapy and their caregivers. Within this context, these end-users are considered as the *customer*.

In order to achieve this aim, the design research methodologies proposed by (Blessing and Chakrabarti, 2009b) and (Duffy and O'Donnell, 1998) were adopted to carry out the entire research, where the identified phenomena described in a descriptive study (DS1) (Balzan *et al.*, 2021) were translated into a knowledge-based model consisting of a framework and a taxonomy of key elements for the design of SALTTs. The knowledge model was used to develop a computer model, in the form of a computer-based requirements generation tool for SALTT. The evaluation study presented in this paper is the second descriptive study (DS2), that has been carried out to evaluate the prototype solution with respect to a number of evaluation criteria. These criteria will answer and

investigate to what extent designers will be willing to use such a framework in their practice, while providing the relative justifying reasons.
Based upon this introduction, the rest of this paper is structured as follows. The first part of Section 2 provides further insight into the field being researched and the importance of design affordances in children's products. Related work is then discussed, along with the identified research gap and evaluation criteria. In Section 3, a prescriptive model is explained by means of an overview of the knowledge and the computer models developed for the investigated customers' needs. The evaluation study is then presented in Section 4 while the results are discussed in Section 5. Conclusions are drawn and future work is recommended in Section 6.

2. Background and Related Work

This research work focuses on the early design process, specifically on the task clarification stage where the end-users' requirements are being generated and understood by the designer. The understanding of the customer's needs is the basis of any design process (Kim and Lee, 2010). Owing to the advancement in various technologies, the number of features that can be integrated into a product is increasing, resulting in more complex requirements (Brace and Cheutet, 2012), especially with respect to product-service systems (Berkovich *et al.*, 2011). Furthermore, the fact that customers' needs often demand knowledge pertaining to various disciplines, nowadays designers, working alone or in small teams, require more support during the design process. For every new product idea, the understanding of the customers' needs, the problem requirements and the way the end-user will interact are crucial to achieve the desired new reality (Dorst, 2004). The design process begins as soon as the customer's needs become known. In the absence of a clear requirements list, the task clarification stage is even more challenging to the designer. Moreover, poorly understood requirements can lead to inappropriate products being developed because either the product does not provide the required functions or end-users are unable to perform the desired actions.
Requirements elicitation is a well-researched area (Darlington and Culley, 2002) and various approaches have been proposed to: support designers in asking the right questions to the right stakeholders when collecting product requirements (Wang and Zeng, 2009), use predefined checklists (Müller *et al.*, 2010; Pahl *et al.*, 2007) to ensure all requirements have been considered, and elicit and analyse requirements through methodological guidelines (Ulrich *et al.*, 2020). Although universal frameworks used to generate requirements are based on a systematic process and can be used in any new product to be designed, they do not sufficiently provide solution-specific support or insight on the customer's needs with respect to a specific context. For this reason, without the relevant experience, designers are unable to perform adequate decisions during the requirements analysis stage.
The theory of affordances looks at how relational opportunities exist between living organisms and the environment. Maier and Fadel (2007) introduced the notion of Affordance Based Design where the customer's needs were represented into affordances that capture the relationships between the designers, the products and the users. In (Cormier and Olewnik, 2014), an affordance-based approach for capturing the needs of users at a problem abstraction level has been established through the affordance basis which explains the benefits that end users will have when using the artefact to be designed. Their work was further extended to cater for user variation and the integration of design specifications (Cormier and Lewis, 2015). This allows them to maintain a relational viewpoint of how the benefits that will be provided by the artefact are linked to the users' and artefact's characteristics.
There is no doubt that the role of industrial designers has become increasingly more important as product competition is driven by the products' appearance, brand, and price, and consequently, by the emotional values that products deliver. Product development of complex systems normally involves both engineering and industrial designers to develop the functional elements and the outside of the product (Kim and Lee, 2010). Given that individuals or small companies often work alone when developing innovative product concepts and the ability to find off-the-shelf mechanical and electrical components, it has become easier to integrate and implement functional elements in products. Although, designers' skillset continues to expand, customers' needs change very fast and to design an appropriate product, in the right time and at the right cost price is not a trivial task. Maier and Fadel (2007) explain the generic affordance structure for any artefact and the four methods of identifying

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affordances: predetermination, direct experimentation, indirect experimentation, and automated identification. Predetermination is the most relevant method at the task clarification stage. Nevertheless, this method relies on the skills, experience, tacit knowledge, subjectivity, and available research time that the designer has. Responding actively and soundly to a demand also depends on the availability of specific, up-to-date explicit knowledge about the problem. For this reason, problem-specific design support during the task clarification stage can provide designers accessibility and understanding of unique end users' requirements, thus shortening the entire (or parts of the) task clarification process, ensuring clear understanding of the customers' needs, and possibly eliminate unnecessary design iterations. Gained development time can be used to involve users more often in the subsequent stages, explore or develop further innovative concepts and ensure adequate user testing.
Furthermore, early design support can also help designer with the phenomenon of design fixation. During the creative process, designers can access four different orders of knowledge (Youmans and Arciszewski, 2014). Cormier and Olewnik (2014) explain that although affordance-based design empowers designers to find innovative solutions, designers still need "additional tools to aid the abstraction of user needs to affordances". Given that there is no support for the design of speech and language therapy devices (or SALTTs), this study addresses the evaluation of a computer model that fills this gap by providing support at the task clarification stage. Moreover, early exposure to different design solutions for the affordances can support the creative process later in the concept stage.

3. ACQUAINT-SALTT: A Prototype Implementation of the D-SALTT Framework

The considerations of end users that designers need to make for SALTT have been listed as a taxonomy of twelve key elements as shown in the Speech and Language Therapy Potential Model (SALT-PM) presented in Figure 1. This model has been evaluated with clinicians working in the field of speech and language therapy in a separate study. Therapeutic toys are another set of toys which share elements with mainstream toys. Each element listed in the SALT-PM is made of sub-elements and the more they are present within a product, the greater its applicability for therapy, hence the name potential model. Furthermore, children can outgrow their condition and thus, the potential of such model also decreases.

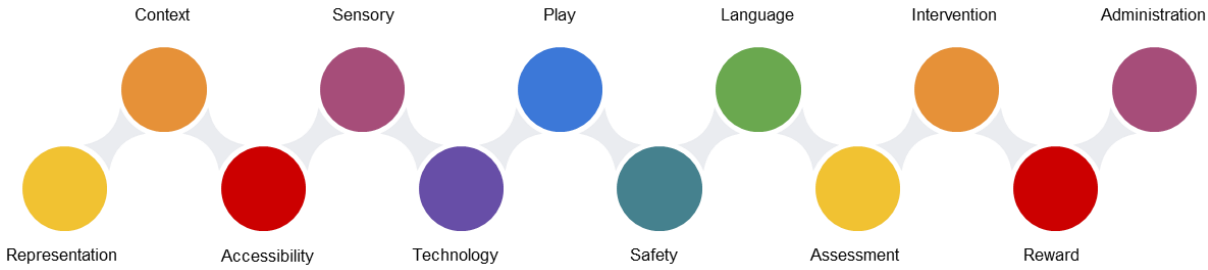

Figure 1. A high-level representation of the Speech and Language Therapy Potential Model

Figure 2 shows a high-level representation of the D-SALTT framework presented in (Balzan et al., 2021), a framework intended to support designers during the Task Clarification stage to generate and understand the users' requirements. The D-SALTT framework consists of five layers. At the core lies the *Stakeholders Layer* consisting of the end-users and the relevant product development stakeholders, whose needs will (directly or indirectly) pass to the designer (Step 1) as a design brief. Sometimes, this initial list of needs (design brief) is not readily available or is not exhaustive enough for the designer to understand it (Balzan et al., 2021). The front end of the computer-model, represented by the *User-Interface Layer*, will allow the designer to input (Step 2) the customers' needs and identify new requirements for the product being designed.

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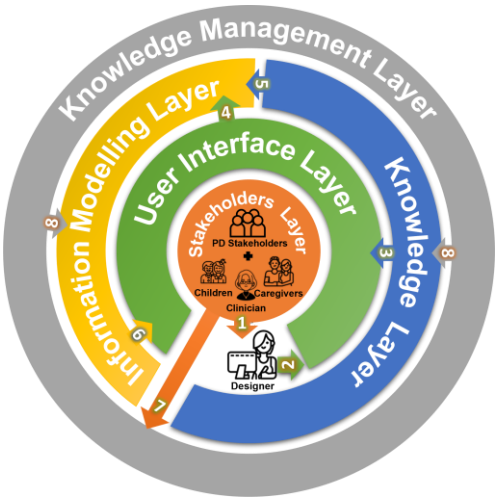

Figure 2. A high-level representation of the D-SALTT Framework

As part of the backend, a *Knowledge Layer* comprising of key knowledge about the product to be developed, checklists, personas and use scenarios would support the requirements refinement stage where new requirements may be identified (Step 3). In this case, the SALT-PM is part of the Knowledge Layer and is being used to refine requirements. The *Information Modelling Layer*, also residing in the backend of the computer model, maps the refined requirements into affordance-based requirements (Step 4). In turn, these are used to find similar products that exist in the market (Step 5) and present them to the designer (Step 6) for inspiration or to further improve the list of requirements being generated. From time to time, the requirements of stakeholders, including the user preferences change (Step 7) or the need to update knowledge models (Step 8).

In Step 4, the refined requirements are mapped into affordance-based requirements (ABRs) such that the intended use of the product is better understood. In this work, the approach of (Cormier and Olewnik, 2014) was adopted in defining SALTT requirements as ABRs, that is, the benefits that the product to be designed shall provide to the intended user(s) through the affordance basis. The formalisation of an affordance-based requirement is as follows: "The [artefact to be designed] affords the [user(s)] the [affordance] with respect to [target object or environmental entity]". Additional information can be added to provide further clarification to the requirement. However, ABRs should remain solution independent.

The D-SALTT framework was implemented into a prototype computer-based support tool called ACQUAINT-SALTT which stands for **A**fforda**n**ce-based Re**qu**irements Gener**ati**o**n** **T**ool for **S**peech **a**nd **L**anguage **T**herapeutic **T**oys. ACQUAINT-SALTT provides a means by which the D-SALTT framework can be evaluated. The requirements for this tool stem from the original requirements of the framework (Balzan *et al.*, 2021), coupled with the modus operandi of toy designers and the aspects of software usability that enhance the user's experience while interacting with software. The level of implementation of the tool when compared to the D-SALTT framework is extensive with the omission of a module that is not the focus of this study. The user interface (UI) of the tool was first prototyped using Adobe XD and then developed as a standalone application using Qt, a cross-platform software development kit that uses Qt Modelling Language (QML), a declarative UI markup language for designing UIs, and C++ and Python programming languages for the backend. When ACQUAINT-SALTT is launched, the designer, that is, the person that is using this tool, is presented with a dashboard that provides information on the UI. Although it was not exhaustively implemented, a Knowledge Library consisting of information about the different aspects of SALTT products, is always made accessible through the main menu.

Once the designer starts a new project, s/he is presented with a user form that allows her/him to input the details of the new product to be designed. The tool offers the option to automatically load the basic requirements for a particular user group within the language impairment spectrum. Once the project details have been inputted, the main UI shown in is presented to the designer. The main menu is in the top-left area of the UI, that is, area **A.** In area **B** one can see the twelve elements of the SALT potential

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model. Although the tabs are presented in a particular order, the designer is free to consider any element and in any preferred order. The designer can input or compile the requirements by selecting the various UI elements (such as sliders, checkboxes, etc,) in the main area of the UI, that is, area **C**.

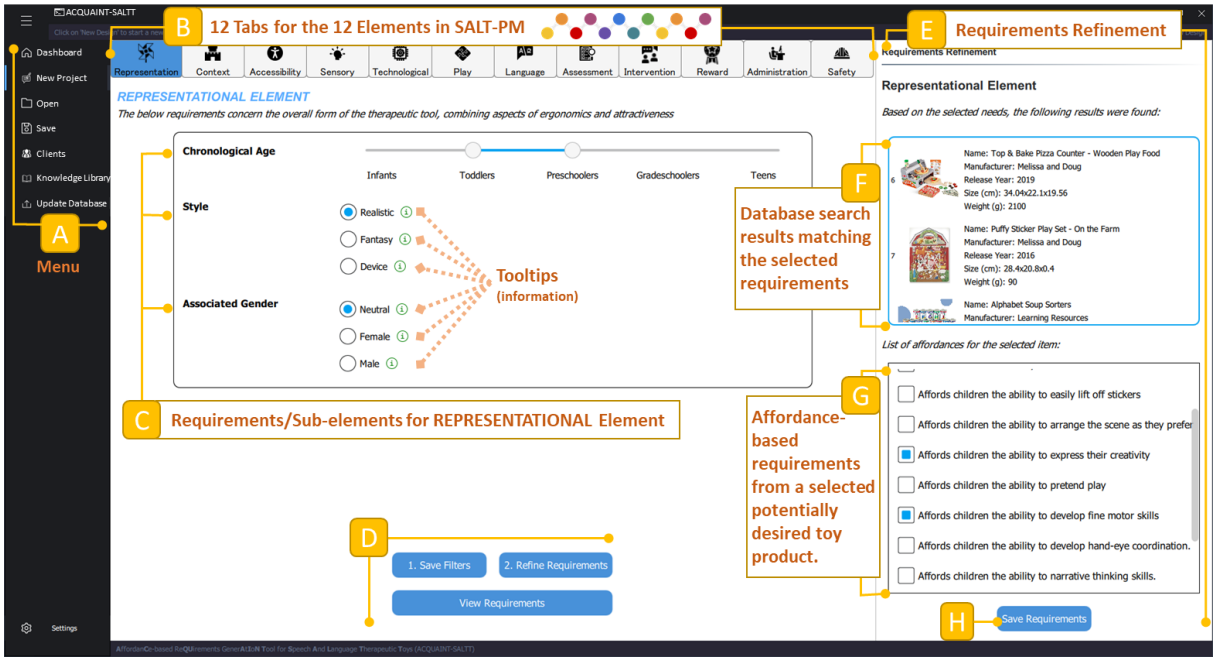

Figure 3. Main user interface of the ACQUAINT-SALTT prototype tool

In area **C**, one can see the sub-elements (requirements) for the Representation element of SALT-PM, that are: the chronological age of children for whom the product is being designed for; the style or the type of overall form that the product will take, and the associated gender of the product. The designer can input or compile the requirements by selecting the various UI elements (such as buttons, sliders, checkboxes, etc,) in the main area of the UI, that is, area **C**. To aid designers understand each element or terms displayed in the UI, tooltips were implemented so that when one hovers the cursor over a screen element such as the info icons, a text box of information about that element is displayed.

When the designer is ready from inputting the requirements related to a particular element, the "Save Filters" button in area **D** can be clicked to keep record of the desired requirements and in turn these are mapped into ABRs. When clicking on the "Refine Requirements" button in area **D**, if the desired requirements match relevant products residing within a precompiled database of actual toys, apps and gadgets used in speech and language therapy, the results are displayed in area ***F*** within area ***E***. Note that each tab (element) produces search results that are independent of each other, allowing the designers to find potential market gaps. Each product in the database is linked to a list of marketable ABRs that was manually extracted from the marketable description found on a leading e-commerce platform. When the designer clicks on the image of a matched product, a list of marketable ABRs is displayed in area **G**. The designer can browse through the list of ABRs of each toy and if a particular requirement is desired, it can be added to the list of ABRs being generated for the new product by ticking the checkbox and clicking the "Save Requirements" button. The requirements being generated can be viewed at any time and from any tab by clicking the "View Requirements" button, where the right-hand portion of the UI is replaced by a text area showing the requirements for the new product. ACQUAINT-SALTT outputs the generated ABRs list both as a text file and as an HTML document.

4. Evaluation of ACQUAINT-SALTT

Since ACQUAINT-SALLT is a prototype implementation of the D-SALTT framework, the evaluation of the tool is the indirect appraisal of the framework and its modules. Prototype or actual tools make it easy for the participants to comprehend the abstractness of the frameworks (Blessing and Chakrabarti, 2009a). The aim of this evaluation is two-fold. The first objective was to understand whether the D-

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SALTT framework would benefit designers in generating and understanding requirements during the Task Clarification stage by means of ABRs for SALTTs. The second objective was to evaluate the actual prototype tool, ACQUAINT-SALTT, in terms of a computer-based tool that guides the designer in understanding the different considerations that need to be taken when developing therapeutic toy products for speech and language therapy, while assessing its strengths and limitations. To address the research question mentioned in the introduction, five evaluation criteria have been postulated:

1. Does the framework fit in the designer's workflow during the task clarification stage?
2. Do requirements, expressed as ABRs, provide better understanding of requirements?
3. Are designers made aware of the different end-users and their requirements for SALTT?
4. What characteristics of the tool do designers find useful and necessary in ACQUAINT-SALTT?
5. Would the intended support planned in the framework augment the benefits of the actual support provided by the prototype tool if it was implemented?

4.1. Participants

Individual, online interviews were carried out with fourteen international designers (seven male and seven females) working within the toy industry as shown in Table 1. The designers' years of experience (YOE) varied between 5 and 30 years (Mean = 14.1 years, Std. Dev. = 8.5 years). Participants were recruited from seven different countries in Europe and the US. In terms of their highest level of education, one was a full professor, eleven had a Masters degree and two had a Bachelor degree.

Table 1. Participants' information (*YOE: Years of Experience)

Participant	YOE*	Background	Participant	YOE*	Background
P1	10	Product Designer / Project Manager	P8	22	Educator and Toy Designer
P2	4	Toy Product Designer and Inventor	P9	11	Product Design Manager
P3	15	Creative Director and Professor	P10	11	Toy Designer
P4	8	Freelance Industrial Designer	P11	10	Marketing and Toy Product Designer
P5	20	Product Research and Development Manager	P12	6	Toy Designer / Founder of a Toy Company
P6	30	Full Professor and Cofounder of a Toy Company	P13	30	Research Development and Innovation Manager
P7	5	Product Designer	P14	15	Product Director

4.2. Procedure

Each evaluation session consisted of three stages. In the first stage, an overview of the studies that were previously carried out to develop the D-SALTT framework and the SALT-PM model was given along with an explanation about ABRs. This introduction was about fifteen minutes long. Through this introduction, the design problem was reconfirmed with the participants agreeing how challenging is to understand and interpret requirements. In the second phase, a demonstration of AQUAINT-SALTT prototype tool that lasted around an hour, was given. This involved a detailed run through of each feature that ultimately generated a complete list of ABRs for a new speech and language therapeutic toy. In the final phase, a structured interview was carried out, where sometimes additional questions were asked to clarify or expand the provided feedback, or to provide examples of general statements they gave. The prepared questions were divided into three parts and were targeted to answer the evaluation criteria. The first part was to evaluate the overall D-SALTT framework on its own. Questions about the adopted format for ABRs statements were asked in the second part. In the third

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part, the questions were asked to evaluate the actual prototype implementation, thus evaluating certain characteristics of the D-SALTT framework. On average, the interviews took around an hour.
Given that statistical analysis does not always present in depth insight about the participant's feedback and experience, qualitative analysis can fill such gaps when describing the reasons for the supplied feedback. Furthermore, thematic analysis, an interpretive and iterative process, allows for the identification of patterns in data that results in understandings about phenomena. For this reason, the qualitative meta-analysis approach described in (Chwo *et al.*, 2018) was adopted in this paper where participants' feedback was organised in themes in such a way that the evaluation criteria highlighted previously with respect to this study's research question are answered. All interviews were recorded and later transcribed for qualitative analysis. Participants' feedback was read and coded in an iterative process to refine the identified themes and address the evaluation criteria for the framework. In the next section, the results are collated under five themes.

5. Results and Discussion

Theme 1: Affordance-based requirements for the Task Clarification stage

Toy designers stated that they prefer to adopt an unconstrained creative process. Although 64.29% of the participants have never heard about design affordances, the use of ABRs was received well. All participants strongly agreed or agreed that ABRs can be understood easier, can facilitate user identification, can help designers understand the benefits that the product will give to the end-user, and are solution independent. Participants were also asked to rate the level of satisfaction on the way ABRs are utilised in practice within ACQUIANT-SALTT. All participants were happy with how requirements are shown, with 78.57% and 21.43% expressing that they were "Very satisfied" and "Satisfied" respectively. Participants were very interested to hear that the marketable description of existent products was used to extract their affordances and in return use them to refine the requirements for product being designed. In fact, this was suggested to be one of the main strengths of ACQUAINT-SALTT, with designers replying that they were "Very satisfied" (85.71%) and "Satisfied" (14.29%) to be able to add ABRs from existent toy products. As stated by participant P4, the way D-SALTT framework (and ACQUAINT-SALTT) handles requirements it gives designers "the ability to discover new things about toys that you may think that you know everything about". The feedback from this theme answered the second evaluation criterion.

Theme 2: Importance of Knowledge, Frameworks, and support tools for SALTT

The design of toy products is heavily unsupported and as a result, toy designers struggle during the early stages of product development. The participants strongly agreed (35.71%) or agreed (64.29%) that the presented framework can support the designer at understanding the given end users' requirements. Thirteen out of fourteen participants agreed (71.43%) or strongly agreed (21.43%) that the framework would support them with the generation of new requirements, motivate them to explore unforeseen requirements and to improve the product being designed. To address the third evaluation criterion, focused questions were asked on the prototype tool to assess the level of implementation of the framework. All participants strongly agreed or agreed that ACQUAINT-SALTT supports the requirements generation task and is useful for the generation of requirements of SALTT products. Almost all the participants strongly agreed (50%) or agreed (42.86%) that ACQUAINT-SALTT helps designers to understand requirements and that it addresses an exhaustive list of user requirements for SALTT. For each question, one participant gave a neutral reply.
Similarly, 85.72% of the participants were in favour that the prototype tool is easy and intuitive, practical to use, helpful for starting to generate design concepts for SALTT and it would be useful for both novice and experienced designers. Participants said that although the tool will support any designer due to its repository of knowledge, they were of the opinion that an experienced designer would benefit more or "might use the tool in a better way" given that they know the market better. Participant P13 stated that this tool alone is not enough to support novice designers. This continues to prove that design support is required at all levels, especially to support designers entering in new fields or industries. From their feedback, it was apparent that creativity was related (and determined) by the number of years of experience the designer have. As mentioned in (Askland *et al.*, 2010) among various factors, creativity

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stems from the designer's pre-existing knowledge and any supporting knowledge at their disposal which will allow him/her to use their experience in a particular design problem.

Theme 3: Differences in the required level of support

This theme addresses the first evaluation criterion. 28.57% and 50% of the participants strongly agreed and agreed, respectively, that the D-SALTT framework would support their role during the Task Clarification stage while the others gave neutral feedback. Those in favour explained that the framework "is very clear and reflects how the designer should work" and "contains all the elements to consider in the early phase design process". The three participants that provided a neutral reply said that it needs to be visually improved to keep it simple.

In equal proportions, the participants strongly agreed or agreed to have a structured way to look at requirements such as checklists that guide designers to systematically look at requirements. Designer P1 commented that, "[with a structured list,] I could take certain categories of requirements or I can delegate some elements to different team members" while P7 said that "since I do not know a lot about SALTT, I find this structured approach very useful in knowing their requirements". P2, P3 and P13 argued that although it is important to have requirements organised, it would be easier for them to start with the most relevant elements and then take on other requirements as the design progresses because "the design process is not linear, it's like a wave. Certain information would be useful at different stages".

Theme 4: Willingness to use ACQUAINT-SALTT

To continue addressing the first evaluation criterion, the participants were asked different questions to determine their willingness to use the tool. All participants said that they would use this it to understand the different requirements for SALTT products, with 78.6% responding "Very Likely" and 21.4% saying "Likely". Moreover, all participants were likely to recommend ACQUAINT-SALTT to a friend or colleague. Participants noted that for such a niche application this tool would be very useful because it is backed by knowledge that has been researched and focuses on the usability of the product. P7 said that "to consider all the different aspects of a speech and language therapeutic toy will take me a lot of time to generate the requirements but the requirements are detailed and ultimately I will end up with a better result." Given the detailed demonstration that was provided on ACQUAITN-SALTT, participants were asked whether they require anything else to use the tool to design SALTT products. Only P12 mentioned that the demonstration was not sufficient. While other participants remarked that they would still need a bit of practice, they agreed that the demonstration was complete and very comprehensive. P6 remarked that the tool "is very specific. Usually, it is very difficult to access experts (clinicians) or to double-check requirements with experts for a second opinion when getting requirements from caregivers". This feedback continues to shed light on the phenomena that designers are not sufficiently close to the end-user and that certain requirements from specific users are more challenging to determine, especially ones that require multi/intra-disciplinary knowledge.

Another question was asked to investigate the applicability of ACQUAINT-SALTT to the requirements generation of mainstream toys. The scope of this question was to understand whether, from the provided demonstration the participants could foresee cases where the tool would be useful. Various sub-themes emerged as they mentioned ways of how the prototype tool can be used in their work. P1 and P14 mentioned that specific elements of the SALT-PM, namely, Safety and Language, would also be applicable to normal toys. P2, P5 and P7 and P9 highlighted the fact that the SALT-PM serves as a checklist, to discover unforeseen or refine the requirements given by Marketing and Sales. P1, P3 and P13 mentioned that having requirements in terms of affordances is beneficial, especially "in cases where there are small children" or "a special group of children" that requires the designer to consider appropriate affordances. As P4 and P11 and P12 highlighted, the tool can display existent toy products that match the desired requirements, making it useful for market research, benchmarking, to identify market gaps, and to explore how one can improve or innovate on existent products. The last sub-theme was adaptability, where P6, P8, P10 and P13 noted that the tool can still be use for the knowledge it contains and to assist in starting a new line of generic or niche products because of the way requirements for different designs can be generated.

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P6 specifically mentioned that the tool would be more usable if more therapeutic areas are considered since some elements within SALT-PM would be common.

Theme 5: From a prototype tool to a software tool

For each feature that was implemented in ACQUAINT-SALTT, designers were asked to rate their overall level of satisfaction to specifically address the fourth evaluation criterion. The ability to start a new project and input relevant details was positively welcomed by all participants except for one designer who does not need to specify who the client will be when starting a new project. All participants were content (78.57% "Very Satisfied" and 21.43% "Satisfied") with the ability to select a user profile and allow the tool to generate a pre-filled list of requirements. The ability to see products used in speech therapy that match the selected criteria was received well (85.72% "Very Satisfied" and 7.14% "Satisfied") while a participant gave a "Neutral" rating. Similarly, the ability to see requirements being generated in the tool while exploring different elements was rated positively (35.71% "Very Satisfied" and 50% "Satisfied"). This time, two participants gave a neutral rating. A 100% "Very satisfied" rating was given to the tool for the ability to display tooltips for each term shown in the interface. Finally, the ability to access the Knowledge Library within the tool was overall positively rated (50% "Very Satisfied" and "42.86% Satisfied" with only one "Neutral" rating. All neutral ratings were given due aesthetical improvements that were suggested to the user interface of the prototype tool.

Participants were then asked to rate their satisfaction if all the modules mentioned in the D-SALLT framework were to be implemented or further improved to address the fifth evaluation criterion. 64.29% of the participants would be "Very Satisfied" while 28.57% would be "Satisfied" to see the remaining features included in ACQUAINT-SALTT. When asked whether they like to have fields where they can specify the design specifications for the requirements, twelve participants (85.71%) were in favour, stating that it would be very helpful and that technical specifications could act "as a filter than would limit the number of results". Participants P2 and P6, who were not positive on this aspect, argued that most technical specifications are identified "at Concept stage or later" and that it is preferrable "to see the expansion of the tool in other therapy areas rather than having technical specifications". Further improvements to ACQUAINT-SALTT were about the knowledge content as this would help them in taking decisions during the design process. In fact, all participants want to see ACQUAINT-SALTT's Knowledge Library further improved in the future. Moreover, all participants wish that the tool would be updateable such that the data and the knowledge models remain relevant. This is crucial "to stay up to date with the market", especially when "tens of thousands of new toys are introduced every year".

A limitation of this study is the small number of participants. However, as could be seen from the results, a clear indicative saturation point was reached for all questions, making results consistent with minimal variability regardless of number of years of experience. As indicated by Morse (2000), when the nature of study is obvious and it has a narrow scope as in this evaluation study, the sample size can be smaller. It is important to highlight the difficulty to recruit participants since no toy designers were available locally. Although many efforts were made to recruit overseas evaluators, it transpired very challenging to specifically reach therapeutic toy designers, since it is a niche area in the toy sector.

6. Conclusion and Future Work

This paper presents the evaluation results for the prototype requirements generation tool for Speech and Language Therapeutic Toy products, ACQUAINT-SALTT. These results showed that design support and knowledge about speech and language therapeutic toys are necessary and beneficial to both experienced and novice toy designers. As future work, the intention is to collate further the suggested improvements about D-SALTT and the prototype tool while potentially collaborate with interested individuals on an open-source level to develop an improved version of ACQUAINT-SALTT which is freely available. The scope of this work was to open the barriers for designers and manufacturing companies to produce media specifically for therapy, starting with the field of speech and language therapy.

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