RESEARCH-ARTICLE

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Designing for Transactional Moments: Features of Tools for Child-centred Speech Language Teletherapy

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Figure 1: The left image shows the therapist conducting therapy online. The middle image shows the client sitting with an adult in a therapy session. The right image shows the client and therapist in an in-person therapy session.

Abstract

Teletherapy for speech-language therapy (SLT) has become essential for many families. Early intervention for young children is important to ensure that developmental milestones are met. In this study, from a corpus of 10 videos, we present three cases of online and in-person therapy sessions with children between the ages of 3 and 6. Our analysis shows how online and in-person SLT sessions use tools, how they are conscripted into social and transactional moments, and identifies features of tools that support or hinder therapists' goals (see Figure 1). From our findings, we discuss in detail four overarching features of tools and implications for design. These features support engagement, space usage, child-centred play, and adaptability in therapy sessions. The paper outlines how these features are present in the tools used in SLT, and describes how they impact SLT activities, therapists' and children's goals, and the environment for social transactional activities.

CCS Concepts

• **Human-centered computing**; • **Human computer interaction (HCI)**; • **HCI design and evaluation methods**;

Keywords

Teletherapy, Children, Therapy Tools, Speech-language Therapy

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1 Introduction

Early support and intervention for language disorders in children is imperative to ensure developmental milestones are met. In remote settings or settings where there are accessibility issues for families to attend in-person therapeutic sessions, parents are often left without local support, and alternatives to in-person therapy sessions are needed. Teletherapy provides a technologically mediated alternative to conducting therapy sessions using video conferencing [63]. Teletherapy delivery has seen a steady uptake in recent years in response to digital technology maturation and COVID-19 social restrictions [56]. It is seen as a desirable service offering advantages over in-person therapy due to being more accessible, efficient, community-based, and educational [4, 7]. However, little is known about how or whether the role and requirements of tools change from in-person to online delivery of SLT (Speech-Language Therapy) sessions.

Familiar playful tools, such as tangible toys and craft materials, are often used in therapy sessions to support engagement in SLT sessions. In therapy, additional conditions are imposed to enable these tools to support therapy goals, constraining their use for children [16]. One such condition placed on tools is what is referred to in this paper as a 'transactional' activity. Transactional activities, into which tools are conscripted, encourage engagement from the child with the offer of a perceived benefit, e.g. a transaction is reached when a child states a required sound or word in response to an expected reward given by the therapist. These activities are seen as playful and directed to the child's interests yet provide avenues for therapists to scaffold language-specific target exercises [12]. Tools are purposefully chosen to meet the child's and therapist's needs in the session. When therapy is conducted online, these transactional activities can become more problematic due to therapists' lack of control over the distributed therapy environment and access to shared physical spaces. Therapists often find ways of using transactional activities over distance by either finding online versions of similar activities, adapting activities in situ to suit the presented online environment, or sending tools out to community centres and homes and enlisting the collaborative help of parents to conduct therapy sessions online. To this point, few studies have attempted to understand how SLT tools afford transactional qualities and how the environment of in-person and teletherapy sessions impacts the use of these tools in transactional moments. Most research has focused on the functions and affordances of mobile applications in teletherapy [46] without considering the environment or the impact on early intervention therapy sessions [64].

This paper analyses how online and in-person SLT sessions use tools and how they are conscripted into social and transactional moments. In this paper, we define 'tools' as objects often used to accomplish a set task and the instruments therapists use for therapy, which, in many instances, are physical handheld props such as cards or plastic figurines. In distance therapy sessions, however, this definition extends to the interactions and movements of touch screens, for example, the handling of the physical iPad and manipulation of the digital objects on its screen. The environment refers to the setup of the therapy session, including the room and its furniture for in-person sessions and the shared visual spaces provided by cameras and viewing screens for teletherapy sessions.

This paper adopts a design-oriented research approach, in which an in-situ evaluation of existing tools is performed to identify important features of tools for teletherapy [19]. We present three cases as examples from a corpus of 10 therapy sessions to highlight the similarities and the particularities of the uses of tools present throughout the online and in-person therapy sessions. With the overarching aim to inform the design of therapy tools tailored to both in-person and remote therapy activities, our research question is:

RQ: How do tools' physical and interactive features support therapist-child transactional moments in therapeutic interactions?

Our analysis examines commonalities and differences between how therapists conscript tools into online and in-person therapies. Findings identify features of tools that can actively support therapy goals worth consideration in the design of novel tangible interactions for transactional moments in SLT sessions, namely: (a) inbuilt layers of interaction to indicate the potential of subsequent activities; (b) mechanisms for control over active and inactive space to support therapists' goals; (c) open-ended distributed points of engagement for child-led collaborative play; (d) content variability to accommodate children's idiosyncrasies and preferences. The features are discussed in light of existing literature in SLT and HCI research, constituting implications for the design of digital tools to encourage therapist-child social transactional moments in teletherapy environments.

2 LITERATURE REVIEW

Due to the more prevalent use of video conferencing services, online therapy sessions have become a realistic alternative to in-person therapy. The positives of remote interventions include providing an equitable and sustainable service to those for whom in-person therapy sessions are inaccessible [12, 25]. There are several reported hurdles, however, that accompany the changes to transactional activities that are implemented in teletherapy settings. These challenges include greater difficulty in encouraging playful social interactions by distance [24], the limited ability of young children to use digital technology-based therapy tools [27, 54], and reduced communication and engagement in online interactions [12, 27]. The shift from in-person to teletherapy sessions means that therapists have had to adapt their activities to the new landscape, including how tools are distributed or re-imagined in activities to suit online environments better whilst maintaining a high service level. We first discuss how tools are conceptualised and used in therapy sessions and how researchers are addressing the above concerns with respect to tools in teletherapy settings.

2.1 The importance of play-based approaches in online therapy

In young children's therapy sessions, play is a predominant motivator for engagement and a natural environment for children

to practise and extend social communication [27, 36]. Play encompasses a range of activities, from adult-led scaffolded play to child-led free play. A systematic review conducted by Gibson et al. [24] on play-based therapy interventions found that play was predominately adult-led when digital technology was used in therapy sessions, whether in person or teletherapy. The researchers called for more naturalistic approaches to digital technology that incorporate free play, which is related to social connectedness and promoting positive behaviour [21, 51]. Considering play is a developmentally appropriate activity to engage children in learning [45, 58], finding ways to encourage play in online SLT settings is integral for positive learning outcomes.

2.2 The role of tools in teletherapy environments

The usage of tools in teletherapy settings has required a shift in therapists' understanding of what activities can be successfully conducted through teletherapy and what hurdles need to be overcome when existing in-person therapy tools are employed online. One main concern for teletherapy therapists is how to encourage transactional moments that incorporate playful social interaction and communication [24]. There are three broad approaches taken by therapists in response: 1) the relocation of physical tools from in-person therapy sessions to be used in homes, 2) the adoption of physical tangible tools into teletherapy, and 3) the introduction of digital tools.

2.2.1 Re-located physical tools create an anxious therapy session. The re-location of physical tools involves 'gifts' (such as board games and craft materials) physically delivered to remote locations such as community centres or family homes. Children are reported to be excited and engaged during and between teletherapy sessions when presented with new physical tools. Campbell et al. [12] discuss the importance of children having ownership of the materials to use and bringing enjoyment to online therapy sessions, such as placing playdough over the image of the therapist. For the therapist, however, relinquishing control over materials means a reliance on parents to ensure physical tools are ready to be used, as well as a reduced ability to manage when and how tools are used. These considerations increase the burden on therapists to ensure that children are attaining speech goals in therapy sessions without being able to use tools as transactional mediators. Therapists have self-reported that they can adapt in several ways to deliver better service using alternative means of engagement, such as competition or providing a selection of activities rather than relying on a single one. Also reported is the negative impact of creating a higher level of anxiety in therapists using these relocated tools in therapy-type activities [12].

2.2.2 Open questions as to the adapted use of physical tools in teletherapy. There is little research conducted on how tools are repurposed over teletherapy, with few notable exceptions. Ekberg et al. [16], using observational data from in-person and teletherapy sessions with young children, discuss how therapists adapt the activities used with existing tools for in-person sessions to teletherapy environments. For example, in in-person therapy, a ball run is used as a reward for correctly making a target utterance. The therapist first illustrates the target utterance through physical gestures and verbal cues. The child then speaks the utterance and is rewarded with physically being able to release a ball down a ball run. In teletherapy, a similar strategy is applied; however, instead of the child being able to control the ball physically, they are encouraged to communicate the target word, and then the therapist releases the ball for the child. The child's role is to observe this activity happening. Other interactions engage the child with some success, such as the therapist using strategies that enable playful pretend embodied interactions after a target sound has been conducted, such as touching the screen as if to release the ball.

As a counterpoint to the above-cited research, general discussion by researchers in young children's therapy regarding the merits of using re-purposed tools in teletherapy environments proposes that if therapy is not centred around playful embodied activities that use physical tangible tools, the engagement level of children will be limited and will reduce their abilities to learn how to successfully communicate in social environments, and restrict their ability (and the therapist's ability) to use other modalities of communication such as physical touch [12, 27], and child-led play activities [13, 24, 36]. The focus on child-led play has also increased the importance of leveraging carer involvement in SLT practices with children [12, 18].

The adaptation of activities requires trial and error to determine what works in teletherapy environments. When tools are adapted for teletherapy purposes, the child has a diminished level of ownership over the tools. Therapists use alternative engagement strategies to counteract the disadvantages of teletherapy environments. Strategies reported include pretend play, competition, collaborative or common digital resources [12, 46], and leveraging parental involvement to continue to promote embodied play. However, strategies involving the modification of activities are often seen as a subsidiary alternative to in-person therapy, causing aspects of existing tools, e.g. tangibility and narrative child-centred free play, to no longer be useful for SLT activities [12]. This prompts questions about the properties of physical tools (physical and digital) that make for effective tools in teletherapy with young children.

2.2.3 Digital tools offer alternative types of motivation, feedback, and timely analysis for families engaging with SLT.. Several digital tools have been developed for therapy sessions. SLT researchers suggest that digital tools that are entertaining and engaging are able to provide a similar response in motivation to physical rewards when children produce a target utterance [12, 28]. Virtual rewards provide motivation for engagement and feedback to inform the child of their progress. Researchers have proposed several types of tools, including digital games and digital tangible tools (including IoT devices), although few have been widely implemented [66].

Digital therapy games: Digital therapy games have been developed for therapy evaluations [2] and training [29], including serious games and therapy applications. They provide an avenue to motivate and support children and parents in practising target exercises outside the therapy sessions [22]. Furthermore, digital games can provide engaging graphics, short-term reward systems, and young children with immediate and consistent feedback when practising mouthing sounds. Digital games for therapy include features such as multi-sensory dynamic feedback [22], personalisation [2, 15] speech analysis and biofeedback that can detect the accuracy of the

spoken phoneme [28, 29, 46, 49], and annotation and recordings [1, 28]. Though sparsely implemented, these tools reveal useful functions digital technology can support in therapy sessions if they align with therapists' and children's goals [53].

Digital tangible interactive tools: Digital tangible interactive tools provide the benefits of being technological artefacts that collect data, provide audio and visual interest, etc., embedded in familiar physical, tangible toys that children can readily socialise within play [40, 43, 52, 54]. Tangible interaction draws on design and computer science fields, combining embodied interactions of the material, digital and the social [31]. Tangible interactive devices that capitalise on opportunities for greater open-ended embodied behaviour compared to traditional user interfaces that are more restrictive, such as the mouse and keyboard, have been shown to support children's ability to think through their hands, aiding their communication through verbal and gestural means [38, 41, 47]. Antle et al. [3] conducted an experimental study to compare the benefits of tangible interactions, mouse gesture user interfaces (GUI), and non-digital tangible technologies with children. Their findings indicate that children spent more time communicating their thoughts with others through tangible tools (digital and non-digital) than with a mouse GUI. These studies highlight the importance of creating digital, tangible, interactive tools that encourage embodied behaviour for young children when communication is an important outcome.

Specific studies targeted towards general therapy have articulated some recommendations when designing tangible devices for children as part of therapy activities. Sitdisanguan et al. [57] conducted a comparative study between a TUI (tangible user interface) system and a WIMP (windows icon menu pointing device) system with 20 low-functioning autistic children, deriving design guidelines for TUI systems, e.g., ensuring tangibles can be manipulated by small children, fit on a tabletop, issue prompts after a set time of no use, include audio when needed, use negative feedback sparsely if at all, provide correct answers after a set amount of tries, and employ clear visuals. This study, while not conducted in SLT therapy sessions and its direct relevance to SLT is not certain, provides rare and potentially useful guidelines when considering the design of digital tangible devices. Relatedly, Santos et al. [54] conducted a focus group with five SLT specialists and found the following recommendations for highly desirable features in IoT tangible devices for SLT: engaging for the child, versatile, facilitating interaction with family members or peers, involving parents, providing storytelling opportunities, including playful interactions, requiring no knowledge of digital technology, involving feedback (including haptic, visual and sound), logging data, resetting remotely, not disrupting daily activities, and being useful. A study conducted by Phykitina et al., [51] which included interviews with mental health therapists, discusses design recommendations for tangibles such as providing child-led safe environments that allow for play, free expression and open exploration.

Overall, digital tools are easy to maintain, provide timely feedback, and promote engaging mechanisms such as competition. However, researchers have cautioned their use in therapy sessions for several reasons. Young children may find technologies difficult to use and are more likely to be adult-directed rather than child-centred, leading to calls for "naturalistic approaches to [digital] technology" [24]. They are also described as being difficult to collaborate on [54]. For example, Campbell [12] describes one hurdle to using digital resources in SLT – the reduction in physically interacting with children. In-person therapy sessions allow clinicians to engage in tactile promptings, such as physically touching a child's cheek to demonstrate different mouth positions or touching a child's diaphragm to enlist breathing techniques. Although tangible and IoT devices can address some of these levelled concerns whilst taking advantage of digital technologies' ability to record and track the activities of children in therapy sessions, there are currently very few studies that report on how digital tangible and IoT devices are or can be embedded in therapy sessions with young children. We need a better empirical understanding of the role of therapists, the tools, and the needs of children to create digital therapy tools that are fit for purpose.

2.3 Summary of Literature Review

The majority of research related to the design of SLT tools for teletherapy has been developed from focus groups of therapists and parents, comparison studies of tangible digital technologies, or general therapy studies [24]. While these studies provide a valuable and formative orientation to the field, we still lack a detailed appreciation of what aspects of these tools either support or hinder the therapist and young children's interactions, including communication and social play. For this reason, we focus on the moments when tools are used in transactional activities to encourage young children to engage with therapists' goals in SLT sessions. In this paper, we address this gap by analysing video data of naturalistic, situated activities and interactions in both in-person and teletherapy environments to determine how the features of SLT tools impact the activities, the therapist/child's goals, and the environment [5, 11].

3 METHODOLOGY

We have taken a design-oriented research approach whereby we analyse the use of existing tools in a naturalistic setting to interrogate problems and propose areas for further design response [19]. Before implementing designed prototypes, generating design ideas, and incorporating participant perspectives, an analysis of existing practices in the field is needed to ensure design interventions bring together the nuances of particular participants, activities and environments [34, 61]. Design-oriented approaches to research are distinct from other forms of inquiry with respect to how they primarily focus on identifying novel opportunities for the design of artefacts rather than on hypothesis testing, theory building, or other valid research objectives. Our adoption of this approach uses video-based methods to examine how existing tools are conscripted into teletherapy and the interactional consequences of their use [19]. The benefit of using a design-oriented research approach is in understanding the set of contextual features of *tools* for teletherapy and how, although the therapist's goals remain the same, this differs between existing and in-person SLT [60].

3.1 Participants

Participants were recruited through a child development service and in compliance with Human Research Ethics Committee (Ref. 1400000864). The corpus presented in this paper involves four children between the ages of 3 and 6, two therapists, and, when

appropriate, the children's carers in ten video sessions (see Table 1). This was taken from a total corpus of data that included three therapists and 11 children. The diagnostic information provided to us by the therapists indicated the children had a range of speech and language conditions associated with developmental delay diagnoses (including Autism Spectrum Disorder and Down Syndrome). Therapists were able to provide both in-person and teletherapy sessions to each client. Informed consent was provided by the child's adult parent or guardian on behalf of their child and, where appropriate, from the child [14]. A heterogeneous purposive sample was collected to include both general and particular interactions in the analysis. Children were selected for the study for their range of developmental diagnoses, with all but one diagnosis represented by at least two participating children. Each type of diagnosis was provided with therapy sessions conducted via videoconferencing and in person. This enabled us to compare treatments across the two environments. Each therapist was considerably experienced (mid-career) and offered a broad range of treatments.

3.2 Collected data

The in-person sessions were recorded from two stationary video cameras in the therapy room, and the teletherapy sessions were recorded from the therapist and the child's screen over videoconferencing software. No researcher was present in either of the types of therapy sessions. Most children participated in at least three separate therapy sessions. A total of five in-person sessions and five teletherapy sessions are presented in this study's corpus.

3.3 Analytic approach and data selection

Our theoretical and analytic orientation adopts a socio-material lens to investigate the relationships between tools, environments, and social connections [10, 20, 35]. This perspective is predicated on the intrinsic relations of material properties of the world to the social contexts in which those properties become visible, noticeable, and/or consequential, informed by the differentiated design stance taken by Leonardi & Rodriguez-Lluesma [39]. This socio-material analytic lens underpins our design-oriented research methodology [39, 48], taking into account the social environments in which therapy tools are deployed to analyse how these complex and relational social systems play out in the activities surrounding the tools [35, 39, 48]. A socio-material perspective is helpful for designers in foregrounding the tools in social contexts, informing the design of outcomes better suited to complex social situations. The analysis interrogates tools' physical, interactive and social requirements for delivering SLT therapy with young children in naturally occurring contexts. To understand the consequentiality of tools in these practices, we used multimodal video analysis methods [30], a data-driven descriptive analysis, to identify what children and therapists interactionally do in sessions [9, 61]. This is particularly important when young children are involved in research, ensuring their actions and perspectives are captured rather than prioritising adults' perspectives [14].

From the therapy videos captured, a corpus of ten sessions were selected based on their use of a range of tools in teletherapy and in-person environments, the age of the children engaged in the sessions, and their relevance to the research question, with the aim to inform the design of therapeutic tangibles for young children: How do tools' physical and interactive features support therapist-child transactional moments in therapeutic interactions?

The 10 videos (detailed in Table 1) were viewed by three researchers (backgrounds in computer science, psychology, interaction design and early childhood) and discussed to ascertain their ability to reveal patterns of behaviour related to the use of tools. Four videos were excluded when they only exhibited repeated behaviours already captured in other sessions or if the tools in the video were used in a limited fashion, e.g., only as a reward or for initial engagement rather than in therapeutic interactions or transactional moments. The remaining six videos were analysed in detail using Nvivo^{TM} software. The analysis included transcriptions of speech, audio and body movements alongside video data, enabling the coding of verbal and visual interactions. These six videos were logged, coded by two researchers [37], and discussed with the other team members.

The data was initially processed by assigning low-level codes to the raw data, such as 'joint play' when we noticed both therapist and child played together, 'distracted' when the child strayed from the task, or noting which tools were deployed. This lower-level coding of the video enabled the team to quickly identify specific interactional episodes that included the phenomena of interest ('transactional moments') and to interrogate recurring features of these phenomena. Secondary codes were based on the types of actions the participants performed in the sessions under general questions posed by the data: How was the activity promoted to the child? What made the child stay in the activity? What made the activity more or less engaging? What was the reason for ending the activity? This process generated subcodes for each of these questions, e.g.; motivated by the therapist (verbal/bodily); motivated by the parent (verbal/bodily); tool-motivated (sound/animation/colour); child-initiated; reward system (for child) evident; no initial motivation visible or needed. After the data was logged and coded as such, relevant sequences could be scrutinised to determine the roles the artifacts and tools played in those transactional interactions to elucidate our research question. From our detailed analysis of these sequences (a sample of three presented below), we looked to identify an initial set of features of tools in SLT sessions.

In this paper, we present detailed analyses of three videos from the six videos analysed, selected based on their ability to showcase the variety of interactions using tools in transactional moments. The three cases of tools-in-environment represented are Mr. Potato Head™ doll in person with binder and cards, Mr. Potato Head™ Application [65] on iPad in teletherapy, and the colour-sorting card game in teletherapy. The three videos involve three types of toys, i.e. application (Mr. Potato Head™), character toy (Mr. Potato Head™), and cards (picture cards), selected as exemplars of the types of findings found in the other cases of SLT therapy. In the discussion, we note where these behaviours have occurred elsewhere in our corpus of video data.

3.4 The general value of few, but detailed, qualitative analyses of cases

The primary research value of analysing only few cases in detail is not (in the first instance) to generalise to a larger population

Table 1: Outline of the 10 videos: the tools used, the environment, the participants, and the activity.

Tool	Mr. Potato head™ Virtual app.iPad	Sound cards	Piggy sorting	Bubbles	Mr. Potato head™ doll,Binder with Cards	Card Matching
Activity	Naming different parts of the doll i.e. hat, arms, eyes.	Target sounds such as 'W' and hand gestures	'Little' & 'big' e.g., little orange, big orange.	Adjectives for blowing bubbles i.e., blow, up, out.	Naming different parts of the doll i.e. hat, arms, eyes.	Repeating animal names and practicing 'same'
Teletherapy Participants	Child (C1) Therapist (T1)	Child (C1) Therapist (T1)	Child (C3) Therapist (T2)	Child (C3) Therapist (T2)		Child (C3) Therapist (T2)
In-person Participants	Child (C4) Therapist (T1)	Child (C4) Therapist (T1)	Child (C2) Therapist (T2)	Child (C2) Therapist (T2)	Child (C2) Therapist (T2)	

of cases. While cases for generalisation will ideally emerge over time with greater volumes of data, there are several other reasons for looking at few(er) cases. In Stake's [59] presentation of case study research, he argues that it is only once phenomena are better understood in detail and in their own terms that more general explanations, accounts or features of cases may be identified as potentially transferable to other cases. This is relevant to our project, as there are currently very few in-situ studies of SLT sessions with young (pre-school) children on which to build. Secondly, detailed analytic research of this kind is still useful to practitioners, designers, and policymakers. By analysing and representing understudied aspects of other people's experiences to designers, the approach effectively extends their experience of the world, making it available as an additional resource for drawing out implications for technologies, tools, and therapy practices, as a means of "disciplining personal and particularised experience" [59]. This resonates with long-standing arguments of the value of ethnography for design—e.g. the need for research to provide detailed accounts of the very practices that designers will need to support with the systems and tools they build [55]. The value of detailed case studies such as ours is not necessarily that they describe general practices that can be predicted to transpire just like this in other cases, but rather in their particularity – that these practices actually transpired in the social world and happened as we describe here (see also [50] regarding therapeutic interactions). Designers who create tools or artefacts for these settings can benefit from taking into account that such therapeutic practices can and actually do happen like this, and that the kinds of interactional contingencies we identify below are precisely those that any new therapeutic tools or systems may have to accommodate.

4 FINDINGS

In this section, we present the three cases that were chosen for their ability to situate interactions with tools for SLT and as exemplars of the findings found in the other seven cases (see Section 5). In each case, we provide 1) a summary of the case, 2) a synopsis of findings, 3) a presentation of the data to situate the tools within the social activity, 4) an analysis (using a socio-material lens) highlighting how the tools either support or thwart the social activity of SLT in order to identify features of the tools that would benefit their use in therapy (see Section 5).

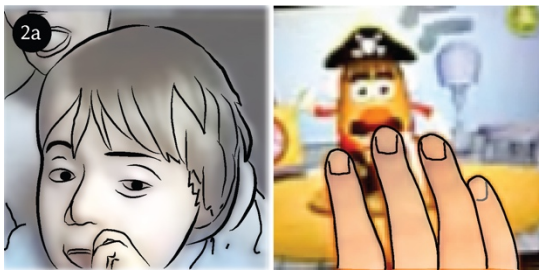

Figure 2a: The child leans forward to watch the animation.

4.1 Case 1: Teletherapy and a Mr. Potato Head™ application

This case takes place online using videoconferencing software. It starts with a therapist videoconferencing with a child seated on their adult's lap. The therapist uses two tools: the mobile application game, which contains various virtual objects as part of the 'Mr. Potato Head™' [65] activity and the iPad tool. The iPad is situated under a document camera, and another camera is focused on the therapist's face. We have analysed these tools (application and iPad) for how their design impacts teletherapy sessions.

This case highlights how existing mobile applications, although they may have the potential to support therapy goals, can derail the transactional moment that the therapist has built into the interaction. Issues identified include how the design of interfaces interferes with the child's focus on communication with the therapist and diminishes the child's control over the activity. The case starts with the therapist choosing the type of Mr. Potato Head™ toy they will 'play' with while the child looks on intently (Figure 2a).

In this case, the application and the iPad tool are seen to positively support a high level of interest and engagement from the child. Initially, the therapist and the child, with the parent's support, undergo several iterations of a transactional SLT activity that involves sound work (See lines 5-13). As can be seen, however, as the therapy progresses, features of the tool's behaviour result

Figure 2b: The child leans back in surprise when the parts fly to different parts of the screen.

Table 2a: Setting up the therapy session with the tools. Key for table: verbalisations that are unable to be translated use (inaudible response). The name of the child is anonymised to (name). Concurrent actions are denoted by * *; activity on the screen is described with [*italics*].

Image	Line	Speaker	
	1	T1	How about we do… this one **[therapist chooses a potato head2]**
2a	2		*{The screen shows a pirate potato head, on a stage. An animation occurs displacing their parts on various places on the stage}.*
2b	3	C1	Woow! *[*child sits back on the chair]**
	4	T1	Oh wow!

Figure 2c: The child points to the screen as they say 'hat'; the therapist is seen moving the hat onto the Mr. Potato Head™.

Figure 2d: The parent and child are discussing possible options. The therapist tries to get their attention.

Table 2b: Transactional moment established by the therapists.

Image	Line	Speaker	
	5	T1	What do I need first (name)? *[Therapist holds hands up as if to shrug]*
2c	6	C1	Look **[bends forward and points to screen]** hat
	7	P1	Hat, good boy
	8	T1	A hat! Okay here comes the hat. Oh! hhhh what's next **[Therapist moves the hat onto the potato and then writes a note on her notebook]**
	9	C1	Shoooees
	10	P1	Good boy
	11	T1	Shoes, okay here's the shoes, what's next?

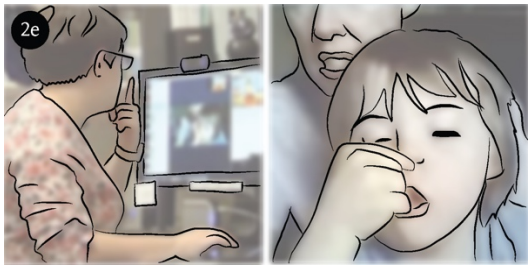

Figure 2e: The therapist has caught the child's attention and is helping the child choose a facial feature away from the application.

in the child being confused about which application elements are selectable. This causes the child to become distracted from the therapist's goals, ultimately leading to having diminished ownership over the play. These three issues are discussed below.

4.1.1 Multimedia interactions support quick engagement. Initially, the digital tools support the immediate engagement of a child. The interaction begins with the therapist using the application of Mr. Potato Head™ to enlist the child's cooperation. The therapist chooses a sequence that is initiated with an animation and sound. The child's reaction is a dramatic "Woow" as they pull back from the screen, displaying surprise. The therapist continues to use the application to encourage the child to pick objects from the screen so that they can move the parts to the Mr. Potato Head™. It is evident in the initial interactions that this approach works effectively as the 'animation' features reward the child when they state what they want. However, as we will see below, these same features can also cause difficulties in teletherapy.

4.1.2 Focus on the tool leads to reduced therapist-child interaction. The next exchange (Table 2c, Line 12) highlights the parent and child's joint attention on the iPad game and how this attention distracts from the therapist's movements and results in a disjointed interaction. The iPad remains stationary under the workspace camera, being heavy, with a flat base and a one-sided touch screen.

Table 2c: Highlights the break in the therapists' transactional moments at key times (bold text).

Image	Line	Speaker	
	12	T1	Okay what else do I need? *[therapist turns to the left to write down]*
	13	P1	What else do we need honey?
2d	**14**	**C1**	**Dey *[child points towards the screen]***
	15	**P1**	**Oh no that not... what, what are these *[parent leans forward and points to the screen]***
	16	T1	*[*Therapist makes a hand movement to say something, but the parent and child are looking at the application*]*
	17	C1	(inaudible response)
	18	P1	Want some, we need some *[*parent moves their arms*]*
	19	C1	Neh *[*Child moves their arms*]*
	20	T1	*Therapist brings her left hand to their face, parent and child are looking at screen*
	21	P1	Can you see them there? *[*parent uses child's arm to point to the screen*]*
	22	C1	Aarrmmms
	23	T1	Arms! Here we go one arm oough two arms! [*Application plays an animation*]
2e	24	T1	I think we are missing something on his face *[*Therapist points around their face*]*
	25	P1	What else do we need on his face?
	26	C1	Nose! *[*Child points to their nose*]*
	27	T1	Nose good work, I am going to put my nose on... what else are we missing on his face?

In Figure 2d (Line 14), we see the child picking "Dey", an object that the parent quickly realises is not selectable and cannot be placed on the virtual Mr. Potato Head™. During this exchange, the therapist tries twice, with no success, to gain the child's attention through the video conferencing screen, watching instead as the parent and the child determine what the 'next' item will be. The therapist moves back and forth four times between the iPad tool and the video conference display to determine what the child and parent are discussing. After confirming the parent's target word of "arms", the therapist moves the arms into place, stating "arms" as they do so, not noticing that the child has yet to pronounce the target word. As can be seen, in this case, both the application and iPad tools play significant roles in focusing attention away from the therapists' goals. Three features of the iPad and application lead to the loss of focus. Firstly, the application's multimedia interactions are fully engaging and self-contained (i.e. information is on the screen), limiting input from the therapist and creating a distraction from the therapy session. This highlights the need for engaging features to be restrained and temporal in their use. Secondly, the iPad's physical affordances enable it to be placed on the table and stationary under the document camera rather than being able to be moved closer to the therapist; the therapist must continually monitor what is happening on each camera (the document and video). Tools require features that allow them to be maneuvered digitally or physically, especially in static environments such as teletherapy. Thirdly, the application's digital (perceived) affordances do not support the child in discerning between what parts can be 'picked' and what parts are background objects. Further work needs to be done to understand how young children's interactions with application elements support their own goals. As can be seen in the data, features of physical and digital tools can cause confusion, resulting in a disjointed rhythm of the transactional play.

4.1.3 The child's agency over the activity is related to the use of the tool. The next turns highlight how children's agency diminishes throughout the interaction as the identification of specific parts of the tool are required. In Figures 2b and 2c, the therapist is seen to engage the child by relinquishing control of what will be chosen, creating a playful interaction that incorporates target word practice "... Oh [inhale] what's next?" asks the therapist, "Shoooees" replies the child, "Shoes, okay here's the shoes, what's next?" continues the therapist (lines 9-11). This interaction continues until the child can't find an item to either point at or state its name on the screen. The co-created 'game' begins to falter as the parent intervenes in the confusion and chooses an item from the application to prompt the child (Figure 2d). The therapist then tries a different course of action. In Figure 2e, the therapist moves away from the application and instead uses hand gestures towards their own face: "I think we are missing something on his face []". The therapist continues to use a sweeping motion "What else do we need on his face?" The child, watching the therapist, points to their own nose "Nose!" The therapist confirms that this is a good response "Nose, good work, I am going to put my nose on... what else are we missing on his face?" (Line 23-26).

The engaging interaction afforded by gaming elements is diminished when the therapist cannot gain control over the application and focuses the child back to them, ignoring the application. As the tool diminishes in focus, the activity becomes more passive from the child's perspective, as the child no longer orients to the tools 'gaming elements' and the choices that it provides, but to the direction of the therapist, who, it is shown, does not hold the same engagement value as the animations in maintaining the child's interest. Further consideration of how features of tools support intermediary social processes of SLT is needed. The game's mechanics interfered with the co-creation of a transactional moment. For transactional moments to occur, two environments (therapist and child) must be considered regarding how they require social access and social input through the tool [c.f. 32]. When tools do not cater for access and input from two separate environments, the therapist and child are unable to build off each other's interactions, and as can be seen, the tool no longer becomes useful. From a therapist's point of view, ensuring that digital games have multiple entry points can support further transactional moments.

Analysis of Case 1 identified that when digital and physical tools are used, features of these tools, such as immersive multimedia interactions, can support social activities such as early engagement. However, although the same tools are used when we examine

social interaction during the activity, these same features can also contribute to losing focus on the therapist's goals. Analysis of the following case, Case 2, highlights how a tool of sound cards used in teletherapy can foster engagement, provoke a sense of anticipation, enable transitions and may also lead to attention being placed back on therapist-child interaction.

4.2 Case 2: Teletherapy and Card Tools

This case is situated online using video conferencing software. It starts with a therapist video conferencing with a child seated on their adult's lap. This case uses sound cards with a coloured dot on one side and an animal on the other. Sound cards allow for colour groups, animal sounds, and animal names to be practised in therapy sessions in a playful manner. This case highlights how simple tools such as picture cards can provide rich modes of interaction in teletherapy environments and support children's broad interests. However, having fixed content does not allow the therapist the flexibility to tailor activities in situ when problems arise. As is detailed below, this impacts the social trust of the transactional activity and has implications for the design of online tools. This case begins with the sound cards laid out colour-dot side-up by the therapist under the workspace camera. In contrast, the other camera is focused on the therapist's face. The child is readily engaged, making mooing sounds in anticipation while waiting for the therapist to begin the activity.

Figure 3a: The child makes a pig noise for the therapist.

Our analysis shows that the children received the card tools designed to support the SLT goals as a fun activity. The cards serve several functions: that the child can choose a card colour, which enables a degree of autonomy in the activity; that the reverse side of the card is unknown, which encourages a sense of anticipation. The revelation of the animal provides the activity—for the child to build animal noises onto the revealed creature. The cards also support being moved from a non-active space (workspace camera) to a more active space (face camera), which allows the therapist to build anticipation and allows the child to focus on both the card in play and the therapist. However, the cards are not adaptable to the child's preferences (i.e., they only support the child's interest in animals) and hinder both the playful qualities and the children's ownership of the activity. Below, we discuss each of these issues and how they impact the transitory flow of the therapy session.

Figure 3b: The child is seen trying to escape the animal the therapist has revealed.

Table 3a: the transactional activity is established with the therapist asking what colour the child wants; colour is stated multiple times by both the child and therapist. The card is then brought up next to the face of the therapist and flipped, and both the child and the therapist make the animal's noise. Key for table: verbalisations that are unable to be translated use (inaudible response). The name of the child is anonymised to (name). Concurrent actions are denoted by * *; activity on screen is described in [*italics*].

Image	Line	Speaker	
	1	T1	Okay, what shall we look at first?
	2	C1	*[Child stares into the camera]*
	3	T1	you choose a colour?
	4	T1	Oh, were frozen! *[*places box away and looks up]**
	5	P1	Which colour honey?
	6	C1	(inaudible response)
	7	P1	Orange
	8	C1	Orange
	9	P1	Orange
	10	C1	Orange
	11	T1	*[points to orange card and makes a 'o' shape with mouth]* We are going to do... *[*clicks mouse with same hand to switch camera from cards to face and then picks up card]* 'Orange' 'Orange' *[*holds card up to face with orange face pointed at camera]* we say orange, ORANGE.
	12	C1	Oh
	13	T1	Good! we say 'Orange' what's on the orange one? [*looks at camera holding two hands up as a shrug, child sits up closer to camera]* Lets have a look? [*turns card around in front of camera]* OH!
3a.	14	C1	Pig! *[*smiles and holds their cheeks while they look up]** ... pig [*turns back to screen]*
	15	T1	Pig! can we say 'oink, oink, oink'
	16	C1	Oink, oink, oink... snort, snort, snort
	17	T1	Amazing! Good work Mr. (name)" *[*Therapist claps]**

Table 3b: The tool's inability to be adapted to the situation causes a problematic state.

Image	Line	Speaker	
3b	18	T1	Hmmm what's on the purple one?... oh?
	19	P1	Ugh *[*makes a disgusted face*]*
	20	C1	Yuk *[*turns their face from the camera and tries to move away*]*
	21	T1	Oh no [*therapist dramatically puts their hand up to their face]* a snake
	22	C1	Yuk!!!! [*the child trying to get away from the card*]
	23	P1	We don't do snake things
	24	T1	Let's do our 'sss' *[*making hand gestures for an s*]*
	25	C1	Ugh yuk [*Child moves off screen*]
	26	P1	Just make a sss sound darling 'sssss' [*turns toward child*]
	27	T1	'ssss' *[*making hand gestures for an s]**
	28	P1	Yeah, they are yukky, they are bad for you... go 'ssss' [*child puts up elbow towards career]*

4.2.1 Hidden unexpected and variable features encourage a sense of anticipation. The therapist, prior to the beginning of this sequence, is required to do some work to align goals between themselves and the child. They use the hidden picture side of the cards to create anticipation, to align to the child's interest in animals to elicit engagement *"[name] we are going to have a look at all the animals and what sounds that they make. Are you ready? We are going to get lots of colours out here!"*(not included in the excerpt above). The child is seen to be interested in the subject area (making mooing sounds as the therapist sets up), and the activity begins. In Figure 3a, the therapist continues to use suspense to engage the child by holding the card up to the camera and asking what it could be. They then slowly turn the card around. The child, in turn, shows his engagement by moving closer to the screen to 'get a better look', which is rewarded with a 'pig' picture. The therapist continues with the same 'reveal' sequence: the child chooses the colour, the therapist holds the coloured card to the camera, the therapist and child say the colour, and after successful completion, the therapist turns the card slowly around to display the hidden animal; therapist and child make the animal sound. Although the child doesn't physically have ownership of the cards, as they would in person, the cards provide a means for the therapist to engage by giving the child a sense of autonomy through the choosing of the colour they want next and building suspension through the dramatisation of the revelation of the card. Features of the tools, such as hidden attributes that only are revealed at the direction of the game and variation between cards, provide a socially engaging way to encourage continued interaction.

4.2.2 The tool being moved between inactive and active space supports continued interaction and focus. The anticipation of the card's 'reveal' is enhanced through the shared understanding that cards in games have dual identities. Cards are 'inactive' when they are not yet in play and/or yet to be chosen, and also 'active' parts of the activity when they are revealed. Note the cameras/video also play an essential role in this case. The therapist begins by laying out cards ready to be chosen (inactive tools) in view of the workspace camera, which allows the child to see all the cards, choose the colour and point towards the card on the screen for added clarity. This is particularly important over video, where audio can be muffled. Once the child chooses the card, the therapist moves the card from an inactive space (the workspace camera) to an active space (where the therapist is visible). By moving the card to the front camera, the therapist calls attention to their face and the paired usage of the cards. This allows for further engagement and communication with the child, using social facial expressions and providing support and feedback in pronouncing colours, animal names and sounds. Tool features perceived to be easily handled and directional to the child (i.e., viewable to the child even when the therapist holds the tool) enable therapists to know how to maneuver tools between active and inactive spaces. This supports engagement in the activity and encourages communication between the therapist and the child.

4.2.3 The tool's inflexibility to adapt to the child's interests derails connection and participation. In the next turns, the cards appear to derail connection and engagement through their lack of accommodation to a particular situation. In Figure 3b, the therapist performs the now-established transactional sequences as highlighted in the above paragraph. However, instead of being rewarded with an animal that the child wants to imitate, they are shown a snake, causing the child to have a visceral reaction and move off-screen away from the offending animal. The parent unsuccessfully tries to explain to the therapist, "We don't do snake things" (Line 23), however having already revealed the card, the therapist persists in making the 'sss' sound, after which the child again tries to move further away from the camera, and the parent consoles the child "Just make a sss sound darling". As the activity progresses, the reliance on the cards to complete the transactional activity decreases, and the cards become increasingly passive players in the therapist-child interaction. For young children, features that are not adaptable to sensibilities in the moment can cause problematic transactional moments.

4.2.4 The tool switching between inactive and active modes allows the child to incorporate play into the activity. The qualities of the cards, as much as they can derail a moment through their lack of complete accommodation, can easily switch between passive and active use. As the use of cards takes on a more passive role, they become perceived to be malleable and able to be adjusted to an activity by their ability to be easily switched from active to inactive tools. The 'reveal' sequence (choose a colour, state the colour, flip the card over) is still maintained by both child and therapist, even when one player seeks to adjust the activity. This adjustment happens when the cards cause animals to appear that are not wanted or have been established to be problematic for the child (i.e., snakes), and the child and therapist can subvert the activity by selecting or making other animal sounds. Furthermore, adjustment happens when the child wants to choose an animal rather than a 'colour' and the therapist, keeping with the sequence of the activity, assigns the animal to a colour later in the session (not shown in the extract above) 'frog' is interpreted to 'green'. In this way, the cards can be

ignored or adjusted when needed, but the cards still passively hold the activity sequence together. Features that are open-ended and can be expanded on as part of an evolving conversation provide more natural and authentic therapeutic communication strategies for therapists.

Analysis of Case 2 showed that engagement, anticipation, transitions, and redirection of attention to the therapist-child interaction were facilitated through the tool's features in teletherapy, indicating that the tool was integral to the interactional sequence. Analysis of our last case, Case 3, highlights how tools foster engagement and child agency, as they can be manipulated to be active or inactive within the provided space.

4.3 Case 3: In-person, Potato Head™ toy and picture cards

The third case is taken from an in-person meeting with a child. This case shows the progression of an in-person SLT session, how therapists navigate SLT sessions where the space is shared, and the possibilities of continuing therapy sessions to include further interactions through free play.

Four excerpts from the entire case are presented below. The case starts in a therapy room, where a child walks around, talking to themselves and switching lights on and off. The therapist tries to initiate interaction so they can begin their activity, offering two toys to 'play' with: 'sorting' or 'Mr. Potato Head™' (Figure 4a). However, the child has focused on the bubbles behind the therapist, and the therapist moves the bubbles to their lap in response, explaining that bubbles will come next but not now. The child is reluctant to 'play,' and the therapist tries to engage the child by first showing parts of the Mr. Potato Head™. When the initiation of 'play' doesn't work, they pull out a binder containing picture cards and sit it in front, facing the child. The therapist selects two cards and places them on the front of the binder, asking the child if they want "shoes or hat?".

Figure 4a: Therapist asks the child what activity they would like to do.

The in-person case highlights what can be perceived as the natural flow of a transactional SLT activity with a young child. We see how tools can be added to support initial cooperation in the 'fun' activity, which moves into a more structured, therapist-led SLT activity than is seen in the other two therapy cases (Section 4.1 and 4.2). As the case continues, however, we see the child able to express their preferences ("Pink?" line 24) and more easily having access to the activity's tools. Finally, the therapist transforms the activity into free play that encourages shared interaction that the child eventually leads. These stages are important to recognise as they point to differences in teletherapy tools to support SLT therapy sessions.

Our analysis reveals three issues: how tools are used to enlist cooperation and, therefore, engagement; the child's increased shared

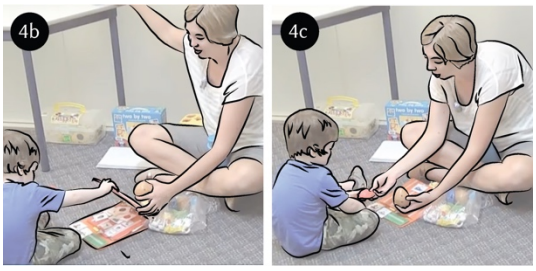

Figure 4b: The child tries to look at what is in the binder. Figure 4c: The therapist leans over the binder, keeping it closed, and gives the child a hat after correct verbalisation.

Table 4a: Therapist establishes the transactional sequence. Key for table: Key for table: verbalisations that cannot be translated use (inaudible response). The name of the child is anonymised to (name). Concurrent actions are denoted by * *; activity in person is described in [italics].

Image	Line	Speaker	
4b	1	T2	Hat on... good boy... what do we want? **[child tries to lift the lid to see what is inside the binder]**
	2	T2	No. *[closes the binder]*
	3	C2	(inaudible response)
	4	T2	I – want - Hat
	5	C2	Hat *[Child sits down]*
4c	6	T2	Good boy, put it on the top **[Therapist points to the top of the potato head]**
	7	T2	Hat on
	8	C2	Hat on... hat *[*child takes the potato head and places the hat on its head}**
	9	T2	Hat on... good boy!

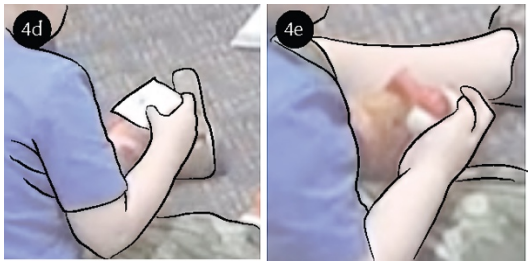

Figure 4d: The Child places the card 'eyes' over the Mr. Potato Head™. Figure 4e: The therapist replaces the cards with the Mr. Potato Head™ part.

Table 3b: The transaction is established. The child displays ownership over the tools used, interchanging between cards and Mr. Potato Head™ pieces.

Image	Line	Speaker	
4d	17	C2	Eyes here *[child takes the card from the binder and places it over the top of the potato head]*
	18	T2	Eyes here yes!
	19	T2	I want eyes
4e	20	C2	Eyes
	21	T2	Eyes, Good boy, I want eyes

Figure 4f: The therapist holds out the shoes for the child to see they are an active tool. Figure 4g: The child tries to take hold of the shoes, but the therapist holds on.

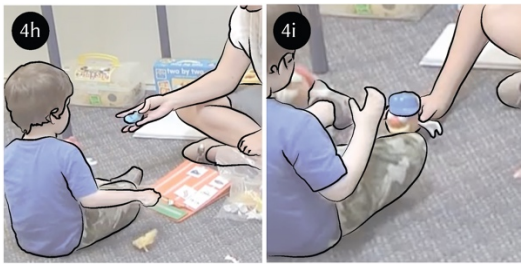

Figure 4h: The therapist offers another piece of the Mr. Potato Head™. Figure 4i: After completing the character, the therapist creates their own and starts playing 'pretend' with the child.

ownership of the activity leading to social play; and the therapist's use of space to afford an understanding of when a tool is active, inactive, and staging area.

4.3.1 Tangible and explorable features draw the engagement of the child. Our analysis shows that therapists often use tools to encourage children to comply and assist in in-person therapy. Although in-person therapy is similar to teletherapy in that tools are employed to gain attention, there are stark differences as the child has more autonomy when in proximity to the tools. In the in-person therapy session, engaging a child in therapy in a space where they are free to roam, explore and express themselves (as seen at the beginning of this section) contains the inherent risk of the child

Table 3c: The child can see that the therapist has other coloured parts and requests one. This slight change shifts the established transactional activity

Image	Line	Speaker	
4f	22	C2	And Shoes in, shoes in *[the child grabs the shoes but the therapist doesn't let go until they say 'shoes in']*
4g	23	T2	I want shoes in, oh shoes in, good boy!
	24	C2	Pink?
	25	T2	You want pink shoes? Oh well I've got some blue shoes?
4h	26	C2	Blue!
	27	T2	Blue shoes good boy

Table 3d: The transactional activity finishes and morphs into free play, allowing the therapist to engage with other forms of language

Image	Line	Speaker	
4i	28	T2	Hello! How are you? *[*Therapist engages (name) in play with their potato head*]*
	29	T2	Are you good? What shall we do today?
	30	C2	Did it! [*child succeeds in placing all the parts together*]
	31	T2	Shall we do some running?
	32	C2	Running
	33	T2	Running, run, run, run, run. *[*therapist moves the potato head up and down*]*.

declining to participate. The therapist offers the choice of two toys to enlist interest and motivation to join in the activity (Figure 4a) and to encourage a transactional moment between the child and therapist. The child almost commits to this interaction of choosing 'Mr. Potato Head™' until they consider 'bubbles' or going 'out' of the room as viable options. The toy does not initially endear itself to the child, and the therapist is then required to go one step further by offering more discreet options, again providing a way for the child to engage in the activity and have some sense of ownership of how it will run. The child begins to show interest, although is still reluctant to participate. Only when the therapist reveals a new part of the activity, the binder, containing more items, does the child decide to sit down (Figure 4b & 4c). The therapist again offers the parts of the Mr. Potato Head™ to the child, but the child is not initially interested, bypasses the toys, and pulls a card from the top of the binder. With the child's attention, the therapist begins the activity 'I – want – mouth', and the child acquiesces, saying 'mouth'. The therapist offers the stated part 'mouth', and the child adds it to their Mr. Potato Head™ as a reward. The child is initially lured to look at the images of the cards over interacting with the parts of the Mr. Potato Head™, even so much as choosing the 'eyes' card (Figure 4d) and putting it on the Mr. Potato Head™ until the therapist replaces it with Mr. Potato Head™ toy eyes (Figure 4e).

The transactional nature of the activity and how objects are used to ensure compliance is seen throughout the activity. In Figure 4f, Charlie places an arm into the side of the Mr. Potato Head™ and then goes to grab onto the yellow shoes. The therapist holds onto the shoes, and Charlie looks up (Figure 4g). "*Shoes in"*, says Charlie, and the Therapist releases the shoes: "*I want shoes in, oh! 'Shoes in', good boy*" (Line 23). Only through correct pronunciation is the shoe released, and Charlie adeptly and quickly conforms to the rules of the activity.

The tools that support initial engagement in this activity are cards hidden (i.e., Case 2) in the binder. However, as Charlie interacts with the small cards, we see them trying to make sense of the relationship of the cards to the toy. The visual nature, tangibility and manoeuvrability of the cards and the Mr. Potato Head™'s features support Charlie's ability to align and make sense of the activity. These interactive tangible features encourage the child to finally engage.

4.3.2 Visible features and options provide opportunities for child agency. In this case, the child has a shared ownership of the task. First, the child can hold out before participating in the activity until the therapist can show them something they are willing to engage with, i.e., the binder. Second, the child also has more autonomy over selecting tool options, as although tools can be hidden or strategically kept away from reach, the child watches the therapist intently as they set up activities. In Figure 4b (line 1), we see the child try several times to 'get into' the binder after watching the therapist pull several cards out, leading the therapist to use two hands to hold it closed and only selectively show three options for the child to choose from. The same applies to the parts of the Mr. Potato Head™. The therapist provides a yellow hat, but the child sees other colours to choose from in the bag of parts and begins to negotiate the colour they want. Although choosing coloured parts is not part of the established transactional activity (pick a card, state a card, the therapist provides the part, the child places the part on the Mr. Potato Head™), the therapist uses this to their advantage by, in the next transactional moment, asking what colour shoes they want (Line 24-26). The child's capacity to maneuver the interaction to suit themselves provides opportunities for both the child and the therapist, as they can then naturally build off the child's interest and lengthen the interaction. The child's agency is supported through the tools' visibility and multiple options, which provide opportunities to negotiate with the therapist. However, although this can appear at times to be challenging, this also aligns with the therapist's goals of encouraging participation in social communication (Figure 4h & 4i).

4.3.3 Transitional use between active, inactive and staging spaces, support focus and interaction opportunities. The use of space can be seen as an important consideration in how the activities are handled and delivered to the child in in-person SLT, but also for how they show how therapists organise activities in space in teletherapy settings and what this affords the child. The therapist uses their body in order to create differences in active and inactive spaces to ensure the child understands and focuses on the current transactional activity. The current activities' tools are strategically placed in an initial inactive space, in this case, a bag, binder or on the therapist's lap—locations over which the therapist has control, and which is perceived by the child as accessible but one that they need to extend themselves to reach, by entering into someone else's 'space'. These inactive tools can then be transferred into the space between the child and the therapist, providing the child with easy access. As the space is co-shared by the therapist and the child, a staging area that discreetly advertises 'next' activities (offering possible motivations, i.e. bubbles) is utilised; the activities in the staging area are kept close and either behind the therapist or on their lap, again ensuring the therapist retains control over them. In the teletherapy sessions, we see therapists using inactive and active spaces in related but distinct ways. However, the lack of a comparable staging area over teletherapy might have positive or negative repercussions for the child's inability to see what is coming next. In person, the child is provided with possibilities for action. Affordances of space provide for the direction of children's attention, make visible what the child can access, and offer opportunities for further action [23, 62].

In this section we have provided an analysis of three field cases where four tools were used to support therapists in SLT activities. We now move to discuss the importance of the transactional moment, and how features of tools can support or thwart these moments. The lessons we draw from these studies in our discussion are grounded in the particularities of our data [32].

5 DISCUSSION

In the three cases, six tools (teletherapy: iPad, virtual Mr. Potato Head™ app, and sound cards. In-person: Mr. Potato Head™ toy and picture cards) represent the tools found in the larger corpus of data (10 videos). The tools used in the therapy sessions support transactional moments, where each participant has some ownership of creating an environment of 'working together' on a task. In in-person therapy, tools for young children are often toys with which children either have a historical association or know the toy's general mechanics (i.e., two-sided cards). From our corpus of data, these tools are then translated from a toy into being used in activities for e-therapy sessions with varying degrees of success. An example of a transactional moment is given in case 3; the therapist relinquishes the body of the Mr. Potato Head™ to the child, although they retain control of the Mr. Potato Head™ parts. After explaining what they (the therapist) need the child to verbalise, it becomes up to the child to respond by verbalising what part they (the child) want: 'I want arms'. If the child successfully pronounces the correct word, they are rewarded with the part. If, however, the transactional moment is thwarted, the therapist is required to find alternative methods to enlist the child's cooperation. From the corpus of data, it can be seen that transactional moments are generative, intentional, and desirable for the therapist, and interestingly, tools can be seen to either thwart or support these social interactions in various ways. In this discussion, using our sociomaterial analytic lens, we focus on how the tool's physical and interactive features support the therapeutic requirements of tools and how these can thwart a transactional moment in teletherapy. We provide directions for future design work in this area**.**

To date, very few studies have looked at how the features of tools in social environments (web application and tangible) support or thwart interactions in SLT environments. Most research is conducted with parents and therapists as participants, with very

little research conducted with children [6, 8, 16, 54]. Those who have developed design considerations discuss the need for tools to support: social interaction with family members or peers [54], reduced repetitiveness of exercises through customisation [15], and engagement through rewards and choice, storytelling and playful activity [54]. Although these considerations provide useful guides, they are often derived outside the context in which these tools are used. In response to our research question, we discuss below the features of SLT tools from our detailed cases, how this study extends and adds to this existing research, and implications for designing features of tools, with respect to transactional moments.

The features of tools we discuss relate to engagement, space usage, child-centred play, and adaptability within the process of therapy. We raise these features not as universal or omnirelevant properties of SLT tools, but as crystallisations of the kinds of flexibility, adaptability and functionality that SLT tools would need to have in order to support the particular therapeutic- and artefact-interactions visible in our data.

5.1 Feature for Engagement: inbuilt layers of interaction to indicate the potential of subsequent activities

In the presented cases, tools are conscripted very early into the therapy sessions to motivate and engage the child in the activity. In case 1, the sounds and animations of the Potato Head™ application were actively used to engage the child. Before the commencement of the application, we see the child reluctant to engage, actively trying to move themselves off their adult's lap away from the screen (Figure 2a). The child's behaviour changes when the therapist moves the iPad, with the application playing, in the workspace area. The child, although is still noncommittally trying to move away, is now seen to be actively watching the screen. When the Mr. Potato Head™ animation finally starts, the child's demeanour changes again; they move closer and pitch forward to the screen, engaged in what Mr. Potato Head™ is doing. The therapist needs to say very little as the child is ready to continue the activity (see Section 4.1.1). In Case 2, the therapist cannot rely solely on the tool, as the sound cards are passive and inactive material that only affords the potential of colour selection. However, 'cards' as tools are also understood to hold possible potential and afford the mechanics of being 'flippable' to reveal hidden content (much like a blank iPad screen), and the therapist uses this mechanic to initially and subsequently engage the child (see Section 4.2.1). The third case, held in person, highlights the required effort to initiate a transactional activity. From our corpus of data, this occurred across three of the five teletherapy and four of the five in-person therapy sessions. The child, being able to see what is on offer in the room or over video-conferencing, needs their interest to be captured by the therapist. It is not until the therapist shows something else that might be of interest, i.e. a binder that contains 'hidden' cards, that the child becomes curious about the activity (see Section 4.3.1).

As seen in these discussed cases, early engagement with activities by the child can ensure that time is effectively spent and that the child stays relaxed and receptive to the activities presented. For teletherapy environments, this is of particular importance as therapists do not have the same control over the child's environment, and children can easily disengage unless parents intervene [12]. In the first two cases, tools were used to initiate a therapy session through 'holding perceived potential'. This was done through using multimedia (digital) animations, personal interest, or physical tools holding the potential to transform — creating anticipation, interest, and reward.

Research has discussed the need for digital home therapy tools to be more engaging by including choice, feedback, and collaboration [54]. The study extends this discussion by advocating for teletherapy tools to consider how they 'hold potential' for an activity. An implication for the design of effective in-person and remote tools would include inbuilt layers of interaction to indicate the potential of subsequent activities to allow therapists to achieve therapy goals in the predetermined amount of time; this has merits in other teletherapy environments, as the therapist has little control over the child's environment and their ability to engage through normative strategies is reduced.

5.2 Feature for Space: mechanisms for control over active and inactive space to support therapists' goals

Our findings show how therapists use physical and virtual spaces to encourage focus and signify what can and cannot be interacted with, during activity. For young children, having multiple opportunities and/or activities can create confusion and distraction from therapists' goals. Therefore, using the affordances of physical or digitally-mediated space to stage possible or future activities can fuel motivation to persist with an existing activity and to signal when one tool becomes the focus rather than others [23, 31, 62]. This ability supports the direction of the child's attention and enables the therapist to manage the activity, ensuring the transactional moments are attended to. In Case 3, an exemplar of the other four in-person sessions, we can see the therapist use physical space to ensure the child can see what is on offer (staging), to show what the child has control over (active space between the therapist and child), and what has yet to be attended to (inactive space, situated in view but just out of reach of the child — see Section 4.3.3). In case 2, a similar method is employed but adapted to the teletherapy environment. The workspace camera is used as an inactive space to showcase the cards that can be selected but are not yet in play; when a card is chosen, the therapist moves the card from the workspace camera into the view of the front-facing camera. The front-facing camera maintains all the action and interaction, including turning the card to reveal the animal next to the therapist's face (see Section 4.2.2). The use of virtual space to support focus was seen across three of the five teletherapy cases. The therapist supported the child's attention by using different spaces in the throes of an activity and focusing attention away from multiple other opportunities, constructing an effective social alignment [26]. The child's focus allows the therapist to ensure target words are pronounced, physical movements such as gesture and mouth positions are realised by the child, and positive reinforcement after and during participation in the transactional activity.

Case 1 highlights how tools not cognizant of 'space' can be detrimental in supporting the SLT activities (seen in one other activity in the corpus of data). In case 1, the iPad tool could not be moved from

the set location under the workspace camera; this, in turn, meant that there was no easy way for the therapists to gain the attention of the children. Furthermore, the busyness of the interface and unclear perceived affordances of active and inactive elements led to misunderstandings about what could be selected (see Section 4.1.2). The busyness of the interface caused problems for the child, as they could not point, verbalise, and gesture to what they wanted, distracting from the therapist's goals and ultimately thwarting the child's turn to pronounce the target word. This is not merely a consequence of poor interface design but of the intersection of its use in a digitally-mediated space in pursuit of a transactional moment. Current research discusses supporting focus through customisation and engaging activities such as storytelling [54]. However, there is a lack of data regarding in-therapy digital games with young children, with most studies focused on individual interactions [17, 33]. We would add that providing ways to direct children's attention whilst they are engaged in activities is additionally important to ensure objectives are met beyond considering age-appropriate interfaces for young children [42].

An implication for design arising from this would be for designers to integrate features in tools that make use of 'spaces' to support, firstly, an adaptable hierarchy of information and, secondly, therapists to switch between an engaging activity to then be able to effectively communicate with their client, including target words, pronunciations, and feedback. For future teletherapy tool design, understanding how they are used over a video connection suggests incorporating strategic mechanisms of control over (physical and digitally-mediated) space to support children's focus on relevant information.

5.3 Feature for Child-Centred Social Play: open-ended distributed points of engagement for child-led collaborative play

Towards the end of the transactional activities, some features of tools enabled the child and/or therapist to further take ownership and extend the activity into playful interactions. Social play can be an important opportunity for further social learning for the child [43, 44, 54]. The in-person Mr. Potato Head™ (case 3) achieved playful interactions through the persona of the tool, enabling therapists to prompt the structured activity into an opportunity for imaginative play from more therapeutic interactions (see Section 4.3.2). This playful prompting was observed in other in-person and teletherapy sessions, where a child was coached to give directions to the therapist (See Table 1 Tool bubbles and Piggy sorting). In teletherapy (case 2), the cards also provided some outlets of improvisational play, such as the child could subvert what the cards asked or spontaneously engage in animal role-play (see Section 4.2.4). This created other avenues, allowing the therapist to build on the child's preferences and engage in therapy goals. This is discussed in research as having multiple entry points that allow for shared social interactions [32]. However, the iPad application tool in teletherapy was much more self-contained, not lending itself to be taken by either the child or the therapist into improvisational play directions (see Section 4.1.3). Participants in SLT became passive viewers rather than active participants in the play, aligning with studies that found children to be less communicative (gesture and vocally) when operating physically restrictive technologies [3, 38]. That said, the final animations of the application game did create a sense of accomplishment in the activity that was not seen in either case 2 or 3.

In future, more work needs to be done to create therapy tools that can extend into playful activities, using 'sand-box' social gamified opportunities such as puppet play or shared on-screen drawing. It is known that more needs to be done to ensure that teletherapy sessions include opportunities to collaborate and socially interact [54]. For young children, this extends to include the capacity for child-led social play [24]. Often, play is included in design considerations without being unpacked as to how it might be realised in SLT tools. From our data, this was accomplished through features such as 1) being less self-contained, which allowed for temporal opportunities of distributed points of collaborative improvisational play, and 2) having open-ended themes rather than specialised obdurate content, e.g., animal themes over pirate-weaponry-themed tools.

5.4 Feature for Adaptability: content variability to accommodate children's idiosyncrasies and preferences

In case 2, a dilemma arose when the therapist showed a card that contained a snake, causing a visceral reaction in the child (see section 4.2.3). As the therapist still needed to hear the 'Sss' sound, the therapist was in a position where it would have been difficult to replace the card with another, so the therapist continued with the activity. The tools provide important prompts in the throes of activity; however, if those prompts cannot be adapted to the child's interests or sensibilities, as seen in this case, this can thwart the transactional activity. Although no other accounts of visceral reactions were noted, in the other nine videos in the corpus of data, it remains that very few activities were or could have been adapted to accommodate the child's interests. Current research in digital applications has advocated for customisation and choice to ensure therapists, parents, and children remain interested in the content [15, 29]. Customisation should also be considered for tangible tools to ensure content is both of interest and sensitive to the needs of children. Tools that support young children and parents' seemingly idiosyncratic preferences may have desirable social consequences, i.e. in rural places, 'hands-off snakes and avoid them at all costs' is essential, and therefore, ensuring activities are in line with this messaging may have more significant social implications. This aspect is not generally discussed in the design of digital therapy tools, and we believe this should be considered, especially for young children. For future design implications for SLT teletherapy settings, providing alternative options for content variability and control, e.g. for the same sound, or feedforward for the child's adult to know what might come next, offer ways to ensure young children's sensibilities/sensitivities are better served.

5.5 Limitations and future work

Two main limitations of this study deserve mention. Firstly, the small corpus of data warrants caution. We are not able, from a corpus of ten therapy sessions, to know how typical or idiosyncratic our data is as representative of SLT with young children. For

reasons outlined in 3.4, we see this as a current limitation but a necessary one at this stage of the investigation of a phenomenon that has seen little detailed study. Future work would benefit from incorporating a larger variety of therapists and children in SLT sessions, providing additional insight into how tools are conscripted in various circumstances beyond those currently represented in our corpus of data. Secondly, the study would be enriched if the outcomes of our analysis were presented to therapists and parents for their reflections and to generate further insights. Future work will apply the design features identified here to an initial technology probe prototype and iterate its design using co-design methods with children and therapists for use in teletherapy contexts.

6 CONCLUSION

Returning to our research question: how tools support transactional moments by SLT therapists with young children (ages 3-6 years) to inform the design of future tools, we analysed six sessions from a corpus of 10 videos, presenting three as cases. Our analysis detailed how tools are conscripted in transactional moments in teletherapy and in-person environments. The socio-material lens used provided a relational approach to understanding how features of tools are conscripted into, but also how they push back on, local social agendas. This creates a formative understanding of the importance of tools not as passive but as an active participant in therapy sessions. Although each tool differed, the therapists' goals remained the same: to ensure the young child participated and engaged in the SLT sessions by pronouncing target sounds [16].

Our study unpacks how tools are used in transactional moments in SLT sessions, drawing out four features of tools in teletherapy sessions that have not been previously identified, showing how these tools have important social consequences for both in-person and online therapy sessions. The features identified are (a) inbuilt layers of interaction to indicate the potential of subsequent activities, (b) mechanisms for control over active and inactive space to support therapists' goals, (c) open-ended distributed points of engagement for child-led collaborative play, (d) content variability to accommodate children's (and parents) idiosyncrasies and preferences.

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