# Design-for-error for a stand-alone child attachment assessment tool

**Maki Rooksby, Dong-Bach Vo, John Rooksby, Mohammad Tayarani, Rui Huan, Alessandro Vinciarelli, Helen Minnis, Steve Brewster**
University of Glasgow (Glasgow, UK) and Northumbria University (Newcastle-upon-Tyne, UK)
maki.rooksby@glasgow.ac.uk

## ABSTRACT

Designing technology for problem-free operation is vital, but equally important is considering how a user may understand or act upon errors and various other 'stuck' situations if and when they occur. Little is currently known about what children think and want for overcoming errors. In this paper we report on design-for-error workshops with children (age 5-10) in which we staged 3 simulated errors with a health assessment technology. In our developmentally-sensitive study, children witnessed the errors via a puppet show and created low-fidelity models of recovery mechanisms using familiar 'play-things'. We found the children were able to grasp the representational nature of the task. Their ideas were playful and inspired by magical thinking. Their work forced us to reflect on and revisit our own design assumptions. The tasks have had a direct impact on the design of the assessment tool.

## KEYWORDS

Psychological assessment; Children; Pervasive health; Participatory design

**ACM Reference Format:**
Maki Rooksby, Dong-Bach Vo, John Rooksby, Mohammad Tayarani, Rui Huan, Alessandro Vinciarelli, Helen Minnis, Steve Brewster. 1997. Design-for-error for a stand-alone child attachment assessment tool. In *CHI*



*CHI 2019, May 2019, Glasgow, Scotland, UK*



ACM ISBN 123-4567-24-567/08/06.
https://doi.org/10.475/123_4

*Conference on Human Factors in Computing Systems Extended Abstracts (CHI'19 Extended Abstracts), May 4–9, 2019, Glasgow, Scotland Uk*. ACM, New York, NY, USA, 6 pages. https://doi.org/10.475/123_4

*"It is relatively easy to design for the situation where everything goes well, where people use the device in the way that was intended, and no unforeseen events occur. The tricky part is to design for when things go wrong."*

Don Norman, The Design of Everyday Things [6], p198.

**Sidebar 1: The concept of design-for-error was introduced by Don Norman**

Psychologists have been paying close attention to attachment disorders. Recent work has found that 86% of young offenders fulfilled criteria for attachment disorders [5]. Attachment is thus potentially a powerful window to identify those children who require clinicians' attention before other problems develop. However, currently available methods for measuring attachment are cumbersome, laborious, and qualified assessors are scarce.

SAM (The School Attachment Monitor) is a system designed to measure children's attachment. It automates the key steps of a gold standard attachment measure, MCAST (see sidebar 3). SAM is an interactive system that delivers stories and questions for children (see [7, 10]). Data is collected via sensors. Assessment of the child's responses are then analysed using machine-learning techniques, modeled on human ratings.

**Sidebar 2: The SAM system**

## INTRODUCTION

"Design-for-error" (Sidebar 1) is increasingly valued; technology errors can only be minimized, not eliminated. Children are today a significant and unique user group of health technologies [4]. However, very little attention has been paid to how to design-for-error in the context of technology for children.

We report design work with children during the development of a mental health assessment tool "SAM" (Sidebar 2). SAM should enable autonomous use by children in order to offer efficient and valid attachment measurement. Any unrelated interruption to the child's deeply primitive and internal attachment drives would cause noise to the accuracy of the results.

This work is among the first to explore design-for-error with children, and is novel in that we chose to combine a participatory based approach with simulated errors. The aim of the workshops reported here was to first learn about children's ideas and behaviors when errors occur, and then to invite them to inform a design feature for the SAM system.

## THE DESIGN WORKSHOPS

We ran two participatory design workshops (specifically, we took what Scaife & Rogers call an "informant-based design" approach [8]). Each workshop had a group of school-aged children. Thirteen children (7 male) took part, organized into two groups based on their age (see table 1). The younger children (5-6 years old) were in group 1, and older (7-10 years old) in group 2. Children had no known attachment or developmental conditions.

The project was approved by a University of Glasgow Ethics Committee and we had additional clearance from Disclosure Scotland. Children's parents received an information pack at the time of invitation, and they gave signed consent on the day. Children gave verbal consent.

We simulated three failures in the workshops. In setting each failure we focused on what we as designers of SAM believed were the likely forms of error and which may be recoverable by the children themselves. Each of the failures was simulated and acted out in a puppet show (sidebar 4). For each error children were asked to discuss the problem and to use craft materials to show/model how they could help the puppet overcome each of the problems.

Our study was performed to inform the development of SAM, and therefore we have used participatory design methods rather than observational study. There is a long history in HCI of involving children in design research [2]. While the end point of SAM will be for solo use, we designed our workshops with groups of similarly aged children most of whom knew each other, so that they feel safe with each other in expressing their own ideas and engaging with collaboration.

The Manchester Child Attachment Story Task (MCAST) [3] is the gold standard for measuring attachment. A child is shown beginnings of story vignettes with dolls, depicting the child and a caregiver figure. The stories are paused just when the child-doll faces an ordinary but alerting event such as developing a stomach ache. Bowlby's classic attachment theory [1], which he termed Internal Working Model (IWM), are used to classify the child as secure [seeking interpersonal strategy], insecure [lack of or inefficient use of interpersonal strategies] or disorganized [lack of a coherent attachment style]. The last category is known to put children at risk for optimal socio-emotional development and susceptible to mental health and neurodevelopmental conditions.

**Sidebar 3: MCAST: The Manchester Child Attachment Story Task**

**Table 1: Participants**

| | Group 1 | | | | | | Group 2 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Participant | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
| Age | 6 | 6 | 5 | 6 | 6 | 5 | 7 | 7 | 9 | 10 | 9 | 8 | 7 |
| Gender | f | m | m | m | f | m | f | f | f | m | f | m | m |

The workshops took place in a child-friendly room with built-in cameras which were controlled in an adjacent room. Notes were taken of children's verbal behaviour and non-verbal behaviour respectively. Each workshop lasted about 1.5 hours. Children's designs were photographed at the end of each session (see Figure 1) and notes were collated. Two of the authors watched the video recording repeatedly and studied transcriptions of children's utterances and actions. We took a phenomenological approach in our analysis.

## FINDINGS: CHILDREN'S RESPONSES TO THE SIMULATED FAILURES

### Failure 1: Abrupt system crash with frozen error message

In the first simulated error, the puppet starts using the SAM system but it fails abruptly showing a sad face and a message saying "Your PC has run into a problem and needs to restart. 0% complete..."

*Group 1.* In response to the error some children said they could not yet read; the error message was read aloud by the Workshop Lead (WL). Once the task was understood, the group began discussing an interesting possibility that perhaps the error message protected them from *"something scary"* (P6) or *"inappropriate"* (P2). These young children seemed to grant some intentionality to the fault and that it is trying to protect them. P6 further elaborated on a scenario that a pirate ship long ago shot the computer with a cannon. This is a classic example of magical thinking, characteristic of this age group [9]. This outlandish idea seemed to be taken earnestly by the fellow members of the group, worthy of consideration possibly because of their developmental closeness.

The group then explored restarting the system. Various sequences of actions were offered here, such as *"turning it off for 5 minutes and then back on"* (P5), P6 was delighted at the idea of turning it off and on again because the same happened in an episode of the British cartoon Peppa Pig. The children's designs for this error included buttons and switches for restarting. The group became keen on pressing a power button on the screen, just to see what happened.

*Group 2.* A child in this group read the error message out loud. Three of them reacted with humour and sarcasm. Referencing media, P10 joked the video has stopped because there was *"an ad"*. This

**Sidebar 4: Sam the puppet**

group also seemed to shift rapidly to focusing on resolving, rather than investigating the problem, for example, P8 remarked that they should *"just press a bunch of random buttons"*.

More knowledge of information technology was evident in this slightly older group. Their ideas included creating access to a help page accessible in the event of a fault which then gives access to re-starting if needed. P9 began designing a menu hierarchy for a help page and, in collaboration with P10 and 11, they started crafting a series of buttons, as shown in figure 1, top left.

### Failure 2: System is unresponsive

In this simulated error, the puppet is following instructions from the system. The puppet completes a story with the dolls, but then nothing happens when the story is complete. The system does nothing.

*Group 1.* This group reasoned that the unresponsiveness was due to the computer's simple inability to hear what the puppet had said. Interestingly, the group then proceeded in creating models of amplifying devices and arrangements such as children joining together and shouting (P5) and standing on a platform to shout at volume 7000 (P6) (see figure 1, lower half). Here, we see these younger children approached the problem from an extremely human-centric angle, in which the computer's unresponsiveness is resolved by humans raising their voice. While this is clearly evidence of problem-solving skills, it requires developmental interpretation.

*Group 2.* In contrast, more experience of computing was evident in Group 2. The idea that became dominant was the system was *"glitchy"*. A hint of humour and sarcastic tone in their collaborative assessment continued. The group's on-going collaboration gave rise to reviewing and re-adopting the buttons and other solutions made for the first failure. P11 thought of adding a quick restart button to the repertoire of buttons. This group clearly favoured generic solutions for errors (e.g. buttons, keyboards and help screens) rather than individual solutions for individual errors.

### Failure 3: Human error (lapse)

In this error, a lapse was caused by the puppet's inability to produce a response to a question. The puppet cannot think of an answer asked by the computer and at a loss as to what to do.

*Group 1.* The group was becoming fatigued at this point. Ideas offered by this group included: *"keep trying"* (P4) and *"hope it doesn't happen again"* (P5). P6 offered: *"I've got a really good idea, you could go to the playground"*. WL asked for clarification and P6 confirmed that he was suggesting for the puppet, and not himself, to go to the playground. WL realised: *"Oh! I see, Sam can go out and play and not worry about the computer game"*. We are quoting ourselves in the analysis to illustrate a realisation and reflection-in-action. We realised that completing a task would not necessarily be the ultimate aim


**Figure 1: Children's designs: Group 1 (lower) and 2 (upper). Group 1 from left- "Shouting on a stage" (P6); mid "Shouting together in the room" (P5); right "Switch buttons" (P5). Group 2 from left- "Collaborative work of soft-dough buttons" (P10,11,12); mid "Keyboard" (P8); right "Keyboard and mouse" (P9)).**

for the children as users. We argue that this is a transferable lesson in design research: the designer's aim does not necessarily match the interests and priorities of their participants.

*Group 2.* This group was also becoming fatigued, manifesting in even more humorous remarks such as a joke *"marshmallow button"* that fires sweets. P9 made an analogous remark to P6's suggestion in group one of going to the playground, by suggesting, *"Skip it"*. Again, we were reminded that while

**Sidebar 5: Smart button developed for SAM.**

The workshops directly impacted the design of SAM. As a result of this work:

- Error text was replaced with graphic instructions to allow our youngest children to complete SAM on their own.
- We developed and integrated a conspicuous 'smart button' (Sidebar 5) which allows the user to communicate with the system as well as recovering from errors. The child can use it to signify when they have finished speaking, to skip a question, or 'ok' a restart.

Over 120 children have successfully used the improved system.

**Sidebar 6: Design outcomes**

considering design concepts that can navigate users through error, we cannot necessarily assume that the user would wish to fix the problem to continue. This is particularly a crucial aspect of designing a system such as SAM, given our vision to widely disseminate automated mental health assessment.

## CONCLUSION AND DESIGN OUTCOME

Our workshops demonstrated that even relatively young children were able to handle the cognitively demanding mental representations between reality (failure) and imagined solution entailed in the activities. The ideas of both groups evidenced divergent reasoning and some innovative as well as playful ideas. Their work directly impacted our design (see Sidebar 6).

We found that children's understandings and approaches to the errors were not necessarily bound to the remit of operating a technology. While the younger group investigated the cause of problems with magical thinking (e.g. amplifying voices), the older group preferred generic solutions such as buttons and keyboards. Ultimately, the value of the workshops was not just in eliciting ideas, but also in exposure to values and perspectives that challenged our assumptions.

## REFERENCES


[1] Edward John Mostyn Bowlby. 1969. *Attachment: Volume One of the Attachment and Loss Trilogy*. Random House.

[2] Allison Druin. 2002. The Role of Children in the Design of New Technology. *Behaviour and Information Technology (BIT)* 21, 1 (2002), 1–25.

[3] Jonathan Green, Charlie Stanley, Vicky Smith, and Ruth Goldwyn. 2000. A new method of evaluating attachment representations in young school-age children: The Manchester Child Attachment Story Task. *Attachment & Human Development* 2, 1 (2000), 48–70.

[4] Andrea Grimes, Desney Tan, and Dan Morris. 2009. Toward Technologies That Support Family Reflections on Health. In *Proceedings of the ACM 2009 International Conference on Supporting Group Work (GROUP '09)*. ACM, New York, NY, USA, 311–320. https://doi.org/10.1145/1531674.1531721

[5] Kate Moran, Jennifer McDonald, Alison Jackson, Sue Turnbull, and Helen Minnis. 2017. A study of attachment disorders in young offenders attending specialist services. *Child abuse & neglect* 65 (2017), 77–87.

[6] Don Norman. 2013. *The design of everyday things: Revised and expanded edition*. Basic Books, New York, NY.

[7] Giorgio Roffo, Dong-Bach Vo, Alessandra Sorrentino, Maki Rooksby, Mohammad Tayarani, Simona Di Folco, Helen Minnis, Stephen Brewster, and Alessandro Vinciarelli. 2019. Automating the Administration and Analysis of Psychiatric Tests: The Case of Attachment in School Age Children. In *Proceedings of the 37th Annual ACM Conference on Human Factors in Computing Systems (CHI '19)*. ACM, New York, NY, USA. https://doi.org/10.1145/3290605.3300825

[8] Mike Scaife and Yvonne Rogers. 1999. Kids as informants: Telling us what we didn't know or confirming what we knew already? *The design of children's technology* (1999), 27–50.

[9] Eugene Subbotsky. 2010. *Magic and the mind: Mechanisms, functions, and development of magical thinking and behavior*. Oxford University Press.

[10] Dong-Bach Vo, Maki Rooksby, Mohammad Tayarani, Rui Huan, Alessandro Vinciarelli, Helen Minnis, and Stephen A. Brewster. 2017. SAM: The School Attachment Monitor. In *Proceedings of the 2017 Conference on Interaction Design and Children (IDC '17)*. ACM, New York, NY, USA, 671–674. https://doi.org/10.1145/3078072.3091977