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# Accessible Creativity with a Comic Spin

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Creativity and humour allow people to be expressive and to address topics which they might otherwise avoid or find deeply uncomfortable. One such way to express these sentiments is via comics. Comics have a highly-visual format with relatively little language. They therefore offer a promising opportunity for people who experience challenges with language to express creativity and humour. Most comic tools, however, are not accessible to people with language impairments. In this paper we describe *Comic Spin*, a comic app designed for people with aphasia. *Comic Spin* builds upon the literature on supporting creativity by constraining the creative space. We report both the design process and the results of a creative workshop where people with aphasia used *Comic Spin*. Participants were not only successful in using the app, but were able to create a range of narrative, humorous and subversive comics.

CCS Concepts: • **Human-centered computing** → *Accessibility design and evaluation methods*; **Accessibility**; **Accessibility technologies**.

Additional Key Words and Phrases: Comic Spin, aphasia, creativity, accessibility, comics, constrained creativity, creativity support tools.

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## 1 INTRODUCTION

Creative activities allow people to express themselves and to broach topics that might be challenging to address with words alone. Such “making as expression” [23] can enable people to convey nuances that would be uncomfortable with more direct communication and is a powerful tool for those who find communication difficult. It has the potential to benefit self esteem [16] and general mental health [9]. Creating humorous content is a particularly powerful tool for people with aphasia [35, 36], a language impairment that affects approximately one third of people who survive a stroke [2].

The internet offers opportunities for people to share the products of their creative activities. For example, a common form of online humorous content is the internet meme, which can create powerful shared understanding among groups of people [24]. However, people with aphasia face challenges when creating and engaging with online content, including humorous content [18]. They therefore lack this means of expression that many take for granted, creating an imbalance in our online communities.

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Work on content creation tools for people with aphasia has used the idea of *constrained creativity* to broaden access. These constrained creativity tools offer limited choices and structured processes to enable people with aphasia to engage in creative writing [29] and in the creation of rich multimedia content [30]. We extend this previous work on constrained creativity to explore whether and how it might enable people with aphasia to create humorous content in the form of comics and report the *Comic Spin* app. We focus on comics because they afford a wide variety of expression, from humour to more serious topics, such as dementia care [19]. Comics also have the potential to be an accessible form of content for people with aphasia as they generally involve a combination of pictorial and textual information; supporting wider access than either modality in isolation. We report how the design of *Comic Spin* followed a Design Thinking approach and drew on findings from previous work [29, 30]. We also report findings from a creative workshop to explore the use of *Comic Spin* and follow-up reflective interviews with people with aphasia. This work makes the following contributions:

- *Comic Spin* – a novel constrained creativity tool for people with aphasia to create short comic strips.
- Findings regarding how constrained creativity can be successfully applied to the creation of comics for people with aphasia.

## 2 BACKGROUND

### 2.1 Creative Tools and People with Aphasia

Aphasia is most commonly caused by a stroke that causes damage to the parts of the brain that are responsible for language. People with aphasia may experience challenges with reading, writing, speaking or listening. Often, aphasia will affect more than one of these aspects of language. Aphasia affects everyone differently. For example, some people might find speaking more challenging than writing or vice versa. Aphasia affects approximately one third of stroke survivors [2]. The number of people living with aphasia is likely to increase in future years, given the increasing number of people in the world living to an age where stroke is more likely. This means that an increasing number of people will lose the language skills that support them in engaging with both creative activities and digital technologies.

With regard to creativity, people with aphasia generally do not experience a change in their intellect [2] and therefore their creativity remains intact. However, many aspects of creative expression need language. For non-digital creativity, additional support can help. This is beautifully demonstrated by the poet Carol Ireland, who has aphasia, and is supported by an editor – a friend who is able to help her edit her work [20, 21].

The barriers posed by aphasia are clearly evident in the context of digital creativity. Many digital technologies are challenging for people with aphasia [17, 26, 34] due to their language demands. Even commonplace tools such as social media platforms can present significant barriers [18, 33].

Digital tools to support people with aphasia have focused on language rehabilitation [31] or on functional activities such as conversation support [22, 42, 44] or non-language-based communication [1, 7, 27]. Recent work has begun to consider how to support people with aphasia in *being creative* with digital content. Neate et al. [30] describe CreaTable, a tangible platform for people with aphasia to create and curate multimedia digital content, and MakeWrite [29], a tool that supports people with aphasia in creative writing. These tools introduced the idea of constrained creativity as a way of making creativity tools accessible to people with aphasia and were co-designed using techniques including co-created personas [6, 28], collaborative evaluation and other co-design methods [45].

## 2.2 Creativity Support Tools that Use Constraints

Creativity support tools utilise “*creativity-focused features*” [15] to “*positively influence users of varying expertise in one or more distinct phases of the creative process*” (ibid.). These features might support users in negotiating particular aspects of creativity which are challenging for them. It is quite common for such tools to constrain the creative process in some way. Painting with Bob [3] supports digital painting by providing guides so that users always paint ‘within the lines’ of existing pictures. Bengler and Bryan-Kinns [4] and Coughlan and Johnson [10] describe tools which limit the options that a user is given when playing music, again to ensure that they are successful.

As mentioned above, this notion of *constrained creativity* has more recently been applied to technology for people with aphasia. The MakeWrite [29] app supports people with mild/moderate aphasia in creative writing by ‘erasing’ pre-existing texts to offer a limited set of words that the user can “arrange” to create something new. CreaTable [30] similarly uses the concept by offering the user a limited set of tangible objects that can be arranged on a tabletop computer and then played in a repeating loop, thus supporting people with severe aphasia in multimedia content creation. *Comic Spin* builds upon the previous success of using constrained creativity as a tool to support people with aphasia [29, 30], but turns its focus to comics.

## 2.3 Comics and Comic Creation Tools

A comic strip is, in essence, a collection of images which tell a story. Comic strips often contain text, although this is not a requirement. Comics are highly diverse in content, form and sentiment. They are effective tools for the expression and negotiation of ideas, including, but not limited to, humour. They have been used to convey complex emotive ideas, for example through visual Hay(na)ku [5] forms<sup>1</sup>, research findings [32] and stories about caring for loved ones with dementia [19].

Several digital tools exist for the creation of comics or comic-like content, including StoryboardThat [37], Canva [8], MakeBeliefComix [25], Explosm RCG [14], Cartoon Comic Strip Maker [11] and Comic Strip! Cartoon & Comic Maker [38]. StoryboardThat [37] is a website which supports the creation of comics consisting of up to 24 panels, allowing for extensive customisation, such as user-uploaded content. ‘Cartoon Comic Strip Maker’ [11] is a mobile application which supports the creation of comics, allowing the user to select pictures and add text bubbles which the user types.

Reviewing these apps against accessibility guidance for aphasia [18] shows that they would present a significant challenge – they include many features which have been shown to make content creation tools challenging for people with aphasia. These features include complex language, lengthy user journeys, distracting/complex interfaces and ambiguous, unlabelled icons. Only Explosm RCG shows promise in terms of these criteria. However, this tool offers no control over the content and only allows for the creation of randomised comics from a set of pre-made content. *Comic Spin* builds upon many of these comic creation tools, but with the needs of people with aphasia at the fore.

## 3 COMIC SPIN

*Comic Spin* is a tablet-based (iOS and Android) application for people with aphasia<sup>2</sup>. It supports the creation of comics through a three step process: choosing the comic’s length (the number of “panels”), choosing themes and selecting cartoon images and text captions (Figure 1). The result is a short comic strip consisting of cartoon images with corresponding text captions. *Comic Spin*

<sup>1</sup>Hay(na)ku are a form of structured poetry created by Filipino poets, including Eileen R. Tabios.

<sup>2</sup>See <https://blogs.city.ac.uk/inca/comicspin> for information on how to access the app. These details are correct as of 21 July 2020.

constrains creativity by providing this highly-structured user journey, by offering a fixed set of choices and by limiting the number of choices.

*Comic Spin* opens on a landing screen which contains only the logo and a “Start” button. An instruction screen then gives a high-level overview of the three main steps to create a comic. In the first step, the “Choose number of panels” screen, users decide how long their comic strip will be – one, two or three panels (Figure 1a). The default selection is three.

The second step, Theme selection, determines the types of images and captions that will be available to the user. For example, selecting the “Animals” theme gives users a selection of animal-related images such as a person playing fetch with a dog and captions such as “Woof” or “So cute”. Users can select up to six themes (Figure 1b). Whether or not any themes are chosen, a default selection of generic images and captions is available at the next step.

After theme selection, users proceed to the comic creation screen (Figure 1c). Depending on their selection on the panels screen, this screen will contain one, two or three pairs of spinners. Users can “spin” these spinners to select theme-based images and captions for their comic. The final screen of *Comic Spin* reveals the completed comic strip (Figure 1d) and has a feature to read it aloud.

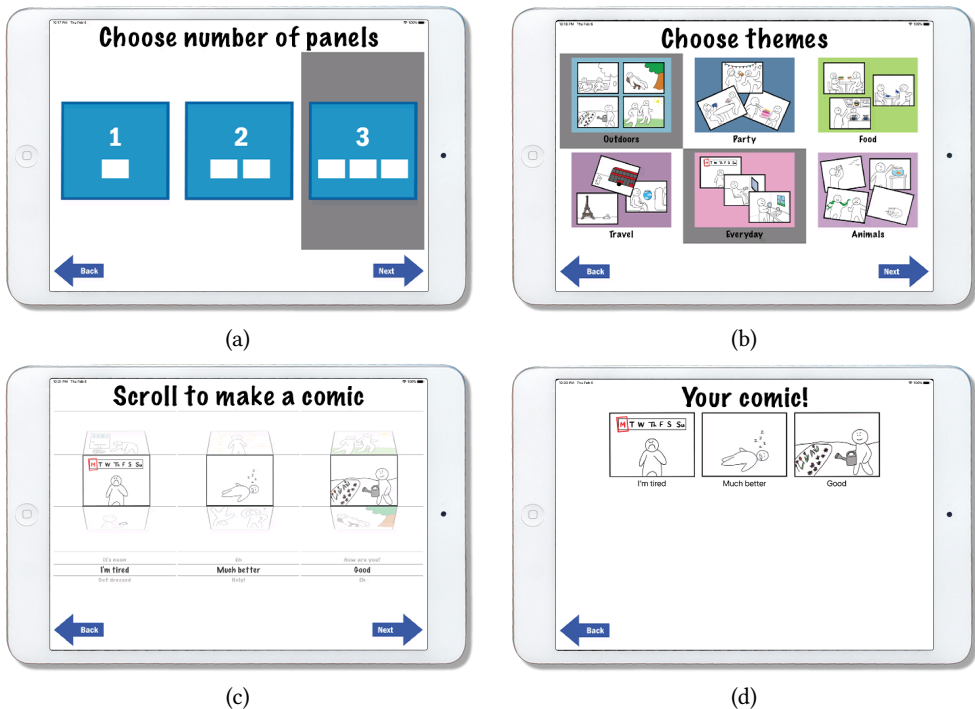


Fig. 1. The key steps in creating a comic: (a) choosing the number of panels, (b) choosing themes, (c) selecting images and captions, and (d) the completed comic strip

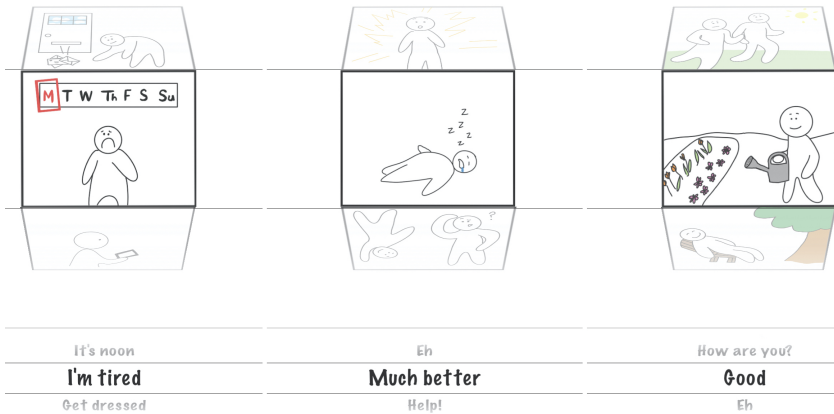


Fig. 2. This larger view of Figure 1c, depicts a three-panel comic. Panel 1 shows a person on Monday with the caption, "I'm tired." Panel 2 shows a person taking a nap with the caption, "Much better." Panel 3 shows a person gardening with the caption, "Good."

#### 4 DESIGNING COMIC SPIN

We followed the approach of Design Thinking [13] in creating *Comic Spin*. This process was valuable for its focus on creative ideation and empathy. In line with this approach, the stages of design were to empathise, define, ideate, prototype and test. Interviews with proxies and first-hand accounts from people with aphasia were used to build an understanding of the intended user group. Findings were summarised and an empathy map was created. An ideation session with designers was held to explore a wide variety of potential solutions. Several iterations of wireframes and prototypes were evaluated with proxies, usability experts and people with aphasia, and the final app was investigated in a creative workshop.

The design of *Comic Spin* also drew on the wealth of knowledge accumulated in the design of *MakeWrite* [29]. Findings from the co-design activities on that project provided a starting point for the design of *Comic Spin*, most notably, the idea of constrained creativity, the overall user journey and some detailed interactions were based on these findings.

##### 4.1 Interviews with Proxies

Two researchers with expertise in human-computer interaction and speech and language therapy were interviewed to learn about their experience designing technologies with and for people with aphasia. Proxies have previously been shown to be an effective approach in designing for people with aphasia [7] for iterative design when access to people with aphasia is limited, as was the case in the initial design of *Comic Spin*. These two researchers, who are also authors of this paper were not involved in the initial design and development of *Comic Spin*, but led the Creative Workshop (Section 5) where they worked with people with aphasia to iterate the design.

The interviews were semi-structured, following a list of questions about aphasia in general and about designing with and for people with aphasia. Key findings from these interviews directly influenced the design of *Comic Spin*, although some may also be generalisable to the design of other technologies for people with aphasia. The findings are listed below in **bold** alongside their impacts.

- **One constraint that can enable creativity is providing a finite set of options.** In *Comic Spin*, users can choose only from provided images and captions.

- **Simplicity is crucial. One task should be presented at a time and it should be clear what that task is and how to do it.** Each of the three main steps of creating a comic strip is presented on a separate page.
- **It should be clear where each task fits into the whole of the application.** The instructions page gives an overview of the app using the exact page headers to help users understand where each task fits into the overall process.
- **The interaction should not require very fine motor skills.** The target size of all clickable items on the app is large. Only two major interactions are required to navigate the app itself: tapping and sliding.
- **Users will want choice and choice can enable a wider variety of people to use an app.** Users can choose the length of their comics and their themes. They can choose to caption their images or not.
- **Simple language should be used, with readable fonts and sizes.** Sans serif fonts were chosen in large sizes. Captions are short and mostly simple.

## 4.2 Voices of People with Aphasia

YouTube videos created by people with aphasia and a paper [33] co-authored by a person with aphasia were utilised to create a deeper understanding of living with aphasia. In a video [41] posted by County Durham & Darlington NHS Foundation Trust, a man named Henry discusses how his life changed after developing aphasia. Each year, a woman named Sarah Scott creates a video with her mother [39, 40] where Sarah demonstrates her speech therapy progress since having a stroke at the age of 19.

Information about living with aphasia was compiled from these sources and combined with findings from the proxy interviews. Points were chosen for their applicability to technology use and their insight into the physical and emotional effects of aphasia. These insights were organised into an empathy map (Table 1) representing people with mild to moderate aphasia.

A mixture of direct quotes from people with aphasia and summary points from the proxy interviews was used. Organising information into “says,” “thinks,” “does” and “feels” sections of the empathy map helped to paint a general picture of living with aphasia. Specific issues related to interacting with digital technologies and potential guidance for app design were captured in the “pain” and “gain” sections.

This empathy map helped focus the goals and requirements of *Comic Spin*. For example, to limit typing we included full captions rather than allowing users to create their own. However, it was important to balance this restriction with the freedom to express ideas and feelings so a wide variety of images and captions were included. Furthermore, the simplicity of the captions and interactions were crucial to the accessibility of the application. This was a guiding principle throughout the design process.

<p><b>SAYS</b></p> <ul style="list-style-type: none"> <li>- <i>“It certainly did not occur to me that any faults may lie with the software and not with me”</i> [33].</li> <li>- <i>“Since my stroke, I have held the view that instructions should be expressed as simply as possible, even if that means that the tasks may appear childish to others”</i>. [33].</li> <li>- <i>“When I had my stroke, everything changed.”</i>[40].</li> </ul>	<p><b>THINKS</b></p> <ul style="list-style-type: none"> <li>- <i>“I still understand everything and think for myself”</i>[33].</li> <li>- <i>“I wish it were easier to hang out with my friends”</i>[39].</li> </ul>
<p><b>DOES</b></p> <ul style="list-style-type: none"> <li>- Uses the TV well, but sometimes presses the wrong button. [33]</li> <li>- Many people with aphasia say they are not able to achieve the <i>“level of access to mainstream technologies”</i> as they had achieved with some <i>“Specifically-designed therapy technologies”</i> [33].</li> <li>- Uses speech-to-text on smartphone to text friends [40].</li> <li>- Uses smart phone to share photos of life – Proxy interview.</li> </ul>	<p><b>FEELS</b></p> <ul style="list-style-type: none"> <li>- <i>“Expressing yourself can be frustrating when you cannot find the right words”</i> [41].</li> <li>- The computer is much harder to use than the TV [33].</li> <li>- Smart phones are a great tool for sharing photos and assisting in communication.</li> <li>- Felt upset and alone after stroke [39].</li> <li>- Feels tired or drained after too much communication.</li> </ul>
<p><b>PAIN</b></p> <ul style="list-style-type: none"> <li>- Unable to read text on websites and menus [33].</li> <li>- Unable to type reliably [33].</li> <li>- <i>“Overwhelmed by busy screens or input interfaces”</i>. [33].</li> <li>- On Facebook on an iPad, buttons, drop-down menus, and tags are challenging [33].</li> </ul>	<p><b>GAIN</b></p> <ul style="list-style-type: none"> <li>- Limiting typing can improve access to technology.</li> <li>- Create a means of expression to help share ideas and feelings.</li> <li>- Simple language and design will help maintain engagement with technology.</li> </ul>

Table 1. Empathy map for *Comic Spin*: “says,” “thinks,” “does,” and “feels” provide a general picture of living with aphasia; “pain” and “gain” provide issues related to digital technologies.

### 4.3 Ideation Workshop

An ideation session was hosted at City, University of London with four Human-Computer Interaction (HCI) students with a designer background. Designers were chosen for this workshop because they had experience with collaborative creative activities and were knowledgeable about designing for specific users.

The main design activity of the ideation session was based around Challenging Assumptions [12]. This technique involves a group listing their assumptions about a project or design idea and systematically questioning whether these assumptions are valid or should be reconsidered.

To introduce participants to the design activity, design guidelines, two personas and example comics were distributed and summarised. The Challenging Assumption activity was explained and participants were given an example of an assumption about the project from the design guidelines. They were asked to list additional assumptions that they had heard, held themselves or imagined could be held about the project. The group produced a list of 10 assumptions. Towards the end of the list, the group began discussing each assumption as it was listed. This generated more discussion and allowed smoother transitions between discussions. Participants then returned to earlier assumptions which had not yet been discussed and the activity evolved to a less formal ideation session. Participants asked the researcher additional questions about the project and proposed their thoughts and ideas freely. A second, less-structured activity asked participants to create their own comic strips from paper cut-outs. The purpose of this activity was to spark creativity and to encourage participants to think about the process of creating comics.

Key findings from the ideation workshop and their impact on the design of *Comic Spin* were:

- **Give users choices when interacting with the application.** This reinforced a finding from the proxy interviews. In *Comic Spin*, users choose their comics' length, themes and whether they want to use captions alongside their images.
- **Give users the ability to customise the content they create.** This informed the decision to separate text captions from images so users could choose their own combinations.
- **Could be helpful to organise components (images and words) into categories.** Themes are used in *Comic Spin* to group images and words.
- **Could be more usable and fun to not start from a blank slate.** The use of spinners means that images and text are already selected when users reach the comic page.
- **Could be more usable and fun to limit options.** Instead of creating their own images and text captions, users select from provided options.
- **Remember that people may want/need different things from the application.** Default selections enable users to create comics without interacting with every functionality.

#### 4.4 Prototypes and Initial Evaluations

Several paper wireframe sketches were produced to represent possible designs for each step of the application. In two evaluations with expert proxies, the researcher and expert sat next to each other at a long table so that paper sketches could be easily rearranged. Experts were presented with multiple sets of sketches and asked their opinions on multiple versions of each feature. The findings and design choices from this were as follows:

- **Buttons like “one panel” have a direct consequence and therefore require less abstraction.** On the "Choose number of panels" page, buttons are given full labels and corresponding images.
- **Certain interactions like “locking” images may be too complex.** Some prototypes presented users with several images and captions and allowed them to "refresh" to see more while "locking" those that they wanted to keep.
- **A default selection can make an app usable to a wider variety of people.** The app defaults to three-panel comics with a generic set of images and captions that do not correspond to a theme.
- **Separating the choices for length and themes could simplify the app.**
- **“Un-selected” images should be greyed out to focus attention on selections.**

Based on feedback from expert proxies, designs from paper sketches were adapted into digital prototypes using Adobe Illustrator and XD. Six usability experts from City, University of London participated in usability testing on two digital prototypes – three experts per prototype. Participants were met one at a time. The researcher distributed and summarised two personas. Participants were then given a few moments to review these personas. The project was described to participants. Participants were asked to think aloud while they tried to create a comic strip. The sessions were video-recorded. Transcripts were analysed inductively to identify recurrent themes. The prototype evaluation findings were as follows:

- **Welcome screen is confusing (overview requires too much abstraction).** The instructions page now uses exact page headers as steps and images that more closely match the actual pages of the app.
- **Drag and drop interface would be too complicated to execute successfully with the features that a user would expect of it.** While the drag and drop prototype came closer to most participants' mental models for any kind of comic or story board creator, these mental models came along with a multitude of complex interactions that would clash with

the guidelines for designing for people with aphasia. For example, some users expected that they could resize or rotate items which would require multiple and varied interactions.

- **Users should be able to select multiple themes simultaneously.**

#### 4.5 Collaborative Evaluation with People with Aphasia

A first prototype of *Comic Spin* was evaluated in a workshop setting with three people with aphasia (Carol, Charlie and Evelyn). Their ages ranged from 55 to 65 years old. All were at least six months post-stroke and had spoken English fluently prior to their stroke. Each experienced moderate to severe aphasic language difficulties as a consequence of their stroke, with spoken language being very limited for two participants (Carol and Charlie). These two participants also experienced limb weakness (hemiplegia) affecting their right arm and both used a stick to walk.

*Comic Spin* was first demonstrated to the participants by a speech and language therapist researcher with extensive experience of supporting access to technology for people with aphasia. Each participant then used the app individually with support from a member of the research team. After use, we captured individual feedback through discussion, facilitated by a large piece of paper with rating scales to support the conversation. We asked participants whether they would like to use the app again, whether the app was easy to use or not, how they felt about each screen of the app, whether they would like to share the comics they made online and the importance of a read-aloud feature.

**4.5.1 Evaluation Findings.** All 3 participants were successful in making comics with the app. The participants created a total of five comics between the three of them. Three comics had three panels, two had two panels. The comics were typical of the participants in the workshop. For example, Carol<sup>3</sup>, who disliked using or engaging with written words, made comics with very few captions - such as the holiday-themed comic in Figure 3.

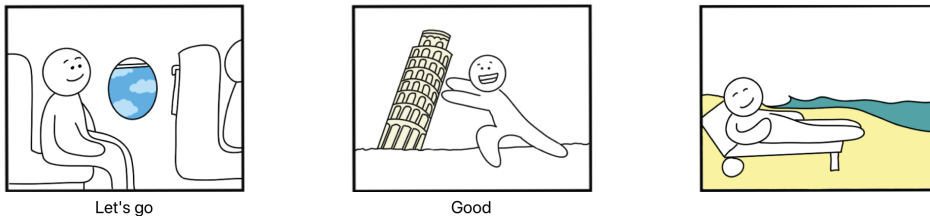


Fig. 3. Carol's holiday themed comic.

The feedback from the session indicated that all participants enjoyed *Comic Spin* and wanted to use it again. Feedback about its ease of use was mixed. While Charlie felt it was easy to use, the other two participants (Carol, Evelyn) had reservations and rated its ease of use as 'neutral'. Participants were effective in choosing themes for their comics and choosing images, although two (Carol, Charlie) were not confident about adding captions to the comics.

While there was a general consensus amongst participants that they wanted to be able to add their own images, one participant (Carol) was strongly against adding his own words as this would be a challenge for him. All participants were very strongly in favour of integrating a read-aloud feature into the app – in fact when asked to rate out of 5 how important this would be, they said it should be a “6 out of 5 priority”. Finally, participants all expressed a strong desire to share their comics online in some way.

<sup>3</sup>Gender-neutral participant pseudonyms have been used throughout this work to maintain anonymity.

Other feedback delivered specific insights into how to improve the user interface to make it more accessible. Participants found some of the smaller interface elements challenging to interact with. Evelyn suggested that we should make the pictures in the spinners larger. In response to the feedback gained during this evaluation, we made changes to the fonts, sizes of pictures in the spinners and the size of the buttons. Based on the discussion about a read-aloud feature, we also added a dedicated text-to-speech button which played aloud the selected caption in the spinner. This was preferred over the alternative of playing aloud every time a new word is highlighted.

## 5 CREATIVE WORKSHOP WITH COMIC SPIN

Following the refinements made in response to the findings from the collaborative evaluation, *Comic Spin* was explored in a creative workshop. The workshop involved eight people who had not taken part in the earlier evaluation session.

### 5.1 Procedure

The creative workshop was one in a series of six workshops exploring novel creative technologies with people with aphasia. Workshops took place within the context of an existing community aphasia support group who met weekly at a specialised aphasia centre. Ethical approval for this research was granted by the Computer Science Research Ethics Committee at City, University of London. The aims of this workshop were for participants to explore the use of *Comic Spin* and for researchers to gather evaluative feedback. Approximately three weeks after the *Comic Spin* workshop, a curation workshop took place, allowing participants to reflect and comment on the content they had created. Approximately one week after this, participants were individually interviewed by researchers separate to those who had undertaken the workshop series in order to gather unbiased feedback about the technologies explored.

*5.1.1 Workshop session structure.* The structure of the *Comic Spin* workshop session will be briefly described next. Once participants had arrived and seated themselves around a large central table, a speech and language therapist researcher introduced and demonstrated the *Comic Spin* app using an iPad connected to a projector. Participants were next presented with either a tablet each or between two and encouraged to explore and use the app to create comics.

Two researchers and an aphasia group volunteer supported participants to explore the app as requested. After around 15-20 minutes of app use, participants each completed a short individual feedback survey. Next, the speech and language therapist researcher facilitated a group discussion about the app, documenting participants' comments on large sheets of flip-chart paper and garnering consensus for suggestions about potential future refinements to the app. Exploration of the tool was then drawn to a close in order to break for coffee. Approximately one month subsequent to the workshop session, participants each took part in an individual interview with a separate researcher to ascertain their opinions about the technologies explored within the workshop series. Interview outcomes pertaining to the *Comic Spin* app will be presented here.

*5.1.2 Data Analysis.* Workshop outcomes were analysed by compiling data from feedback questionnaires, analysing transcription from the group's consensus discussion and undertaking structured observation of video data of the group members using the app. Data from the subsequent interview were transcribed and analysed thematically to explore positive and negative perspectives about the app, comments about the implications of constraints on the process of creativity and suggestions for future refinements. Based on prior experience, we opted not to log the time spent using the interface or number of choices made within the app. Such data poses challenges to interpret due to the different aphasia profiles of the participants taking part and the group nature of the activity.

For example, the length of time taken between interactions can vary greatly dependent upon the severity of each individual's aphasic difficulties.



Fig. 4. Workshop participants using *Comic Spin*.

## 5.2 Participants

Eight participants with aphasia took part in the creative workshop (Alex, Jo, Hilary, Pat, Ceri, Jodie, Dom and Dev). Participants experienced a range of aphasic language difficulties as a consequence of stroke – as is representative of the wider population of people living with aphasia. Spoken word-finding ability was very limited for one participant (Dom), other participants experienced milder spoken difficulties. Several participants experienced mild to moderate difficulties in understanding spoken language and one participant reported specific and significant difficulties with reading (Jodie). Participant ages ranged between 47 and 68 years old. All participants were at least six months post-stroke and all had spoken English fluently prior to their stroke. Five participants had hemiplegic limb weakness which restricted the use of their right arm and leg.

## 5.3 Results

Results reported here are drawn from the creative workshop itself plus activities undertaken in a subsequent curation workshop and individual follow-up interviews. Both the curation workshop and follow up interviews were carried out online, via video-conferencing, due to the COVID-19 pandemic.

**5.3.1 Comics.** We present an analysis of the comics produced in the workshop, followed by examples of the comics, presented as vignettes. The comic creation session lasted approximately 18 minutes before switching to feedback about the app. During this time, 24 comics were saved to the devices. The majority of the comics created had three panels. Four comics had two panels and only one comic had one panel. Participants used all of the themes at least once. The predominant themes used in the final collection of comics were party (seven comics), animals (five comics), gardening (three comics) and travel (three comics).

Many of the participants used the content from the themes to present creative, often comical and subversive messages. Alex, for instance, created the comic presented in Figure 5. This was the

first comic that he created, doing so after about two minutes and 30 seconds of being given the app. In discussions with Alex, the researchers assumed that this comic strip was about how Alex used gardening to calm him down when he was annoyed. The researchers were wrong. As Alex explains: “*it is about being annoyed by someone, then putting them 6 feet under*”. When asked about his thought process when creating this comic, he noted “*it was just what I was shown*”, implying that he had not actively decided to conjure up this story, but that it is simply what had ‘jumped out’ at him when using the app. This comic was very positively received by the group in reflections on the session, indicated by laughter and a discussion about the apparent innocence of the third panel in contrast to its underlying darkness.

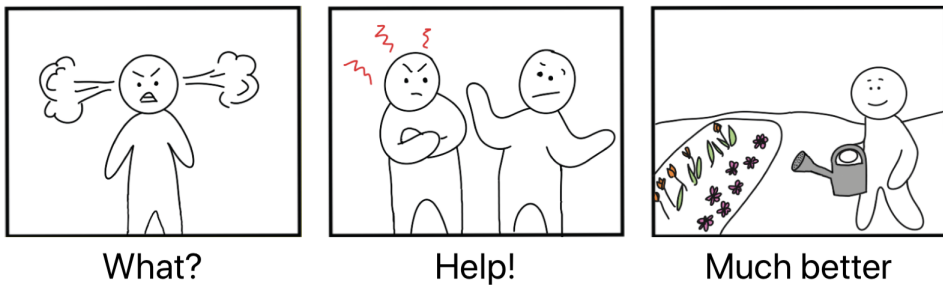


Fig. 5. Alex’s comic about gardening, with a twist

Other comics were reflections of real life experiences, presented in alternative or comical ways with the material within *Comic Spin*. Hilary created the comic shown in Figure 6, which she entitled ‘Surprise Proposal’. She used this comic as a way to announce to the full group, beyond the few members she had previously informed, that her son was getting married. Reflecting on the comic, she provided the following context to the group: “*That is my son and prospective daughter-in-law having being proposed to. He proposed to her as a surprise, then we all got together and had a meal and a surprise party.*”, promoting discussion with other participants. She then, instead of taking a screenshot with the tablet device, took a picture of the comic with her phone to show her family and sent it via Whatsapp.



Fig. 6. Hilary’s real life story re-tell.

5.3.2 *Likert Results.* Feedback questions asked on the day are shown in table 2. In total there was 10 instances of ‘strong agreement’ in positively phrased questions, five instances of ‘agreement’ and one instance of ‘neutrality’. This indicates that the vast majority of the feedback was positive.

All participants felt that they “did something creative with the app” (S1). Five out of eight participants strongly agreed with this statement. All but one felt that the app was “easy to use” (S2). The majority (five out of eight) strongly agreed that the app was easy to use.

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1) <i>I did something creative with the comic app</i>	0	0	0	3	5
2) <i>The comic app was easy to use</i>	0	0	1	2	5
3) <i>I enjoyed using the comic app</i>	0	0	0	3	4
4) <i>I feel proud of my creation</i>	1	1	0	4	1

Table 2. Frequency of Likert scale responses from the workshop from 8 participants.

### 5.4 Session Observation and Discussion

After using the app, we had a brief discussion about the app with a view to get feedback about the participants’ experiences, and to ideate what might be done to improve this app and future developments. The app was generally praised as being simple to use: “it was quite straightforward” (Hilary) and “good to use”(Jo). Hilary noted how they liked that the structure and the finite opportunity (i.e., constraints) the app provides allows for supports creativity – “I like the themes. It gives it a bit more structure. If you have it just open... it is a whole lot of words. Makes it just very hard work.”.

The participants were asked for improvements for the design. They said that they would like more panels for the comics – “More screens. More choices. Not just three. [unclear] so you are making more of a story...”(Jo). Group consensus thought that allowing for up to three more panels (i.e. up to six in total) would be optimal. Participants also suggested the inclusion of more themes and words “...there were four phrases for the animal ones, yes? So you might want to have...Lots more, yeah? Yes.” (Pat) – “you have to change the language... The words”. [researcher – “you would like to put in more words”]. “Yes.” (Ceri). However, participants were aware of the inherent tension of adding more words and the increased complexity of the app – “There is gonna be point where there is too much isn’t it? Cause you need to... [scrolling gesture].” (Hilary). General agreement was that by default there should be fewer words to choose from, but then you can use a ‘more words’ button if you are short of words.

Participants were generally against the inclusion of their own, personal content, but quickly began to ideate new content which might be used in the app. Participants seemed to enjoy the simple comic aesthetic of the pre-made content – “I liked that it wasn’t too much colour and things. It just had little bits of colour.” (Jo). They suggested that punctuation alone might offer an approach for expression – “some more... exclamation marks, question marks, not so much words. You can say a lot with an exclamation mark.” (Hilary). This response received an excited response from Dom “YES! YES! [points at (Hilary)]”. Hilary later suggests “a few z z z – sleeping”.

### 5.5 Exit Interview

Data from exit interviews conducted one month after the workshop indicated that the prevailing sentiment remained - that *Comic Spin* app had been well received by nearly all of the participants. Six out of eight participants reported entirely positive experiences; commenting that they found the app fun and easy to use. One participant reported a mixed experience, stating that whilst he enjoyed using the picture components to build a sequence, the reading impairments caused by his aphasia meant that they found the “words difficult” (Jodie). One participant was more negative overall about the app, observing that the comics format and style of images were not to their taste: “I would sooner present my pictures to tell their own story” (Ceri).

In terms of the final design of the comics created in the app, several participants indicated that they would like to see more than three panels available to convey their story. They acknowledged however that they would find it harder to work with a very large number of panels: “*Can make comic is the one: fine, and, uh, six pieces: fine and, uh, seven and eight: forget it! (laughs).*” (Dom). These findings echo the ideas raised in the workshop discussion.

Three participants expressed a desire for a larger number of images to select from when composing a comic strip, indicating that greater choice might support them to be more creative. Others, however, felt the constraints in choice encouraged creativity: “[*The app*] was really good because, um, there’s, um, 30 images. Which one? Do you know what I mean? You have to find one of them. You know. For one of them. And then you have the words. Um.. might be, I don’t know, 20 words. And you have to find a how the wor[ds].. well you could have to do it.” (Alex). Here, Alex demonstrates his engagement in creating new content - indicating the active choices he was making at each stage of the process.

## 6 DISCUSSION

### 6.1 Efficacy of Comic Spin

The speed and the efficacy with which people were able to create short comics, coupled with the observations and self-reported data, indicated that *Comic Spin* was effective in supporting people with aphasia to create comics. Moreover, it was an enjoyable medium for doing so. A range of interesting, expressive comics were created which communicated a variety of fabricated and factual topics. Participants expressed humorous, joyful and dark sentiments, which overflowed into the discussions in the workshop.

*Comic Spin* provided an accessible experience for people with a range of aphasia profiles. Compared to a fully text-based tool, such as MakeWrite [29], we saw a distinctly wider range of aphasia profiles able to engage with *Comic Spin* successfully. In both the collaborative evaluation and the creative workshop, people with severe aphasia were able to engage with the app independently. These activities also revealed potential future refinements to *Comic Spin*. Some participants expressed a desire to create longer comics with additional panels. Others requested more images and captions, including some non-verbal captions such as exclamation and question marks. In future work, it could be helpful to ask participants directly whether the app allows them to create something they might not otherwise have been able to create.

### 6.2 How Comic Spin was Appropriated

Reflecting on content such as that shown in Figure 5, we see that people did not simply compile a comic from the predefined elements; rather they elaborated their own comic stories around these constrained choices. In this case, in a macabre and subverted way. This unexpected use of the tool was similar to observations from Neate et al. [29], in which a participant appropriated their constrained writing tool to make funny, rude or odd-sounding sentences instead of what one might traditionally consider as ‘creative’ writing.

An unexpected use of *Comic Spin* was as a medium, and indeed a provocation, to tell real-life stories. In ‘The Surprise Proposal’ (Figure 4), *Comic Spin* not only supported one of the participants in telling a story, but it also provided them with an opportunity to reveal something that had happened that week. The app allowed them to share a real-life story – the story of their son’s proposal – with the group. This is analogous to the act of providing a ‘ticket to talk’ discussed by [43], and might be considered analogous to a conversational support tool (such as [22, 44]) in the way that is used as a conversational ‘prop’ to scaffold conversation. It provides an opportunity to stimulate a conversation which might have never happened (especially within the group) otherwise.

Without the context of using their comic, this participant might have found it taboo, or perhaps embarrassing, to share this piece of positive news with the entire group at the same time. In creating their comic and sharing it with the entire group, the participant was given a platform to do so.

### 6.3 Constrained Creativity

The work reported here has provided further evidence that constrained creativity is a powerful approach for enabling people with aphasia to create digital content. This success was demonstrated in both the comics that people created and in participants' self-reports. By constraining creativity through means such as a limited set of themes and limited content within the themes, participants in the sessions were able to make creative content with ease.

The balance between constraining creativity and allowing enough freedom to tell a story sets *Comic Spin* apart from other comic creation tools. While the form of comics – their panels; a series of images have some form of constraints, most tools do not heavily constrain creativity beyond this. In most, a complex interface and multitude of options mean that comics are challenging to create. *Comic Spin* strategically limits the options for creating a comic in a way that forces users to think of a story line based on available images and captions. However, it differs from more restrictive tools because it offers choice rather than random generation. It is this *ability to iterate* through the choices in a systematic manner, so that the users can simply select 'what works' promotes access.

### 6.4 Comic Forms

People with a range of aphasia profiles used *Comic Spin* effectively, but in differing ways. For example, those with milder aphasia expressed a desire for more choices in the content of their comics. With longer use, people with more severe aphasia might also appreciate more choices. Group consensus was not clear about where this content would be sourced from. Although some desired to put in their own content, it was clear that the simple aesthetic of the drawings the app provided were positively received. Another future possibility might be to extend the app to include more elaborated stories to weave longer, rich digital tales (as we see in comic books). Currently, what we see produced – due to the constraints designed into the app – are 'comic strips' similar to the visual Hay(na)ku forms [5] discussed in the background of this paper.

Regarding the form of comics as a means to express – we found, as expected, that the *comic form* afforded humorous content. Humour is an important part of many shared groups, especially for those who have a shared health condition. As Sherratt and Simmons-Mackie [35] put it in their analysis of shared humour in aphasia peer groups – “*They should be called cheer groups*”. Humour serves an important role in providing solidarity and togetherness. It is an important medium through which people with a range of difficulties produced by aphasia to manage their identity, to diffuse tensions and communicate. We observed that the content created with *Comic Spin* allows for this humour to be expressed through comics in novel ways which might not be done so easily through traditional communication that one would see in such an aphasia group. Our future work involves developing materials which will support the leaders of such aphasia groups in utilising *Comic Spin* to supplement their sessions.

Finally, regarding personal content – we actively chose not to support users in using their own content in these sessions due to: 1) the tensions observed in our previous work [30] when using personal content in group settings and, 2) the additional – potentially challenging – process of choosing and organising content this would have implied for the workshop. Ultimately, this has allowed us to explore the core constrained creativity characteristics of the app. This noted, we acknowledge that the integration of personal content might be desirable for some. Future work will consider integration of personal content into sessions for individual use, and will explore how conflicts around personal content can be circumvented in group settings.

## 7 CONCLUSION

Digital content is an increasingly important part of many of our social groups, communities and societies. It is therefore essential that a wide range of people can create digital content. However, much of the current technology for content creation does not support access for people with aphasia. Building upon previous work on using *constrained creativity* to enable digital content creation, we have created a tool which supports the creation of comics by people with aphasia. The app – *Comic Spin* – was built through a Design Thinking approach involving collaborative activities with expert proxies, designers and people with aphasia. In a creative workshop, participants with aphasia were able to create interesting, funny and auto-biographical content that they would not have been able to create otherwise. We provide insights from the design process and the creative workshop to inform the design of future technologies which support diverse groups of people in digital creativity. This work offers further evidence that computationally-supported constrained creativity can enable people with aphasia to create digital content.

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## REFERENCES

- [1] Abdullah Al Mahmud and Jean Bernard Martens. 2013. Amail: Design and evaluation of an accessible email tool for persons with aphasia. *Interacting with Computers* 25, 5 (2013), 351–374. <https://doi.org/10.1093/iwc/iws025>
- [2] Aphasia.org. 2018. National Aphasia Organization. <https://www.aphasia.org/>
- [3] Luca Benedetti, Holger Winnemöller, Massimiliano Corsini, and Roberto Scopigno. 2014. Painting with Bob: assisted creativity for novices. In *Proceedings of the 27th annual ACM symposium on User interface software and technology*. ACM, 419–428.
- [4] Ben Bengler and Nick Bryan-Kinns. 2013. Designing collaborative musical experiences for broad audiences. In *Proceedings of the 9th ACM Conference on Creativity & Cognition*. ACM, 234–242.
- [5] Amy Bernier, John Bloomberg-Rissman, Sam Bloomberg-Rissman, Horacio Castillo, Ira Franco, Jane Ogilvie, Ernesto Priego, Eileen R Tabios, and Ginger Stickney. 2019. *The Strip Hay (na) ku Project. A collaborative experiment in sequential poetics*. Meritage Press/ie press, and Laughing/Ouch/Cube/Publications.
- [6] Aikaterini Bourazeri and Simone Stumpf. 2018. Co-Designing Smart Home Technology with People with Dementia or Parkinson’s Disease. In *Proceedings of the 10th NordiCHI Conference*.
- [7] Jordan L. Boyd-Graber, Sonya S. Nikolova, Karyn A. Moffatt, Kenrick C. Kin, Joshua Y. Lee, Lester W. Mackey, Marilyn M. Tremaine, and Maria M. Klawe. 2006. Participatory Design with Proxies: Developing a Desktop-PDA System to Support People with Aphasia. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (Montréal, Québec, Canada) (CHI '06)*. Association for Computing Machinery, New York, NY, USA, 151–160. <https://doi.org/10.1145/1124772.1124797>
- [8] Canva. [n.d.]. Comic Strips. <https://www.canva.com/create/comic-strips/>
- [9] Tamlin S Conner, Colin G DeYoung, and Paul J Silvia. 2018. Everyday creative activity as a path to flourishing. *The Journal of Positive Psychology* 13, 2 (2018), 181–189.
- [10] Tim Coughlan and Peter Johnson. 2007. Constrain yourselves: Exploring end user development in support for musical creativity. In *Proceedings of the 6th ACM SIGCHI Conference on Creativity & Cognition*. ACM, 247–248.
- [11] Csmartworld. [n.d.]. Cartoon Comic Strip Maker. [https://play.google.com/store/apps/details?id=com.csmart.cartooncomic.stripmaker&hl=en\\_US](https://play.google.com/store/apps/details?id=com.csmart.cartooncomic.stripmaker&hl=en_US)
- [12] Rikke Friis Dam and Yu Siang Teo. 2017. Learn How to Use the Best Ideation Methods: Challenge Assumptions. <https://www.interaction-design.org/literature/article/learn-how-to-use-the-best-ideation-methods-challenge-assumptions>
- [13] Rikke Friis Dam and Yu Siang Teo. 2019. 5 Stages in the Design Thinking Process. <https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process>
- [14] Explosm. [n.d.]. Random Comic Generator 2.0. <http://explosm.net/rcg>

- [15] Jonas Frich, Lindsay MacDonald Vermeulen, Christian Remy, Michael Mose Biskjaer, and Peter Dalsgaard. 2019. Mapping the Landscape of Creativity Support Tools in HCI. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) (*CHI '19*). ACM, New York, NY, USA, Article 389, 18 pages. <https://doi.org/10.1145/3290605.3300619>
- [16] Ronald E Goldsmith and Timothy A Matherly. 1988. Creativity and self-esteem: A multiple operationalization validity study. *The Journal of psychology* 122, 1 (1988), 47–56.
- [17] Carole-Ann Greig, Renée Harper, Tanya Hirst, Tami Howe, and Bronwyn Davidson. 2008. Barriers and Facilitators to Mobile Phone Use for People with Aphasia. *Topics in Stroke Rehabilitation* 15, 4 (2008), 307–324. <https://doi.org/10.1310/tsr1504-307>
- [18] Brian Grellmann, Timothy Neate, Abi Roper, Stephanie Wilson, and Jane Marshall. 2018. Investigating Mobile Accessibility Guidance for People with Aphasia. In *Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility* (Galway, Ireland) (*ASSETS '18*). ACM, New York, NY, USA, 410–413. <https://doi.org/10.1145/3234695.3241011>
- [19] Simon Grennan, Ernesto Priego, and Peter Wilkins. 2017. *Parables of Care. Creative Responses to Dementia Care, As Told by Carers*. City, University of London, University of Chester, Douglas College.
- [20] Chris Ireland and Maria Black. 1992. Living with aphasia: the insight story. (1992).
- [21] Chris Ireland and Carole Pound. 2003. Cebrelating aphasia poetry power. *Aphasia inside out: Reflections on communication disability* (2003), 145.
- [22] Shaun K Kane, Barbara Linam-Church, Kyle Althoff, and Denise McCall. 2012. What we talk about: designing a context-aware communication tool for people with aphasia. In *Proceedings of the 14th international ACM SIGACCESS conference on Computers and accessibility*. 49–56.
- [23] Amanda Lazar, Jessica L Feuston, Caroline Edasis, and Anne Marie Piper. 2018. Making as expression: Informing design with people with complex communication needs through art therapy. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–16.
- [24] Chi-Chin Lin, Yi-Ching Huang, and Jane Yung-jen Hsu. 2014. Crowdsourced explanations for humorous internet memes based on linguistic theories. In *Second AAAI Conference on Human Computation and Crowdsourcing*.
- [25] MakeBeliefComix. 2006. Create Your Own Comix Strip. <https://www.makebeliefscomix.com/>
- [26] Fiona Menger, Julie Morris, and Christos Salis. 2016. Aphasia in an Internet age: wider perspectives on digital inclusion. *Aphasiology* 30, 2-3 (2016), 112–132. <https://doi.org/10.1080/02687038.2015.1109050> arXiv:<https://doi.org/10.1080/02687038.2015.1109050>
- [27] Karyn Moffatt, Joanna McGrenere, Barbara Purves, and Maria Klawe. 2004. The participatory design of a sound and image enhanced daily planner for people with aphasia. *Proceedings of the 2004 conference on Human factors in computing systems - CHI '04* 6, 1 (2004), 407–414. <https://doi.org/10.1145/985692.985744>
- [28] Timothy Neate, Aikaterini Bourazeri, Abi Roper, Simone Stumpf, and Stephanie Wilson. 2019. Co-Created Personas: Engaging and Empowering Users with Diverse Needs Within the Design Process. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM. <https://doi.org/10.1145/3290605.3300880>
- [29] Timothy Neate, Abi Roper, Stephanie Wilson, and Jane Marshall. 2019. Empowering Expression for Users with Aphasia through Constrained Creativity. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) (*CHI '19*). Association for Computing Machinery, New York, NY, USA, Article 385, 12 pages. <https://doi.org/10.1145/3290605.3300615>
- [30] Timothy Neate, Abi Roper, Stephanie Wilson, Jane Marshall, and Madeline Cruice. 2020. CreaTable Content and Tangible Interaction in Aphasia. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) (*CHI '20*). Association for Computing Machinery, New York, NY, USA, 1–14. <https://doi.org/10.1145/3313831.3376490>
- [31] Rebecca Palmer, Pam Enderby, Cindy Cooper, Nick Latimer, Steven Julious, Gail Paterson, Munyaradzi Dimairo, Simon Dixon, Jane Mortley, Rose Hilton, et al. 2012. Computer therapy compared with usual care for people with long-standing aphasia poststroke: a pilot randomized controlled trial. *Stroke* 43, 7 (2012), 1904–1911.
- [32] Ernesto Priego. 2016. Comics as research, comics for impact: The case of higher fees, higher debts. *The Comics Grid: Journal of Comics Scholarship* 6 (2016), 16.
- [33] Abi Roper, Ian Davey, Stephanie Wilson, Timothy Neate, Jane Marshall, and Brian Grellmann. 2018. Usability Testing - An Aphasia Perspective. In *Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility* (Galway, Ireland) (*ASSETS '18*). ACM, New York, NY, USA, 102–106. <https://doi.org/10.1145/3234695.3241481>
- [34] Abi Roper, Jane Marshall, and Stephanie Wilson. 2014. Assessing Technology Use in Aphasia. *Assets'14* (2014), 239–240. <https://doi.org/10.1145/2661334.2661397>
- [35] Sue Sherratt and Nina Simmons-Mackie. 2016. Shared humour in aphasia groups: “They should be called cheer groups”. *Aphasiology* 30, 9 (2016), 1039–1057.

- [36] Nina Simmons-Mackie and Misty Schultz. 2003. The role of humour in therapy for aphasia. *Aphasiology* 17, 8 (2003), 751–766.
- [37] StoryboardThat. 2012. Storyboard Creator. <https://www.storyboardthat.com/>
- [38] Roundwood Studios. [n.d.]. Comic Strip! Cartoon Comic Maker. [https://play.google.com/store/apps/details?id=com.roundwoodstudios.comicstripit&hl=en\\_US](https://play.google.com/store/apps/details?id=com.roundwoodstudios.comicstripit&hl=en_US)
- [39] SymphUK. 2010. Expressive Aphasia - Sarah Scott - Teenage Stroke Survivor. <https://www.youtube.com/watch?v=1apITvEQ6ew>
- [40] SymphUK. 2018. Sarah Scott Talks About Aphasia, November 2018. <https://www.youtube.com/watch?v=PFfr5TFtgII&t=158s>
- [41] County Durham Darlington NHS Foundation Trust. 2017. Henry's Story of Living with Aphasia. [https://www.youtube.com/watch?v=\\_Sbv3VXOHdQ](https://www.youtube.com/watch?v=_Sbv3VXOHdQ)
- [42] Annalu Waller, Fiona Dennis, Janet Brodie, and Alistair Cairns. 1998. Evaluating the use of TalksBac, a predictive communication device for nonfluent adults with aphasia. *International Journal of Language & Communication Disorders* 33, 1 (1998), 45–70.
- [43] Daniel Welsh, Kellie Morrissey, Sarah Foley, Roisin McNaney, Christos Salis, John McCarthy, and John Vines. 2018. Ticket to talk: Supporting conversation between young people and people with dementia through digital media. In *proceedings of the 2018 CHI conference on human factors in computing systems*. 1–14.
- [44] Kristin Williams, Karyn Moffatt, Jonggi Hong, Yasmeeen Farooqi-Shah, and Leah Findlater. 2016. The Cost of Turning Heads: A Comparison of a Head-Worn Display to a Smartphone for Supporting Persons with Aphasia in Conversation. In *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility* (Reno, Nevada, USA) (ASSETS '16). Association for Computing Machinery, New York, NY, USA, 111–120. <https://doi.org/10.1145/2982142.2982165>
- [45] Stephanie Wilson, Abi Roper, Jane Marshall, Julia Galliers, Niamh Devane, Tracey Booth, and Celia Woolf. 2015. Codesign for people with aphasia through tangible design languages. *CoDesign* 11, 1 (2015), 21–34.