The PhonicStick – A Joystick to Generate Novel Words Using Phonics

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ABSTRACT
Current Voice Output Communication Aids (VOCAs) give little support for playing with sounds and blending these into words. This paper presents a joystick that can be used to access six different letter sounds (phonics) and blend them into short words. Seven children (five with some degree of physical and/or learning disability) showed their ability to use the device after only one 20 minutes introduction session.

Categories and Subject Descriptors
H5.2 [**Information Interfaces and Presentation**]: User Interfaces – *Input devices and strategies*; *Interaction styles*; K.3.1 **[Computers and Education]**: Computer Uses in Education; K.4.2 **[Computers and Society]**: Social Issues – *Assistive technologies for persons with disabilities*; H.1.2 [**Models and Principles**]: User/Machine Systems – *Human factors*; *Human information processing*;

General Terms: Experimentation, Human Factors.

Keywords: Human-Computer Interaction (HCI), joystick, phonological awareness, phonemes, phonics, literacy, Augmentative and Alternative Communication (AAC), education, learning, cerebral palsy, disability, speech output, voice output.

1. INTRODUCTION
Not being able to speak can impact on later language development and specifically on literacy learning [1]. Researchers agree that phonemic awareness is an important predictor of the ability to learn reading and writing and Voice Output Communication Aids (VOCAs) have been used to support literacy learning. Few past systems allowed for access to novel words using sound based methods [2, p. 60, 3].

2. CONCEPT
The author's observations from his experience in working with children with severe physical impairments were about the contrast of successfully driving an electric wheelchair by means of a joystick and problems in physically accessing a communication device using touch screen or switch access. The joystick has previously been investigated for text input [4, 5]. For access to sounds a stylus text input method by Perlin [6] was adapted (Figure 1).

Synthetic Phonics, as endorsed by the UK government for teaching literacy [7], and based on the sounds of around 42-44 letters and letter combinations was chosen to provide the sounds for generating words. The programmes usually start by introducing six or seven phonics which allow creating a number of short words when blending the sounds together. For the purpose of investigating the feasibility of playing with sounds to generate words the first stage Phonics of the Jolly Phonics teaching programme were used[1]: /s/, /a/, /t/, /i/, /p/ and /n/.

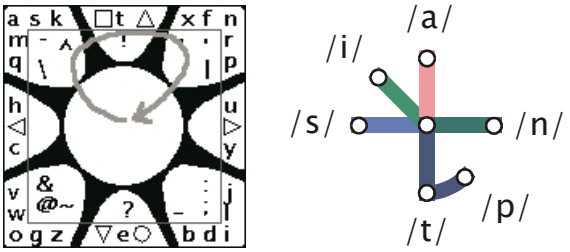

Figure 1. Quikwriting, selecting 'k' (left) and PhonicStick, six-phonic-map (right)

The six phonics were mapped on joystick movements in a way to allow the investigation of all access movements (Figure 1): forward/backwards, left right, diagonal and combined (backwards and along circumference). In order to select a phonic the user moves the joystick along the given path and then back to the centre, e.g. /p/ by tilting the joystick backwards and then along the circumference to the right for 45° and back to the centre.

Different methods for blending the sounds into words were explored (e.g. with a speech synthesizing chip [8]) but it was decided to use high quality voice recordings to allow for sufficient speech quality.

3. THE PHONICSTICK
The first PhonicStick prototype used switched joysticks (see Figure 2). Two non-latching switches allow for playback or clearing of the selected/blended phonics. The device is connected via serial port and audio cable to a PC for playback of the recordings.

All phonics (letter sounds) and all their possible combinations[2] for two and three phonic words were recorded by a native English speaker and saved as wav files. The files were played back from a laptop with the loudspeaker being located in the PhonicStick.

The user gets immediate feedback of the sound selected with the joystick and can choose to hear the blended version of previously selected phonics by pressing the green playback button.

[1] http://jollylearning.co.uk

[2] This included "non-desirable" words (such as '/tit/' and '/pis/') which are usually omitted on standard VOCA vocabulary, but have the potential to greatly increase motivation of device use.

ASSETS'11, October 24–26, 2011, Dundee, Scotland, UK.
ACM 978-1-4503-0919-6/11/10.

Figure 2. The PhonicStick

4. EVALUATION AND RESULTS

An evaluation was set out to answer the following questions: 1) Would children be able to remember the movements required to access the six phonics without being shown a visual mapping representation? 2) Would children grasp the concept of "collecting" sounds sequentially which could be blended into words?

4.1 Methodology

During the evaluation seven children were introduced to the PhonicStick (see Table 1). Five had some degree of physical and/or learning disability, three of whom have cerebral palsy and use joystick controlled wheelchairs, all had little emerging literacy. The typically developing children were both literate. All children were given two 20-minute sessions, alone or in pairs, on subsequent days (where possible) to learn how to use the device. Visual and spoken prompts were used to ask the children to reproduce phonics, play a game by generating short words and to produce their own words using the PhonicStick.

Table 1. Participants

Age/ Sex	Aetiol.	Mobility Aids	Comm.
10:10 M	Cerebral palsy	EPW with joystick	Clear speech
12:6 M	Cerebral palsy	EPW with joystick	Clear unaided yes/no, some spoken words and some Makaton signs, VOCA
11:11 M	Cerebral palsy	EPW with joystick	Clear un-aided yes/no, some spoken phrases, VOCA
6:7 M	Down's Syndr.	None	Good range of spoken vocabulary (poor intelligibility), previous Makaton user
15:1 M	Dancing Eye Syndr.	Walking frame	Clear speech
9:4 M	Typical	n/a	Clear speech
9:6 M	Typical	n/a	Clear speech

4.2 Results

All seven children were able to retrieve all six phonics in order to sound out words within a game scenario after one training session. Although, two children experienced difficulties in accessing some of the phonics positions due to their physical disabilities, they were able to demonstrate that they knew the position of all six phonics. One participant demonstrated how the PhonicStick could be used as an augmentative aid by intuitively using it to clarify her dysarthric speech when asked to identify a phonic. The typically developing children initiated the generation of novel words such as their own names. One child with cerebral palsy who was initially not very interested in the device demonstrated a similar ability some time after the study when he was invited to 'play' with the device. This was particularly interesting since the word he generated was a "non-desirable" word which he produced during an official event. He visibly enjoyed the resulting attention from his environment.

4.3 Discussion

This study showed the potential of the PhonicStick to give non-speaking children access to playing with sounds and enabling them to generate novel words without the need of being literate. This is in contrast to current VOCAs, which only allow access to novel words via letter input. Users can directly listen to the blending of letter sounds to create words, a method used in literacy teaching and so far not accessible to non-speaking individuals.

5. NEXT STEPS

Further work will need to address the remaining access difficulties due to physical impairments, e.g. by using haptic feedback and support or different access methods such as eye gaze. Currently more studies are investigating in more detail, how different groups of children (pre-school, Down's syndrome) can use the Phonic-Stick and how different Phonic layouts and feedback methods can improve usage of the device.

6. ACKNOWLEDGMENTS

I would like to thank my supervisors Dr Annalu Waller and Jeremy Linskell. I would also like to thank Capability Scotland for their support, both financially and by giving me access to their schools for user evaluation; Dundee Council for giving me access to their schools; Ruli Manurung for his Java program linking my PhonicStick prototype to a PC; Graham Pullin for his suggestions on the phonic mapping; and last but not least all the children, their parents and staff at their schools for the endless support, enthusiasm and time during the evaluations.

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