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► **To cite this version:**

Dorothe Smit, Saskia Bakker. BlurtLine: A Design Exploration to Support Children with ADHD in Classrooms. 15th Human-Computer Interaction (INTERACT), Sep 2015, Bamberg, Germany. Lecture Notes in Computer Science, LNCS-9299 (Part IV), pp.456-460, 2015, Human-Computer Interaction – INTERACT 2015. <10.1007/978-3-319-22723-8\_37>. <hal-01610822>

**HAL Id: hal-01610822**

**<https://hal.inria.fr/hal-01610822>**

Submitted on 5 Oct 2017

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# BlurtLine: A design exploration to support children with ADHD in classrooms

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**Abstract.** This paper presents BlurtLine, an interactive belt designed to support children with ADHD in regaining control over their impulsive speaking in class. Two exploratory evaluations of BlurtLine indicate that the design can indeed identify indicators of blurring and was experienced positively by a boy with ADHD and his mother and teachers.

**Keywords.** research-through-design, ADHD, blurring, classroom, interaction

## 1 Introduction

The number of students with extra needs in regular primary schools is increasing. The largest subgroup of these students is diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) [4]. A symptom of ADHD is verbal impulsivity, or ‘blurring’ [1]: speaking in direct reaction to stimuli, without first considering the appropriateness to the situation. Supporting children with ADHD in regaining control over their blurring



**Fig 1.** BlurtLine prototype

behaviour could potentially improve their learning situation in the classroom.

This paper presents the iterative design and evaluation of ‘BlurtLine’; a belt that informs children when they are about to blurt through a softly vibrating signal (Fig. 1). BlurtLine monitors the wearer’s breathing patterns. Since respiratory rate is changed extensively by emotional changes [2], rapid inhaling can be seen as a precursor for blurring. BlurtLine measures the chest circumference and constantly compares this to a baseline measurement. If BlurtLine is stretched beyond a certain set value, it

sends out a signal to the wearer by vibrating, enabling him to consider his verbal actions.

This paper presents two exploratory studies using a prototype version of BlurLine: a lab study in which the practical functionality of BlurLine is explored and a field study to gain first insights in how BlurLine is experienced in the classroom.

## **2 BlurLine in the Lab**

The lab study with BlurLine served to assess both its most suitable placement on the body, and its suitability to recognize breathing patterns in adults. The test took place in a controlled setting with seven adults of 19 to 23 years old. The participants performed a reading exercise and a breathing exercise twice: once with the BlurLine prototype worn around the chest, at the height of the sternum, and once with BlurLine worn around the abdominal area, at the height of the navel, as excited breathing often engages the chest while relaxed breathing engages the abdominal area [5]. Participants were asked to read three paragraphs of text in three different volumes: normal speaking volume, very low volume and very loudly. After reading, the participants were asked to breathe in deeply, first slowly, and then quickly. If they felt a vibration from BlurLine during the exercise, they were to ring a bell. Afterwards, the BlurLine was moved to the second location and the test was performed again.

The goal of this test was to determine whether BlurLine can distinguish between different volumes of speech and to confirm that rapid breathing is more prevalent in the chest area than in the abdominal area. During reading at high volume, three out of seven of participants set off the vibration motor with their chest breathing patterns when speaking loudly, while only one participant set off the vibration motor when speaking at high volume wearing the band around the abdominal area. The prototype did not vibrate for any participant during reading at normal and low volume. These findings indicate it is unlikely that a wearer will receive a false signal during normal speaking. When asked to take a quick, deep breath, all participants triggered the vibration motor when wearing BlurLine around the chest, while four out of seven participants failed to trigger the vibration motor when wearing BlurLine around the abdomen. This indicates that fast, impulsive breathing is mainly situated in the chest.

## **3 BlurLine in the Field**

Following the promising findings after exploring BlurLine in the lab, a second study was set up at a primary school with an 8-year-old boy diagnosed with ADHD. The goal was to gain first insights into the child's experience of wearing BlurLine to regain control of his blurting behaviour. Secondly, we aimed to determine whether the child or teachers derived any benefit from it, and to gain insight in whether child, teachers or parents experienced moral concerns regarding the use of BlurLine.

### **3.1 User Study Setup**

The field study with BlurLine spanned three consecutive mornings. The participating child wore the prototype during the last two mornings. The first morning was included for the child to get used to the presence of the researcher, and for the researcher to gain insight in the child's normal blurting behaviour. The second morning was used as a habituation period. During the third day, the participant was closely monitored to review the possible effects of BlurLine on his behaviour in class. During the whole study, a webcam was set up in the classroom, directed towards the table of the participant. The first author monitored the participant's behaviour from a different room via a live stream. This video stream was also recorded for later analysis. To grasp the experience of using BlurLine, interviews were conducted with the child, his mother and his teachers on the final day of the user study. Both teachers of the child were asked whether they had noticed any differences in the behaviour of the child. The participant and his mother were asked about their experiences during this user study.

### **3.2 Results**

Throughout the study, the participant mentioned several times that the signals he received made him mindful of his behaviour, and encouraged him to think about the ways in which he could contribute to the class conversations. However, he also indicated that he did not always feel like he was about to blurt when he received a signal. As a result, the participant would sometimes ignore the signals and still speak out in class. The signals that the participant received from BlurLine were described as clear, non-invasive, but sometimes too present due to their frequency.

During the interview, the participant disclosed that he did not mind wearing BlurLine. It was clear that he was very excited about participating in the test. After initial enthusiastic interest from his peers, the children in the classroom went about their day without taking much notice of BlurLine. One of the child's teachers said that she did not notice much difference in the participant's behaviour; the other teacher mentioned that he behaved very differently, though she remarked that this might have resulted from the presence of the camera. Overall, both of the teachers were positive towards the idea of using this tool, when its function has been proven.

The mother of the participant recounted that she did not notice any extraordinary behaviour in her child. None of the interviewees had any moral objections against the use of BlurLine to support the child in gaining control of his blurting behaviour. The mother and teachers agreed that if it helps the child, there is no apparent problem.

## **4 Discussion**

This paper presents a lab and a field study with BlurLine, a belt designed to support children with ADHD to control speech impulsivity, in order to improve their learning environment. Both studies were exploratory, yielded a number of points for discussion and brought along a few limitations. Firstly, a limitation of the presented field study is the clear presence of the Hawthorne effect [4], indicating that a longer accli-

matisation period may have been helpful. Secondly, since the user study was conducted with a first prototype version of BlurLine, false positives have likely been present, affecting the participant's experience. Future work should therefore involve a more sophisticated, accurate prototype that can be used for an extended period of time. Despite these limitations, the performed explorations led to valuable insights into the possibilities to help children gain awareness of their blurting behaviour. During the field study, it became clear that the prototype performed well in a real life setting. However, the participant also mentioned that he wasn't always aware of his imminent blurting when he received a signal, which could either indicate false positives or unawareness of his blurting behaviour. This might pose a limitation of the study; we cannot be sure if signals were false or not. However, it may also indicate the potential value of BlurLine: children indeed seem unaware of their blurting behaviour right before they are about to blurt. BlurLine may thus assist them recognizing the signals that indicate impending blurting. A potential risk of using devices such as BlurLine is that it may have a stigmatizing effect for the user. During the field study this did not seem the case, nor did the participant's mother or teachers observe negative effects. Despite the small scale and exploratory nature of the study, we believe this is a promising finding, which deserves more exploration in future work.

## 5. Conclusion

This paper presents BlurLine, a belt designed to support children with ADHD, who show impulsive speaking behaviour (blurting), thereby unintentionally interrupting their own learning process in the classroom. BlurLine provides tactile feedback at moments the wearer is about to blurt, potentially enabling them to regain control of their behaviour. Two exploratory studies with a prototype version of BlurLine indicated that (1) BlurLine can accurately measure rapid inhaling, a precursor for blurting, when worn around the chest, (2) the 8-year-old participant in our field-study positively experienced wearing the prototype and was encouraged to consciously think about his speaking intentions and (3) no stigmatizing effects were found. While exploratory, we believe these findings are encouraging future research in which BlurLine would be used for a longer period, by a larger number of children in a classroom. Considering increasing diversity among students in classrooms, this paper contributes by laying out an opportunity to support children with ADHD to improve their learning experience and increase their ability to reach their full potential in regular education.

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