REAL-TIME EMBEDDED TRACKING OF PATIENT REPORTED VOCAL DISCOMFORT IN PROFESSIONAL SETTINGS

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Abstract: The aim of the present study was to evaluate patient-report of vocal discomfort by means of a portable device, designed for the continuous assessment of voice disorders with real-time coupling of acoustic and patient self-evaluation measures. 10 teachers were equipped with the portable device embedding our vocal discomfort software during 3 days in their professional settings. They had to note their vocal discomfort during the day on a visual analogue scale (VAS) ranging from 0-100 units, either spontaneously, or following an auditory prompt. The adequacy of the device and of the software was evaluated by a questionnaire addressing the wearability of the device, the easiness of the software, the adequacy of the scale and the subjects’ annotation behavior. The adequacy of the scale was further examined by the analysis of the vocal discomfort ratings and their change in value across time. The results show good wearability, easiness, and annotation behavior scores, subjects made regular annotations even without auditory prompting. The discomfort scores generally increased during a working day. The real-time embedded tracking of patient reported vocal discomfort in professional settings can thus be advantageously performed by a portable device, embedding our auto-evaluation software.

Keywords: Vocal discomfort, real time embedded tracking.

I. INTRODUCTION

Voice assessment is usually carried out in voice laboratories. Although it is advantageous because of the possibility to perform measures in a reproducible setting, the assessment is however limited for patients whose voice problems arise only in specific situations, as for example teachers in a working environment [1, 2]. The possibility to complete voice laboratory measurements with real-life assessments would be valuable in the diagnostic phase of a voice disorder, for treatment outcome evaluation and for patient monitoring purposes [3].

We are in the development phase of a portable device, designed for the continuous assessment of voice disorders with real-time coupling of acoustic and patient self-evaluation measures. The aim of the present study was to evaluate the adequacy of this device and the software developed on this platform for patient-report of vocal discomfort.

II. METHODS

Subjects were 10 teachers (8 women, 2 men), mean age 35 (Standard deviation - SD: 8,45). Two were teaching in kindergarten, four in primary schools and 4 in secondary school. All subjects judged their professional voice use as intense, none reported suffering from dysphonia. Each subject was equipped with the portable device, embedding our software allowing the notation of vocal discomfort. The notation is performed by the displacement of a cursor along a VAS ranging from 0 – 100 units divided in three colored compartments labeled “low”, “moderate” and “high”. A validation button has to be pressed to confirm the notation. The last two notations made by the subject were kept visible on the screen. The position of the cursor and the time in seconds is recorded continuously; every activation of the validation button is registered.

Subjects were tested in their professional settings for three consecutive weeks, always on the same day (eg: one subject was tested on three consecutive Mondays while another was tested on three consecutive Tuesdays). A condition where the subjects were asked to make their vocal discomfort notations spontaneously and a condition where they were reminded every 30 minutes by an auditory prompt were tested in a crossover design where subjects were randomly assigned to either group A (auditory prompt on the 1st 3rd week) or group B (auditory prompt on the 2nd week).

As the final objective of this project is to couple continuous audio-recordings with the auto-evaluation of the patient, a microphone was fixed on the subjects’ collar in order to test the entire device, although no
sound was recorded at this time of the study. Written and oral information on the use of the device and the software were given to each subject.

The adequacy of the device and of the software was evaluated by a questionnaire addressing the wearability of the device, the easiness of the software, the adequacy of the scale and the subjects’ annotation behavior. The questionnaire was answered each test day, answers were given on a 10 cm long VAS. The adequacy of the scale was further examined by the analysis of the vocal discomfort ratings and their change in value across time.

Moreover, subjects were asked to give us a duty roster for each of the test days where they also could report any comments that could be of interest regarding their vocal use.

III. RESULTS

A. General results.

All subjects were able to participate on the three days. 29 out of 30 questionnaires were returned. Discomfort notations were collected on 23 out of 30 days. 6 subjects exited the software by mistake during one or two test days. Subjects wore the device for a mean of 7,3 h (SD: 2h) and made a mean of 10,4 annotations per day (SD: 8,6), the mean interval between annotations was 49,4 min (SD: 28,1 min). Validations of the same vocal discomfort value that were made in an interval of less than 10 minutes were not taken into account, indeed subjects 2, 5 and 6 made abnormal amounts of validations in a short duration of time (up to 16 validations in the lap of 123 seconds), which was regarded as an artifact.

The auditory prompts were heard on 4 out of 15 days, and on 2 of those days, the subjects had exited the software by mistake. No computations regarding the prompt condition have thus been carried out.

B. Adequacy of the device and the auto-evaluation software.

The questions regarding the device’s wearability obtained a mean score of 6,8 each (SD: 3,5) (see Fig. 1).

The questions regarding the easiness of the software obtained mean scores of 8 (SD: 2,6), 7,1 (SD: 3,1) and 7,8 (SD: 3) (see Fig. 2).

The questions regarding the adequacy of the scale obtained mean scores of 7,9 (SD: 2,7), and 8,1(SD: 2,6) (see Fig. 3).

The questions addressing the subjects’ annotation behavior obtained a mean score of 5,6 (SD: 2,4) and 6,9 (SD: 3,1) (see Fig. 4).

B. Vocal discomfort measures.

Fig. 5 shows the mean discomfort value (computed on the three consecutive days) for each subject. On the first annotation of the day, the mean discomfort value over the subjects was 11,3 (SD: 10,5), and 41,1 (SD:
30,1) on the last annotation of the day. Subjects two, six and eight did not show an increase of their mean vocal discomfort value during the day.

Looking more closely at their answers (Fig. 6), we see that subject six and eight show overall null and flat vocal discomfort responses. Subject two has a similar answer pattern on day three but on day two, we see that there are increases and decreases of his vocal discomfort until the last hour of the day where it decreases below its initial value; this subject revealed having had a great vocal use on that day, apart from the last hour, where he kept quiet while his students made exercises.

Different patterns of vocal discomfort value changes during the day can be observed (Fig. 6), some subjects give flat responses that do not evolve during the day (subjects 8, 6 and subjects 2 and 7 on day 2), some subjects have responses that evolve in a saw tooth pattern (subject two on day three, subject seven on day one and three and subject two on day two and three) and some subjects have responses that evolves gradually over the day (subjects 1, 4, 5, 9 and 10).

We see that subject 6, 3, 9, 5 and 10 have consistent vocal discomfort patterns over the test days while subjects 2 and 7 have not. Subject 2 reported that he had a trainee on day 2 that did class instead of him while he had an intense voice use on day 1. Subject 7 indicated that there was a strike on day 2, she had less students than usual and reported less intense voice use on that day.

IV. DISCUSSION

The adequacy of the device and the software was confirmed by high wearability and easiness scores, the subjects did not find the device bulky nor annoying to wear, the cursor was reported easy to move and to place on the right spot and it was easy to remember validating changed discomfort values.

The adequacy of the scale was confirmed by high scores at the questions evaluating the scale, it was regarded as highly adequate for the notation of vocal discomfort and the labels were rated as helpful.
vocal discomfort values would be expected with a reduced vocal load after work. This study was done in subjects who reported no dysphonia, it will be interesting in future studies to observe how these values are impacted by a vocal disorder.

Although the auditory prompt was not heard in a majority of cases, frequency of annotations was high and a reminder does not seem to be needed to obtain regular ratings over a day.

Seven days of data were lost due to subjects exiting the software, the implementation of a password controlled lock could prevent for that in the future.

Several subjects made spontaneous comments about the fact that the device had helped them to get conscious of their vocal use during a day and of their vocal discomfort, which they had not been reflecting over before their involvement in the study. This indicates that our software could be useful not only for diagnostic and outcome measures purposes but also in the context of vocal load monitoring in vocal professionals.

V. CONCLUSION

The real-time embedded tracking of patient reported vocal discomfort in professional settings can be advantageously performed by a portable device, embedding our auto-evaluation software. This study confirmed the validity of the scale we have developed for the tracking of changes in self-reported vocal discomfort in voice professionals.

REFERENCES

