

Main title: Clinical evaluation of an app which measures speaking voice frequency in adolescent boys.

Short title: Boys' Voice and Puberty Study

Chief Investigators:

Professor Gary Butler, Department of Paediatrics and Adolescent Endocrinology, UCL Hospitals NHS Trust.

Professor David Howard, Department of Electronics, University of York.

Professor Martin Ashley, Liverpool Edge Hill University.

Background:

Maturation of the voice is an integral part of male puberty. The lowering or 'breaking' of the voice arises from the increased size of the larynx and in particular length of the vocal folds under the influence of testosterone, the male sex hormone. This lowering of the voice occurs in parallel with the general increase in height and weight-the growth spurt- and this is closely linked to the physical changes of puberty.

Aim:

The *SpeechTest* app has been designed by Prof David Howard to measure the average peaking voice frequency in males by asking them to perform a simple test-counting backwards from 20 to 0. The numbers are displayed on the screen to aid memory and to avoid issues of embarrassment especially if learning is delayed. It is intended that the accuracy of the app is validated in parallel with clinical evaluation of pubertal maturation during routine clinical examination in the outpatient clinic by a senior paediatric endocrinologist. This will allow the puberty ratings displayed on the app to be validated and adjusted so the voice frequency analysis can be used as a proxy assessment of pubertal status in future studies without the need for clinical pubertal staging, an awkward and embarrassing procedure when not required as part of a medical clinical examination.

Method:

100 boys attending the paediatric and adolescent outpatient department of University College Hospital will be invited to participate. They will be recruited principally from the endocrinology clinics as a formal clinical examination to evaluate the stage of pubertal development is a routine assessment. This examination is performed by a senior paediatrician/endocrinologist according to the internationally recognised scale Tanner stages of puberty. In addition the growth of the testes is measured in comparison with a set of beads, the Prader orchidometer, which also provides another standard measure of pubertal development.

A member of the study team will then ask the subject to perform the Speech Test using the app. This involves counting backwards from 20 to 0 with numbers displayed on the screen as a prompt. He and his parent(s)/guardian(s) will also be asked to perform their assessment as to in their opinion as to the extent of pubertal development that has taken place by means of simple instructions and line

diagrams using the validated approach of puberty phases promoted by the Royal College of Paediatrics and Child Health.

The participant will then be provided with a saliva (spit) collecting tube and package to collect a spit sample at home, first thing in the morning on the next day as soon as he wakes up. The measurement of testosterone in saliva is well validated and this avoids having to have a blood test for this research project. The sample can be posted back to us the same day for freezing at -20C. The steroid molecule is very stable and this approach has been used in multiple previous studies.

As this is a research project and not like a hormone test done in the clinic, no individual results will be available and all information will be used anonymously in the statistical calculations done. Any personal information we gather such as date of birth, height, puberty stage and voice pitch will be kept securely within the UCLH firewall and accessed by the study team only.

This is a voluntary study which we have designed to be fun to participate in, but potential participants may not wish to join in and can withdraw at any stage without a reason needing to be given.

Professor Gary Butler MD FRCPCH
Consultant in Paediatric/Adolescent Medicine and Endocrinology
Telephone: 020 3447 9455
Email: gary.butler@ucl.ac.uk

Steps of puberty: what point has been reached in the parent/guardian and participant's opinion?

1. **Prepubertal:** His voice is still like a young boy. He doesn't have any signs of puberty happening such as growth of the penis or testicles and no pubic hair has developed.
2. **In-puberty:** Changes to his body have begun with growth of the penis and testicles, and pubic and he might have got some armpit hair too. His voice is getting a bit deeper.
3. **Completing Puberty:** his puberty is well developed with a man-like penis, testicles and pubic hair. His voice is deep (often called broken) and he is developing a moustache and sideburns.