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To cite this article: Boaz M. Ben-David , Maya Mentzel , Michal Icht , Maya Gilad , Yehuda I. Dor , Sarah Ben-David , Micalle Carl & Vered Shakuf (2020): Challenges and opportunities for telehealth assessment during COVID-19: iT-RES, adapting a remote version of the test for rating emotions in speech, International Journal of Audiology, DOI: [10.1080/14992027.2020.1833255](https://doi.org/10.1080/14992027.2020.1833255)

To link to this article: <https://doi.org/10.1080/14992027.2020.1833255>



Published online: 16 Oct 2020.



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Challenges and opportunities for telehealth assessment during COVID-19: iT-RES, adapting a remote version of the test for rating emotions in speech

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ABSTRACT

Objective: COVID-19 social isolation restrictions have accelerated the need to adapt clinical assessment tools to telemedicine. Remote adaptations are of special importance for populations at risk, e.g. older adults and individuals with chronic medical comorbidities. In response to this urgent clinical and scientific need, we describe a remote adaptation of the T-RES (Oron et al. 2020; IJA), designed to assess the complex processing of spoken emotions, based on identification and integration of the semantics and prosody of spoken sentences.

Design: We present iT-RES, an online version of the speech-perception assessment tool, detailing the challenges considered and solution chosen when designing the telehealth tool. We show a preliminary validation of performance against the original lab-based T-RES.

Study sample: A between-participants design, within two groups of 78 young adults (T-RES, $n = 39$; iT-RES, $n = 39$).

Results: iT-RES performance closely followed that of T-RES, with no group differences found in the main trends, identification of emotions, selective attention, and integration.

Conclusions: The design of iT-RES mapped the main challenges for remote auditory assessments, and solutions taken to address them. We hope that this will encourage further efforts for telehealth adaptations of clinical services, to meet the needs of special populations and avoid halting scientific research.

ARTICLE HISTORY

Received 12 August 2020
Revised 30 September 2020
Accepted 2 October 2020

KEYWORDS

COVID-19; telehealth;
speech and hearing
sciences;
remote assessment

Dear Editor,

Social isolation measures (“lockdown”), as a global response to the COVID-19 spread, present new challenges for health care and research. Of special interest are older adults and individuals with chronic medical comorbidities, for whom strict social restrictions have been recommended (World Health Organization 2020). Inevitably, these restrictions are reducing the availability of medical services, and limiting clinical research focussing on populations at risk (Tuttle 2020). In an effort to offer access to necessary medical care, while maintaining social distancing, health systems have been encouraged to provide virtual medical care whenever possible (Wijesooriya et al. 2020). The COVID-19 crisis has also accelerated the need for assessment tools adapted to tele-medicine (e.g. the Montreal Cognitive Assessment test; Phillips et al. 2020) for both clinical and research purposes.

COVID-19 presents unique challenges in the fields of audiology, speech and cognitive sciences. For example, auditory tests are routinely conducted in sound attenuated booths, and the stimuli are presented and controlled (sound level, signal to noise ratios, etc.) by dedicated audio systems. These are not available in remote testing, mandated by COVID-19 social restrictions.

Overcoming these barriers is necessary to maintain adequate services and research with populations at risk. This calls for the adaptation of current assessment tools for telehealth.

In response to COVID-19 challenges, we conducted a remote adaptation (an online version) of a speech processing assessment tool, the Test for Rating Emotions in Speech (T-RES, Ben-David et al. 2016), that has been recently found to be an effective gauge for performance of individuals with auditory symptoms (e.g. tinnitus; Oron et al. 2020; Cochlear implant users, Tailtelbaum-Swead, Icht and Ben-David, submitted). The original T-RES was designed to assess the complex ability to process spoken emotions, based on the identification and the integration of information in the semantic channel (the meaning of the words) and the prosodic channel (tone of speech, intonation of voice, indexical cues). The T-RES has been used as an assessment tool for younger and older adults (Ben-David et al. 2016, 2019); with clinical populations: e.g. undergraduates with high functioning autism spectrum disorder (Ben-David et al. 2020); and adapted to different languages: English (Ben-David et al. 2016), Hebrew (Ben-David et al. 2019) and German (Defren et al. 2018). In this letter, we present the design of the T-RES remote version, iT-

Table 1. iT-RES telemedicine adaptation: Challenges and solutions in design.

Challenge	Solutions
Participant-related	
Audition	Participants were asked to perform the test in a quiet environment (e.g. shutting doors and windows). Recommended using personal hearing devices (e.g. hearing aids, personal sound amplification devices). Recommended using personal headphones/headsets, rather than speakers, to minimise environmental noise. The session began with practice trials (equivalent to the stimulus-set) to adjust the audio device to most comfortable listening level.
Vision	Recommended using personal visual aids if necessary (e.g. glasses). Used large and readable font, and highly discriminable colour contrasts. Tested the material on several computers and screens, finding the common denominator. Used a full screen mode, to avoid distractions.
Language	Performed the test in participant's native language. Verified language proficiency level (spoken and written), using a designated task or questionnaire.
Cognitive abilities	Divided the experimental session to relatively short tasks, to avoid fatigue. No response coding was performed by the participants, to avoid unintended dual-tasking. Considered the time of day at which the test was conducted (tailoring to the target population).
Test-related	
Technological issues	Designed the experiment to meet minimum system requirements (personal computer configurations, hardware specifications, and different browsers). Considering unstable internet connections – no connection was needed to perform the experiment (but for webpage download and final submission). The experiment could only be performed on a personal computer to prevent using mobile phones (inappropriate screen size and less-controlled settings). Avoided recording devices (microphone, webcam), due to the additional related ethical issues. Used a web browser, rather than a stand-alone app or file download, to avoid privacy risks and minimise technical challenges. Limited the use to specific web browser (the most popular ones), ensuring consistency. Asked participants to close all other open windows and apps, to avoid slowdown and pop-up notifications. Used a single identifying code, to ensure anonymity, no identifying information was collected by the system. Assigned a random code upon task completion to be sent to the experimenter before compensation.
Instructions	Used simple and short sentences, avoided professional vocabulary, and unfamiliar words. Demonstrated clearly how to input responses and correct mistakes. Added a visual symbol to indicate the presentation of auditory stimuli, in case sound is momentarily not audible.
Response	Allowed the use of either keyboard or mouse, according to personal preferences. Recorded response latencies (as performance may vary across the session), and total session duration (to monitor for break duration).

RES, with a careful consideration of participant- and task-related factors and an initial validation against the lab-based T-RES.

Method

A group of 39 participants (age: $M = 25.23$ years, $SD = 2.422$ years) were recruited during the months of May–July 2020. Their performance on the iT-RES was compared to the performance of an equivalent group of 39 participants (age: $M = 23.461$ years $SD = 1.619$ years) that completed the T-RES task in the lab, during the months of November–December 2019 (following the full procedure described in Ben-David et al. 2019). Participants in both groups were native Hebrew speakers, as assessed by a questionnaire, with no reported cognitive, auditory or visual difficulties, and no severe affective symptoms (stress, anxiety, and depression) as assessed by the DASS-21 (Henry and Crawford 2005). Participants were university undergraduates or their peers and received either partial course credit or volunteered for the study. The study was advertised on a designated campus website, and by word of mouth.

The current comparison used the Hebrew version. Stimuli include two sets of 15 spoken sentence with different combinations of prosodic and semantic emotions (anger, happiness, sadness and neutrality), pre-recorded by a professional female

actress. Participants were asked to rate how much they agree that the speaker conveys a predefined Target Emotion (anger, sadness, or happiness), in three separate tasks (rating the prosodic content; rating the semantic content; rating the spoken sentence as a whole).

T-RES

The study was conducted in a (sound proofed) lab, stimuli were presented using standardised equipment (computer, professional headphones). A research assistant was present throughout the session, reading instructions and aiding when necessary.

iT-RES

The novel remote version, iT-RES, is available at www.canlab.idc.ac.il/itres (Hebrew, English and German versions), developed using the PsyToolkit software (Stoet 2010, 2017; www.psytoolkit.org). The study was conducted in participants' homes, stimuli were presented using participants' own computers and auditory equipment, with no experimenter present. Table 1 presents the steps taken to minimise possible biases arising from participant- and task-related factors.

Results and discussion

Analyses used mixed-model repeated-measures ANOVAs (GLM) with average ratings as the dependent variable, Group (x2: T-RES vs. iT-RES) as a between-participants variable, and Target Emotion (x3: rating anger, sadness, or happiness) as a within-participants variable. Each test included one other within-participants variable. Analysing the data (participants' ratings), no significant group differences were found on the three main experimental factors: 1) Identification of the prosodic and semantic emotions - when participants were asked to *focus* on either the prosody or semantics. No group differences were found, comparing ratings for sentences in which the target emotion was present or not in the prosody or semantics, $F(1,76) = 2.358$, $p = .129$. 2) Selective attention - when participants were asked to *focus* on one channel and ignore the other. No group differences were found comparing congruent sentences that present the target emotion in both semantics and prosody, with incongruent sentences that present the target emotion only in the prosody or semantics, $F(1,76) = .017$, $p = .896$. 3) Integration - a prosodic bias, when participants were asked to rate the spoken sentence as *a whole*. No group differences were found, comparing sentences that present the target emotion in the prosody with those that present it in the semantics, $F(1,76) = 1.767$, $p = .188$. In sum, performance on iT-RES closely mimicked that found in the T-RES, replicating main trends. This is noteworthy, given the study design: comparing participants that performed the task in the lab before the outbreak of COVID-19 pandemic, with different participants that performed the online version at home, during the pandemic.

Conclusions

Given the prolonged nature of social restrictions due to COVID-19, specifically for populations at risk, scientific research activities are halted. This has far reaching effects on health services and scientific progress, with the risk of further marginalisation of vulnerable populations (e.g. older adults), calling for remote adaptations of clinical tests and scientific tools. Challenges are even increased in the field of hearing and speech sciences, given the sensory nature of assessments, and the special needs of clients and participants. The design of iT-RES, a remote speech processing assessment tool, maps the main challenges for remote auditory assessments, and solutions taken to address them. The challenges and solutions listed in Table 1 may assist researchers and clinicians in further adaptations in the fields of audiology (e.g. discrimination tests, speech-in-noise tasks) and speech-language pathology (e.g. oro-motor assessment, picture naming tests). Indeed, several studies already indicated the improved access to care with remote hearing assessments, screening and intervention (e.g. hearing aid verification, counselling; for reviews, see Swanepoel et al. 2010; Molini-Avejonas et al. 2015). Clearly, audiologic remote assessments may not be as accurate as those routinely gauged in clinical settings (e.g. audiometric thresholds). Such limitations should be considered in future telehealth adaptations.

Finally, we hope that this example will encourage a collective effort for telehealth adaptations of assessments and research.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Israeli Science Foundation [861/18].

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