# Face-to-face and radio communication in high-level background noise and field recording of weapon shots

*Final report for Callup #2 against Standing Offer W7719-135193*

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## Defence Research and Development Canada

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# Abstract

This report outlines the work performed under Standing Offer W7719-135193, Callup #2 entitled "Face-to-face and radio communication and sound source identification in high-level background noise from vehicles."

The work for this callup included (1) the debugging of software created for Callup #1, (2) multiple trips to Meaford to record impulse noise generated by two different weapons, (3) the creation of software to assist with the analysis of the weapon noise data, and (4) the creation of software to support the automated presentation of speech materials (specifically the Modified Rhyme Test and Speech Perception in Noise test) for protocols that were to be run in the Noise Simulation Facility located at Defence Research and Development Canada – Toronto Research Centre.

# Table of contents

# 1 Noise Simulation Facility (NSF) Software Upgrade

During this callup, existing software was modified in support of experiments that would be undertaken in the Noise Simulation Facility located at Defence Research and Development Canada – Toronto Research Centre (DRDC- Toronto Research Centre). The existing software had numerous bugs which were found and corrected. More extensive changes were also implemented, in order to accommodate a new protocol.

## 1.1 Software modifications in support of Protocol 2012-035

In compliance with the Statement of Work for Callup #1 software was developed in support of the implementation of Protocol #2012-035 – "The benefit of text for resolving auditory overload." While testing the first few participants, the researchers noted software errors associated with the running of a number of the experimental conditions. These problems were found and fixed.

## 1.2 Failed DVD Source

A failed DVD was found to be the root cause of distortion of recorded vehicle noise used in the experiments. The original recordings were consulted and a fresh copy of the noise source was created, as well as several backups. So that this problem would not occur in the future, modifications were made so that background noise used in the experiments would be presented in real time using software, in conjunction with an existing Tucker Davis Technology system whose main job has been the oversight of the timing and presentation of events during experimental trials. This approach removes the reliance on physical media and further enhances the system's reliability.

## 1.3 New software in support of speech-in-noise testing

New software was developed in support of future reiterations of Protocol #2014-040 – "Communication between native and non-native speakers of English in noise". The objective was to automate the presentation of two types of speech materials in noise and recording of participants' responses. Thanks to the structuring of the software used in Callup #1, it was a simple matter to implement the second protocol. This new protocol leveraged much of the existing software.

The new software collects and stores information about the participants, including ID, gender, age, military experience, native or non-native English speaker and handedness. For pairs of participants who qualify for the experiment, the software essentially runs the experiment, pacing the talker, presenting the talker with the speech materials, accepting responses from the listener and logging the results. The benefits include decreased workload for the experimenter with consistent, soft copy data from the participants, and linkage to existing statistical software.

# 2    Meaford Recordings

Travel to the 4th Canadian Division Training Centre Meaford was arranged to obtain recordings of gun fire from two weapons, the C7 rifle and 9 mm pistol. Recordings were made over a two-day period with the help of qualified shooters. Recording equipment, including an acoustic test fixture, blast probe, various ambient microphones, cabling and sound level meters were setup on the firing range.

A new portable sound recording system was purchased for use in the field. The system is called a 'SoundBook' and is a rugged laptop built for the purpose of carrying out portable recording of sounds. The system was set up at DRDC Toronto Research Centre and its capabilities were demonstrated by the supplier. The system was used at Meaford as the primary recording system for the gun shots.

Various conditions of gun fire, including the distance to the recording equipment, angle to the binaural head, and single vs multiple shots were carried out. The resulting recordings needed to be analyzed. Due to the quantity of data, some software was written to assist in the analysis. The raw waveform data was exported and processed through software to identify the peaks within the waveforms. Those peaks were then aligned in time for the purpose of comparing the recordings.

# 3    Conclusions

As a result of this callup, the Noise Simulation Facility at DRDC Toronto has become more capable. With two protocols available to experimenters, a more diverse range of experiments can be undertaken. Also proven with this callup is the structure of the software and how easy it was to add this new protocol. This makes the system more flexible for future protocols.

There is always room for improvement with software and the NSF is no different. There will always be new variations of protocols required in the NSF, but the basic setup of the system provides a flexible framework upon which to build any auditory protocol, with any sound source. This standing offer has shown how the system can be used and provides the grounding for all future work in the NSF, using the Tucker Davis System.

The NSF is a unique facility that supports complex research in communication in noise. The contractor, Garry Dunn, would like to thank Ms Ann Nakashima and Dr. Sharon Abel for the opportunity to contribute to this project and their support on this standing offer. It has been a pleasure working with both of you.

# List of symbols/abbreviations/acronyms/initialisms

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| NSF | Noise Simulation Facility |
| DRDC | Defence Research and Development Canada |
| TDT | Tucker-Davis Technologies |
| MRT | Modified Rhyme Test |
| SPIN | Speech Perception in Noise |