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Towards a Taxonomy of Vibro-Tactile Cues for Operational Missions

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Introduction

- Most of the **communication** between soldiers is handled via **audio** and **visual** devices [1].
- A possible **solution** is to add information in the **tactile modality** [2-4].
- In operational settings **tactile alerts** can:
  - **Enhance** user performance.
  - **Improve** transfer and processing of information
- Previous work with SMEs led to the identification of three key topics where having tactile cues can be useful during operational missions: Warning, Awareness or Orders [5].

Objectives

Our aim was to examine how users (infantry soldiers) perceive tactile cues in terms of implication and urgency during operational missions.

- Describe each cue's features and identify which type they have experienced (five cues were presented).
- Classify each cue to the most appropriate meaning: Warning, Awareness or Orders.
- Classify the most appropriate cue to each semantic meaning.

Method

Participants

15 undergraduate students (12 males). All were military reserve soldiers who have been on active duty during the year prior to the experiment.

Apparatus

Dome laboratory illustration (Figure 1a); Tactile interface, contains two tactors for a strap (Figure 1b); First person view of the operation mission in a virtual environment in the Dome laboratory (Figure 1c); Subjective Questionnaires

Experimental Design.

Five cues were designed (Figure 2), each participant was randomly exposed to three different cues out of the five. Presentation time gap between two succeeding cues was at least 3 minutes. Participants were asked to characterize the given cue and classify it, based on their subjective opinion, to one out of four categories: 'Immediate danger', 'Be aware'/'Pay attention', 'Give orders', or Else.

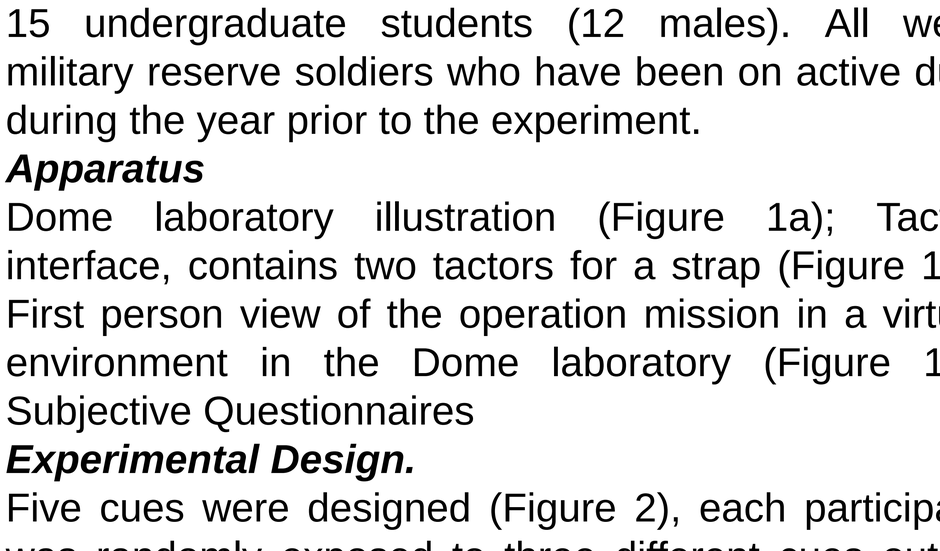

Figure 2. Illustration of the five tactile cues used in the study.

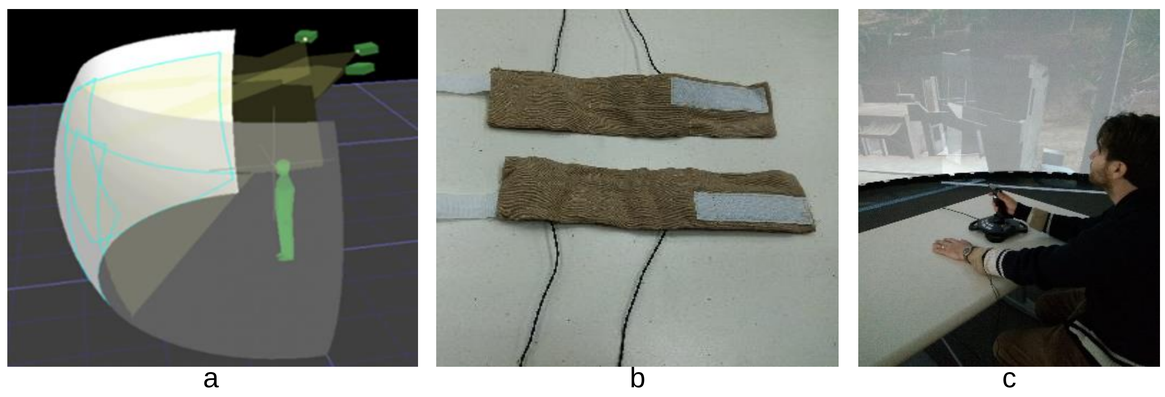

Figure 1. The experimental apparatus: a. Dome setup, b. Tactile wearables, c. The setup in the Dome

Results

Accuracy in identifying the tactile cue

This measure examines users' ability to identify the tactile cue during the virtual navigation mission.

Table 1. Cues' accuracy identification

What participants declared	What was displayed in practice: A	B	C	D	E
A	100%	77.8%	20%	44.4%	
B		11.1%			11.1%
C		11.1%	80%		
D				55.6%	
E					88.9%

Legend
A- Short intervals fixed intensity
B- Long intervals fixed intensity
C- Intervals with increased intensity
D- Intervals with decreased intensity
E- One continuous signal

Classification of cues to semantic meanings

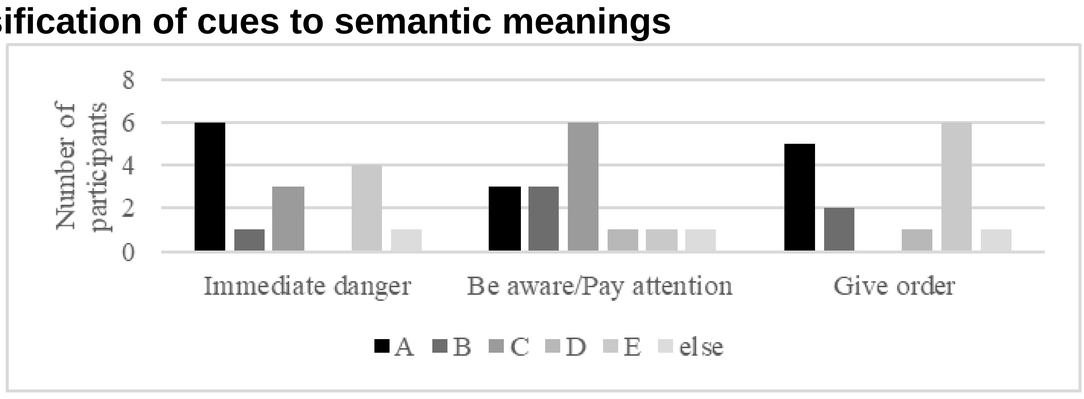

Figure 3. Subjective preferences for linking cues to semantic meanings

Discussion

The results showed consistent findings for semantic meaning and intuitive classification: immediate danger – short-intervals, general attention – increasing-intervals and specific order – continuous signal.

Future work should include:

- Examination of the suggested cue meaning while relevant events occur in the scenario under different conditions.
- Consideration of design challenges such as: specific tactile message for each topic and/or sub-topics.

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