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Interactive sonification for blind people exploration of geo-referenced data: comparison between a keyboard-exploration and a haptic-exploration interfaces

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Background

Representing geographical information in non-visual modalities is a complex problem that deserves special attention since this could be a way to facilitate the access of visual impaired subjects to this type of special information once proved the correspondence among the different sensory representation. Tactile maps and, more recently, on-screen text readers have sought to solve this problem but tactile maps are difficult and expensive to produce and text readers do not allow an analogical representation of information.
Recently alternative solutions have been found by using sonification (the use of nonspeech audio to convey information). iSonic, a prototype developed by the H.C.I Lab. at the University of Maryland brings a new interactive approach allowing users to navigate into acoustic sonificated maps. In iSonic each subject action on the map triggers sounds that inform about the placement and the features of a given region.
This sonification design allows two different kinds of map exploration: one using the computer keyboard (KB), the other one using a touch tablet (TT). KB exploration proceeds by discrete steps. Subjects can move through the map using the arrow keys. KB exploration is analytical, systematic, and symbolic. Differently, TT exploration allows users to move freely in every direction with no constraints. TT exploration is global, analogical, and leads to a more isomorphic representation of the map space.
Our research aimed at:
- Evaluating how well iSonic unable users to perceive and represent shapes and data patterns on maps.
- Assessing the effects of exploration methods (KBTT) on map knowledge acquisition and pattern recognition.

Method

Seventeen blindfolded sighted students completed four tasks of progressive difficulty. Sonificated and tactile maps were used as experimental stimuli changing in shape (task 4) or in the distribution of the different levels of the variable across the states (tasks 1, 2, and 3).
Subject started exploring for 3 min the sonificated map by means of a touch-tablet or a keyboard. Then they were presented with four tactile maps. One of them was equal to that one just acoustically explored and the other three were distractors.
The task consisted in identifying among the four tactile maps the one they previously heard during the exploration. They had to assign a value from 0 to 10 that rates each map for the probability of being the actual map they heard.

Results

Globally considered our results indicate that geographic

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map exploration by means of a sonification tool leads to a fairly good representation of the map. In fact rates of recognition of the target maps in the four tasks are, almost always, significantly higher than the rates of distractors. Only in task 1 we observed a distractor map to be confused with the target map. The confusion could be due to the great similarity between these specific target and distractor. Considering the relative effectiveness of the two kind of interfaces we found that in the easier tasks (1, 2, 4) Keyboard and Touch Tablet showed no differences in recognition performances. However, in task 3, the hardest one, in which subjects were asked to recognize complex patterns, it seems that the Touch Tablet having no direction constraints allows more accurate explorations, leading to higher scores of recognition.