

# brainbasher

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## introduction

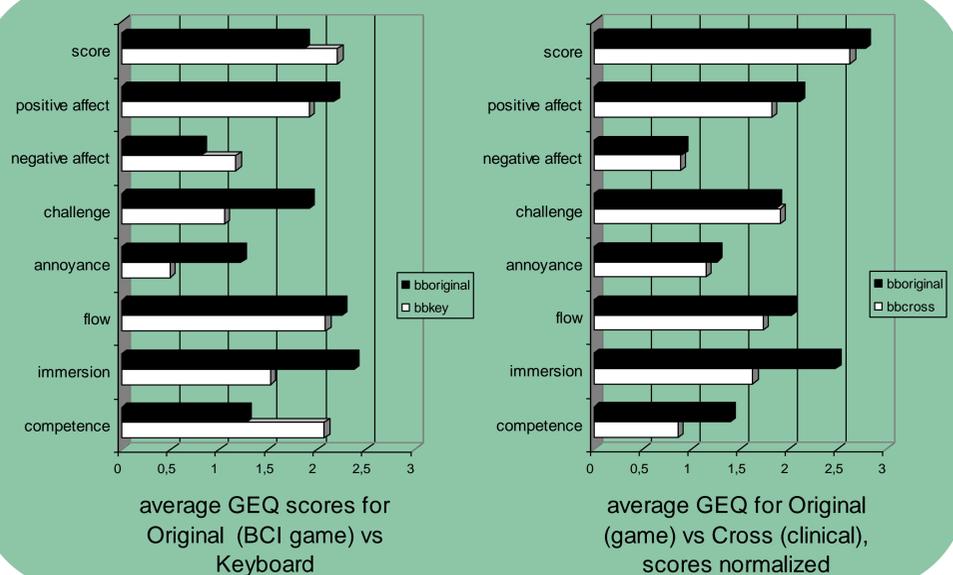
Brain-computer interaction (BCI) is starting to focus on healthy subjects. This research addresses the effects of using this novel input modality to control a simple game, and also looks into the beneficial effects of bringing game elements into BCI experiments.

## methods

BrainBasher, a simple BCI game, has been developed and evaluated with fifteen subjects using the Game Experience Questionnaire (GEQ) from the Eindhoven Game Experience Lab. Three variations of the game were evaluated for comparison: the original game with BCI input, one with keyboard input, and one with a more clinical look leaving out all extraneous information.

## results

The keyboard-controlled game was considered easy and boring, whereas using BCI for input resulted in a more challenging, immersive, and richer experience. The design and additional information presented by the game also resulted in higher immersion compared to the clinical design.



## conclusions

BCI as input modality can certainly add to the game experience, and vice versa: the effects game elements (like an explicit goal, scoring, feedback) can have on subject motivation during clinical experiments should not be ignored.



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## what is brainbasher?

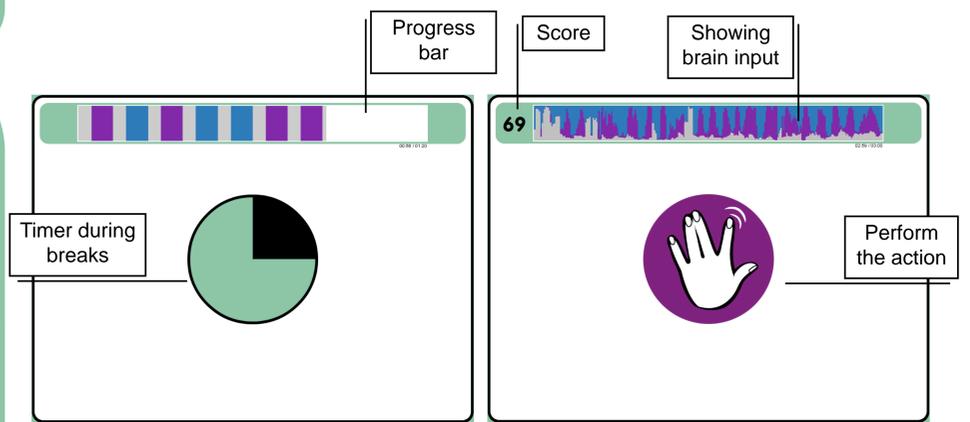
BrainBasher is a simple BCI game you can control with your brain. The goal is to perform specific brain actions as quickly as possible. For each correct and detected action you score a point.

## brain actions



Game control by two mental tasks:  
*Left hand imagery:* Imagine moving the left index finger up and down.  
*Right hand imagery:* Imagine moving the right index finger.

## session modes



The game consists of multiple phases: training and gaming. In the *training phase* the user is instructed to produce a given brain action. The signal is recorded and after a short break the next task is displayed. The data of the different brain actions is collected and the classifier is trained to recognize them during the later games.

For gaming the user can choose between the game and the free play mode. *BrainBashing:* The user has to perform given brain actions as quickly as possible for a high score. *FreePlay:* The user can perform brain actions freely while the system shows what it is detecting.

## data flow

The user executes the brain actions to control the game. The EEG recorder measures brain activity from 32 electrodes at 256 samples per second from the user's scalp. EEG analysis consists of preprocessing (bandpass filter), feature selection (CSP), and classification (LDA) to determine the user's actions. The application processes the incoming BCI control data and reacts accordingly, providing feedback to the user. Markers are added to the EEG for relevant UI events.

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