IBPoet: An Interactive & Biosensitive Poetry Composition Device

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UbiComp/ISWC'17 Adjunct, September 11–15, 2017, Maui, HI, USA

ACM ISBN 978-1-4503-5190-4/17/09.
https://doi.org/10.1145/3123024.3123176

Abstract
Through a digital interface and biosignal feedback, the IBPoet makes explicit the embodied and cognitive processes at play in everyday language interactions. A Reader reads a pre-selected poem to a Readee in front of an Audience. The Readee, who sits comfortably and listens to the poem, is instrumented with two primary biosensors: an OpenBCI Electroencephalogram (EEG) and an electromyogram (EMG) sensor. The Reader receives direct sensory feedback from these sensors in the form of a vibration band and heat gloves. Projected behind the Reader and Readee is the text being read, with keywords replaced by empty boxes. New words will appear that are selected according to the Readee's emotional state –thanks to an algorithm that interprets her/his biosignals. With the contrast and similarities between the spoken and projected poems, the Audience senses the emotional connection between the Reader and Readee as it shifts through states of resonance and dissonance, calm and stress.

Author Keywords
sensors; arts; language interaction; multi-modal interaction; social aspects; interactive system; emotion recognition; metaphors as interface.

ACM Classification Keywords
J.5.6. Computer-aided poetry composition; Literature.

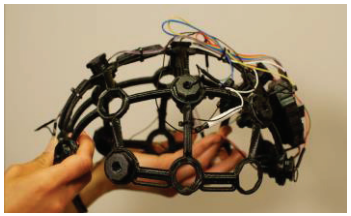

Figure 1 The OpenBCI EEG headset used to measure the PDR signal in the Readee.

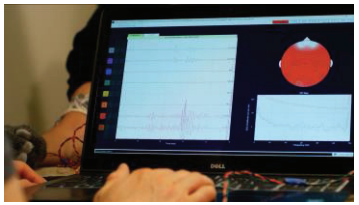

Figure 2 OpenBCI software running in Processing 3.1.2 is paired with the OpenBCI EEG to collect and filter the data.

Introduction

Have you ever played with a magnetic poetry kit on your fridge? The semantic constraint of creating poetry with a defined set of words is the analog inspiration of our project, IBPoet. IBPoet adapts this concept for modern technology by adding a digital interface and biosignal feedback. It curates a situation in which embodied metaphors are experienced in new sensory modes through the use of computers, projections, and biosensors. The result is that participants using IBPoet develop a deeper understanding of the effect of language on themselves and others.

Overview of the IBPoet Demonstration

IBPoet has three participants: the Reader, the Readee, and the Audience. The Reader sits with the Readee in front of the audience, where she or he will read a pre-selected poem. Sitting comfortably next to her/him with eyes closed is the Readee, who is instrumented with two primary biosensors: an OpenBCI EEG to detect the posterior dominant rhythm (PDR) as a measure of focus [Barry et al. 2007] and an EMG to detect deepness of breath as a measure of calmness. The Reader receives direct sensory feedback from these sensors in the form of a vibration band, which shakes proportionally to the Readee's breath rate, and heat gloves, which warm or cool in proportion to the amplitude of the Readee's measured PDR signal. As the Reader presents the poem out loud, she feels the Readee's emotional response.

Projected behind the Reader and Readee is the text of the poem, with key words removed and replaced with empty boxes. The Audience participates by observing the Reader and Readee, listening to the poem, and witnessing how a new poem is generated on the screen. Through the course of reading the poem, a new text begins to populate the empty boxes. The new words are selected based on the Readee's emotional state thanks to an algorithm on the computer that interprets his or her biosignals; the words are drawn from pre-populated word banks entered by the Readee before the demonstration and from the original words in the poem. With the contrast and similarities between the spoken and projected poems, the Audience senses the emotional connection between the Reader and Readee as it shifts through states of resonance and dissonance, calm and stress.

I am of old and young, of the foolish as much as the wise,
Regardless of others, ever regardful of others,
Maternal as well as [ ] a child as well as a man,
Stuff'd with the stuff that is [ ] and stuff'd with the stuff that is [ ]
One of the Nation of many nations, the smallest the same and the largest the same,
A Southerner soon as a Northerner, a planter [ ] and hospitable down by the Oconee I live,
A Yankee bound my own way ready for trade, my joints the [ ] joints on earth and the [ ] joints on earth,
A Kentuckian walking the [ ] of the Elkhorn in my deer-skin leggings, a Louisianian or Georgian,
A boatman over lakes or bays or along coasts, a Hoosier, Badger, Buckeye;
At home on Kanadian snow-shoes or up in the bush, or with fishermen off Newfoundland,
At home in the fleet of ice-boats, sailing with the rest and [ ]
At home on the hills of Vermont or in the woods of Maine, or the Texan ranch,
Comrade of [ ] comrade of free North-Westerners, (loving their big proportions,)
Comrade of [ ] and coalmen, comrade of all who shake

Figure 3 The text of the poem "Song of Myself" by Walt Whitman, processed and projected for the audience using the Processing programming language.

IBPoet is built primarily on open source hardware and software. To measure EEG signals, we use the OpenBCI Cyton Biosensing Board (**Figure 1** The OpenBCI EEG headset used to measure the PDR signal in the Readee.which is paired over a Bluetooth wireless link to a personal computer running the OpenBCI software (**Figure 2** OpenBCI software running in

Processing 3.1.2 is paired with the OpenBCI EEG to collect and filter the data.) in Processing 3.1.2. The analog EEG signals are measured and digitized on the Cyton Biosensing board, then transmitted to OpenBCI software where the data can then be digitally filtered, saved, and incorporated in other Processing scripts. For the PDR signal, we use EEG channels closest to the optical cortex, corresponding to channels 7 and 8 of the OpenBCI Cyton. We then filtered the data for PDR signals using a 7-13 Hz bandpass filter along with a 60 Hz notch filter to remove power line noise from the sensitive analog measurements. For the EMG sensor, we use MyoWare Muscle Sensor with Skintact F301 pediatric foam solid gel electrodes. The EMG sensor outputs analog signals which are digitized and processed together with the PDR amplitudes on an Arduino microcontroller; the Arduino then controls thermoelectric Peltier heaters/coolers and mobile phone vibration motors to provide biofeedback to the Reader.

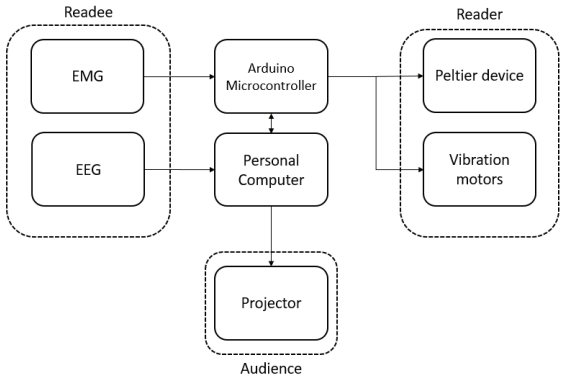

Figure 4 Overview of the IBPoet hardware

Conceptual Motivation

Metaphors are not restricted to poetry and fiction; they are abundant in everyday language [Lakoff and Johnson 1980]. The word "metaphor" originates from the Greek *metapherein*, "to transfer", and it can be described as the "surface realization of ... cross-domain mapping in the conceptual system" [Lakoff 1979]. A metaphor brings together ideas, experiences and thoughts through the use of a unifying image. These images create a shared, specific embodied response within the minds and bodies of both speakers and listeners. According to renowned psycholinguistic research professor Raymond W. Gibbs:

"[M]etaphor understanding allows us to imaginatively project ourselves into other people's minds and worlds. ... [This] imaginative engagement arises from metaphor understanding not as an after-the-fact reaction to metaphor, but as a fundamental part of how we ordinarily interpret metaphorical meaning. People may create embodied simulations of speakers' messages that involve moment-by-moment 'what must it be like' processes which make use of ongoing tactile-kinesthetic experiences." [Gibbs 2006]

How do we account for these tactile-kinesthetic, embodied responses that form the common ground of human subjectivity and linguistic interaction? This is the question the IBPoet seeks to address.

The Impact of the IBPoet

The IBPoet changes the experience of metaphor understanding in three ways.

The ethical dimension: By making the embodied response of the Readee visually and sensorially intelligible (through the projection, the vibration band and the heat gloves), the IBPoet offers new means of interfacing the Readee's subjectivity. This creates an

enhanced engagement with the 'other', symbolically represented by the Readee, which fosters empathy and attention to someone else's internal life.

The emotional dimension: By highlighting the psycho-physiological involvement of the Readee with the poem and its utterance, the IBPoet allows a deeper understanding of language's rhetorical dimension. The IBPoet calls attention to the emotional and cognitive effects of language that often go unacknowledged or remain implicit.

The pedagogical dimension: With the IBPoet, the text is understood as the literal poetic manifestation of someone else's physiological and cognitive states. The relation to the poem is changed as its empathetic power and emotional effects are revealed through the visual display (projection) and sensorial apparatus (vibration band, heat gloves). The IBPoet offers a new way to engage with literary material, making its physiological, emotional, cognitive and social dimensions explicit.

Conclusion

Metaphors are constantly used in everyday speech, creating strong embodied responses in both speakers and listeners that often remain unnoticed. The IBPoet reorders, remakes and ultimately transforms these metaphors into what is understood as being a translation of someone's physiological and cognitive states, making explicit a process that is at play in our daily interactions. As such, it has the potential to change the participants' understanding of an important "tool" we have for experiencing others' subjectivities, that is, language.

Acknowledgements

We thank the faculty of the University of Washington Center for Digital Arts and Experimental Media (DXARTS) without which this project would have never seen the light. Special thanks to Afroditi Psarra, faculty member of DXARTS and multidisciplinary artist, who encouraged us to apply to this conference. Gabrielle gratefully acknowledges the grant from the Nesholm Family Endowment Fellowship and the support from the University of Washington French and Italian Studies department.

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