

Fostering **creativity** in **learning**
through digital **games**



Creative Emotional Reasoning Computational Tools Fostering Co-Creativity in Learning Processes

www.c2learn.eu

EMOTIVE REASONING & EMOTION DETECTION COMPUTATIONAL TOOLS

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EXECUTIVE SUMMARY

C²Learn at a glance

C²Learn (www.c2learn.eu) is a three-year research project supported by the European Commission through the Seventh Framework Programme (FP7), in the theme of Information and Communications Technologies (ICT) and particularly in the area of Technology-Enhanced Learning (TEL) (FP7 grant agreement no 318480). The project started on 1st November 2012 with the aim to shed new light on, and propose and test concrete ways in which our current understanding of creativity in education and creative thinking, on the one hand, and technology-enhanced learning tools and digital games, on the other hand, can be fruitfully combined to provide young learners and their teachers with innovative opportunities for creative learning. The project designs an innovative digital gaming and social networking environment incorporating diverse computational tools, the use of which can foster co-creativity in learning processes in the context of both formal and informal educational settings. The C²Learn environment is envisioned as an open-world 'sandbox' (non-linear) virtual space enabling learners to freely explore ideas, concepts, and the shared knowledge available on the semantic web and the communities that they are part of. This innovation is co-designed, implemented and tested in systematic interaction and exchange with stakeholders following participatory design and participative evaluation principles. This happens in and around school communities covering a learner age spectrum from 10 to 18+ years.

About this document

Deliverable D3.3.1 reports on the design of the first version of the Emotive Reasoning Computational Tools that will be used within creative activities designed in C2Learn, in order to foster Emotive Lateral Thinking, as it is defined by the C2Learn theory for creativity. The document provides information on the different types of computational tools, indicates their conformance with the underlying reasoning theories, and presents details on the experimental design for training the components.

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LIST OF TERMS AND ABBREVIATIONS

Term/Abbreviation	Definition
CER	Creative Emotional Reasoning
LT	Lateral Thinking
LTC²	C ² Learn's Lateral Thinking
DLT	Diagrammatic Lateral Thinking

1. INTRODUCTION

C2Learn's Lateral Thinking (LTC²) theory is built on Lateral Thinking and Brainstorming Techniques. The term Lateral Thinking (LT) is invented in 1967 by Edward De Bono [1]. As he elucidates:

"The brain as a self-organizing information system forms asymmetric patterns. In such systems there is a mathematical need for moving across patterns. The tools and processes of lateral thinking are designed to achieve such 'lateral' movement. The tools are based on an understanding of self-organizing information systems."

"In any self-organizing system there is a need to escape from a local optimum in order to move towards a more global optimum. The techniques of lateral thinking, such as provocation, are designed to help that change."

In deliverable D2.1.x (Creative Emotional Reasoning), three kinds of LT are suggested: Semantic, Diagrammatic, and Emotive. In the context of the present deliverable, we elaborate on the Computational Tools related to the last of these kinds of LT, i.e. Emotive Lateral Thinking.

1.1 THEORETICAL BACKGROUND

The following subsections provide a brief analysis of the elements and techniques of Emotive Lateral Thinking, with respect to the process of identifying the type of computational tools needed to support them within a digital environment. For further details on the techniques, cf. deliverable D2.1.2, Creative Emotional Reasoning.

1.1.1 BASIC EMOTIVE REASONING PROCESSES

Emotive Lateral Thinking distinguishes between two levels of emotive lateral judgement, that is, the ascribing of emotive value in a given disruption element:

- ***First-order Emotive Lateral Judgement***: This type of Emotive Lateral Judgement is associated with the emotive impact of entities on a human actor. It, therefore, allows the identification of analogies between entities, in terms of their emotive impact, i.e. their *emotive value*.
- ***Second-order Emotive Lateral Judgement***: This second level at which emotive techniques operate deals with the alteration of the established rules for solving a problem, while being aware of the emotive response from other observers (the public, examiners, etc.).

1.1.2 EMOTION DETECTION TOWARDS EMOTIVE REASONING

In order to automate the process of identifying the emotive state for a human actor, it is necessary to establish a way of determining in real-time the emotive value of the entities that are the focus of the actor's attention, either as a creator or as a consumer. To this end, the proposed computational tools aim to automate emotion detection, based on specific characteristics of such entities. In general terms, the tools incorporate machine learning techniques for identifying the correlation between features of the examined artefacts and human emotive responses. The problem, thus, is essentially defined as a classification of the artefacts' features to classes representing known emotions. For the training phase of the machine learning experiment, we will use the Emotiv EPOC+ headset¹, a Brain-Computer Interface able to automatically detect the following range of emotions:

- Instantaneous excitement
- Long term excitement
- Frustration
- Engagement

¹ <https://emotiv.com/epoc.php>

- Meditation
- Interest/ Affinity



Figure 1: The EPOC+ Headset

Additionally, the EPOC+ headset recognises the following facial expressions, indicating the user's emotive state:

- Blink
- Wink
- Frown (frown)
- Raise brow (surprise)
- Smile
- Clench teeth (grimace)
- Glance
- Laugh
- Smirk

The training sessions will feed an appropriate configuration of the Weka framework [2], in order to produce the classification module that will associate features of the examined artefacts with the described emotive states. The following section presents the C2Learn tools that will realize emotion detection, describing the training process and the flow of the training sessions and the usage of the resulting classification modules.

2. EMOTIVE REASONING COMPUTATIONAL TOOLS

The C2Learn Emotive Reasoning Computational Tools Suite is designed to analyse different characteristics and behaviours in order to detect the emotive response of human actors associated with an artefact.

The first version of the suite comprises tools for detecting the emotive response of humans when creating and when accessing or viewing textual and pictorial artefacts.

2.1 EMOTION DETECTION OVER TEXTUAL ARTEFACTS

The core premise of the tool is that the emotive response of humans to a textual artefact is related to specific features of the text in hand. This section presents the experimental setup for training a component that identifies the emotions linked to a text, based on the latter's characteristics.

2.1.1 TRAINING PHASE

The human actors participating in the training phase are groups consisting of C2Learn consortium members. The groups participate in two distinct experiments.

During the first experiment, the groups are called to peruse a set of short texts under different topics and forms (formal documents, prose, poetry, etc.), while using the EPOC+ headset.

Human Actors: C2Learn consortium members

Training Data Set: Stories created under a specific topic

Features: Text Language, Sentence Number, Dominant Terms

Observations: Time series of emotive responses (Time intervals along with the dominant emotion for each interval)

During the second experiment, the groups are called to create a story under a predefined topic, while using the EPOC+ headset. The training component captures their emotive state while writing the story and associates that state with the text that is being written at that moment.

Human Actors: C2Learn consortium members

Training Data Set: The stories created by the human actors

Features: Text Language, Text Sentence

Observations: Time series of emotive responses (Time intervals along with the dominant emotion for each interval)

2.1.2 TEXT-BASED EMOTION ANALYSIS SERVICE

The trained module will be used as a service for indicating the emotive response of humans to a given textual artefact. The service accepts as input the said text, and a parameter indicating whether the emotive response of the creator or the consumer is requested. The service responds with an Emotion Vector, indicating the emotions emerging from the consumption of a text, along with their perceived intensity.

2.2 EMOTION DETECTION OVER PICTORIAL ARTEFACTS

The core premise of the tool is that the emotive response of humans to a pictorial artefact, i.e. an image, is related to specific features of the image in hand. This section presents the experimental setup for training a component that identifies the emotions linked to an image, based on the latter's characteristics.

2.2.1 TRAINING PHASE

The human actors participating in the training phase are groups consisting of C2Learn consortium members. The groups participate in two distinct experiments.

During the first experiment, the groups are called to peruse a set of pictures representing different object or abstract notions, while using the EPOC+ headset. The system then associates the sequences of pictures and the respective emotive changes observed.

Human Actors: C2Learn consortium members

Training Data Set: Set of pictures

Features: Image Colours, Image Semantics

Observations: Time series of emotive responses (Time intervals along with the dominant emotion for each interval)

For the second experiments, the users are called to use the C2Create tool to construct pictures given an initial theme. The training module records their usage of shapes and colours and associates it with their emotive response as reported by the EPOC+ headset.

Human Actors: C2Learn consortium members

Training Data Set: Stories created under a specific topic

Features: Image Colours, Image Shapes

Observations: Time series of emotive responses (Time intervals along with the dominant emotion for each interval)

2.2.2 IMAGE-BASED EMOTION ANALYSIS SERVICE

The trained module will be used as a service for indicating the emotive response of humans to a given pictorial artefact. The service accepts as input a representation of the said image, and a parameter indicating whether the emotive response of the creator or the consumer is requested. The service responds with an Emotion Vector, indicating the emotions emerging from the viewing or creation of the image, along with their perceived intensity.

3. CONCLUSIONS

The presented experimentation steps for the algorithmic design and the development of the C²Learn Emotive Reasoning Computational Tools aim to foster the Emotive Lateral Thinking techniques as defined by the theory, within C2Learn gaming environments.

The tools to be incorporated will be based on Machine Learning techniques that aim to discover correlations between textual and pictorial artefacts, and human emotive states. During the training phase, specialized equipment will be used to detect the emotion of the users during their activities and associate it with specific features of the artefact at hand. Subsequently, the trained components will be used in real-time gaming sessions in order to transparently detect the emotive state of the players.

The usage of the C²Learn Emotive Reasoning Computational tools within different C2Learn Games will be defined by the Game Design of each individual game. It is, thus, expected that as the Game Design evolves, the suite of Emotive Reasoning tools will be expanded and refined in order to adhere to the requirements of the relevant C2Learn games. The modifications on existing tools and possible additional tools will be reported in the next version of this deliverable, D3.3.2.

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- [1] LATERAL THINKING WORKSHOP – Thinking Tools, <http://edwdebono.com/debono/worklt.htm>, last accessed July 2013
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