In the Mood for Learning: methodology

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Ivon Arroyo, Benedict du Boulay, Ulises Xolocotzin Eligio,
Rosemary Luckin and Ka!ka Porayska-Pomsta

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Introduction

This technical report arose out of a workshop on Evaluating Affect organised by Rosemary Luckin and held at Bath in 2006. The workshop was concerned with the many interactions between affect and learning, and particularly with the implications of these interactions for the design of technology enhanced learning. One of the outputs of the workshop was a cooperative

1. CONTEMPORARY METHODS FOR AFFECT-RELATED KNOWLEDGE DISCOVERY AND EMOTION MEASUREMENT IN LEARNERS

Ka!ka Porayska-Pomsta[1], Manolis Mavrikis[1], Sidney DÕMello[2], Cristina Conati[3] and Ryan Baker[4]
[1]London Knowledge Laboratory, Institute of Education, London, UK
[2]Institute for Intelligent Systems, University of Memphis, Memphis, USA
[3]Department of Computer Science, University of British Columbia, Vancouver, Canada
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Introduction

This chapter of the Report considers the methods that are available for studying learner affect and for formalising the results of such studies in computer systems. Although most of the research methods that have been used before the advent of technology and affective computing are still in use (Coan & Allen, 2007), technology has brought with it new ways of studying the phenomena in question and, indeed, new questions. It has also opened the possibility of using the established methods in new ways, often in combination with emerging methodologies from data mining and machine learning. One of the major attractions of using technology to study affect in relation to learning is the fact that it allows us to build real-time dynamic models of affect in educational interactions (e.g. Conati & Zhou, 2002), to log such interactions and to test the models repeatedly and systematically.

This chapter intends to provide an introduction to the continuously changing methodological landscape of the current state-of-the-art in the field and ultimately to serve as a starting point for a broad spectrum of readersÕ methodological decision making in their own endeavours. The sections in this part of the report are also intended to illustrate the existing tensions between the different research perspectives and to demonstrate how these differences may be used constructively as a vehicle for a comprehensive exploration of the field.

Description of key methods

Researchers often have a wide choice of different methods through which to study learner affect. The choice that they make needs to be guided by the questions that they ask and the kind of technology that they want to design. Current research in the area can be broadly described in terms of two overarching goals that relate to (1) detection of learner affect and (2) acting on learner affect. The goals are related in that in order to be able to act on learner affect, it is necessary to know what the learner is experiencing at any given point, while choosing how to act involves the consideration of how the specific action will impact the learnerÕs affective and cognitive states. When translated into a typical design of a learning environment, the goals are motivated respectively by the need to inform the learner model component responsible for tracking the learnerÕs states, and by the need to know how to respond to the states that are being detected. Both goals are concerned with providing guidelines about the best design of technology-enhanced learning experiences, whereby ÒbestÓ is measured typically by the effectiveness of the learning outcomes.

The two overarching goals are approached by different researchers in different ways and typically involve a combination of traditional research tools such as questionnaires, self-reports and control measures, as well as purpose-built computational tools for accurate real-time data capture, such as interaction and decisions logs, and physiological sensors. Again the choice of a specific tool or a combination thereof depends on the exact research focus. For example, detection of learner affect often requires the researcher to identify the affective states that they want to model, to define them and to categorise them. In order to do this, it may be sufficient to rely initially on qualitative approaches such as self-reports from the learners or on teachersÕ annotations of the video and audio recordings of learners engaging in specific educational interactions. However, in order to be able to detect learner affective states in real time, additional tools are often required, such as physiological sensors and sophisticated inference mechanisms that are based on accurate information such as linguistic cues in learnersÕ verbal responses, mouse and keyboard actions, time spent on task, information about help-seeking behaviour, etc. A further consideration relates to how to act on the detected states to enhance the learning experience for individual learners and its effectiveness. Although often separated from the question of how to detect learner affective states, acting on affect is crucial because it inevitably influences the learnerÕs states during an interaction. Relying on human tutors/teachers as the source of information in relation to both detecting and acting on the diagnosis of their learnersÕ affect, is the obvious option. However, accuracy of human tutorsÕ inferences, effectiveness of their actions, their experience, and the ecological validity of the environment in which the data is collected are all, but not exclusively, issues to be consider32 (w) - 3 (s) 1 (295(v)] TJ ET Q q 45 0 0) 1 (29-4

approach ignores the possibility that some states cannot be differentiated using general

therefore impact on the number of reports that will be realistically generated. Introverted or shy learners will have greater difficulty in providing self-reports and may require additional prompting or specially designed materials to help them in the process. Such prompting may result in the greater level of intrusiveness and may bias the resulting reports. A further difficulty will be the ease with which the different emotion categories generated through self-reports may be reconciled across participants. The same emotions may be labelled differently by the participants and similarly, different emotions may be referred to by the same names. Therefore, post-processing of the data collected would

Case Study 1: WaLLiS

Mavrikis et al. (2007) used self-report during video-stimulated recall interviews. Learne were presented with replays of their ov interactions with an Interactive Learnin

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calculating inter-rater annotation agreements crucially depends on the same intervals being judged by multiple annotators, and therefore researchers managing such annotations should be aware of the importance that their in population (

set of judgments can be made at a given set of points to answer some theoretical question. At a

Case Study 3: Graesser et al. (2006)

One example of retrospective affect reportin
is the Graesser et al. (2006) study. In this
study, 28 students were tutored on topics in
Computer Literacy with an Intelligent
Tutoring System. Videos of the studentsÕ faces
and computer screens were recorded. Thes
videos were subsequently used in three follo
up analyses that were inspired by the
retrospective protocols. In one analysis, the
students themselves engaged in a retrospec
affect annotation task (retrospective self
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being that the tutors' input is particularly valuable when they have actually tutored the learners about whose affect they are asked t

Advantages and disadvantages of tutors reporting on affect

In contrast to data collected from annotators, collecting reports from tutors has the crucial, advantage of generating data that helps not only in diagnosing learnersÕ affective states but also in modelling pedagogy and designing appropriate responses to learnerÕs affect. In particular, it allows the researchers to link the tutor diagnoses of learner affective states, with the information that tutors rely on when performing such diagnoses, and with the way in which they act on such diagnoses.

The disadvantage of this method is that it imposes a significant cognitive load on the tutors. For example, in the most extreme cases, tutors are asked not only to tutor in real-time, but also they need to type in order to comm

Table 3. Summary of the instruments required during the tutor participant and the advantages and disadvantages of the method

Tutor participant annotation	Concurrent	Retrospective
Involves	Tutor reporting on student's affect during a computer-mediated tutor-student interaction	Tutor revisiting the concurrent annotati

methods. Validity in affect measurement is critical, because akin to most psychological variables affect is a construct (i.e., an inferred conceptual entity). Therefore, it cannot be directly measured and one can only approximate its true value. This approximation raises critical validity concerns in the measurement of human emotions. These include conclusion validity, internal validity, construct validity, and external (or

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available (Gunes & Pantic, 2010). Equally, the correspondences between the data obtained through physiological sensors, the emotions experienced and the effect that these have on learning for different individuals are yet to be established and validated across different learning contexts.

Behaviour sensing

Behaviour sensing relates to gathering data about behaviours, which, although observable, are difficult to record and sometimes register overtly with the Ònaked eye/earÓ. The behaviours in question involve eye pupil dilation, eye gaze and eye fixation, posture or acoustic characteristics of someoneÕs speech. All of these behaviours, individually and in combination, can be manifestations of a personÕs emotional states. Among the most frequently used behavioural measures are a variety of cameras able to detect a userÕs eye movement and eye gaze direction at any given point during a personÕs interaction with a system, posture chairs able to detect a personÕs posture while s/he engages in a task and computer mice able to detect the pressure of a personÕs clicks. With the advent of commercially available and affordable touch and multitouch devices, the pressure and the nature of touch, e.g. one or more fingers, whole hand, etc., can also be used for behaviour sensing purposes. Acoustic sensors are able to detect and analyse voice frequency, amplitude and tone.

importance of encouraging physical movement in children and their exploration of the different regions of the virtual space portrayed, this set up makes it difficult for the eye gaze tool to record all of the needed informationÐ

2. DESIGNING FOR AFFECT

Ivon Arroyo[1], Benedict du Boulay[2], Manolis Mavrikis[3]
[1]G-+'6*&)!/01&,0&!%&'()*+&,* 8<,1H&)71*5!-.!I(77(0:67&**8=+:&) 7*8!</=
[2]Human Centred Technology, University of Sussex, Brighton, UK
[3]London Knowledge Laboratory, Institute of Education, London, UK

and the ways and the points at which it can provide affective responses. So the chapter (i) categorizes different ways to take studentsÕ affect into account in the context of an educational scenario, (ii) describes work that has been done to promote desirable emotional states or traits, and (iii) identifies new areas of research.

This chapter examines several of the issues that need to be confronted when taking affect in the design of educational technology into account. It does not attempt to be a Òhow to do it guideÓ, but rather to elucidate the issues involved. The case-studies also play such an illustrative role. The focus of the chapter is on how macro-adaptive and micro-adaptive technologies can be designed to customize instruction to individual or group student affect dynamically. This is in contrast to systems that are non-adaptive dynamically and where any affective dimension of the interaction is fixed from the start and is the same for all users.

When designing technology for affect, it is important to consider three dimensions: (1) Categories of Technology, i.e., what kinds of technologies are being considered and their roles in relation to the student; (2) Degree of Adaptability, i.e., how adaptive or adaptable to affect the technology could or should be; and (3) How the System can Respond, i.e., the specific ways that the technology provokes or responds to student affect.

Categories of technology

When discussing affective technologies, it is important to keep in mind the kinds of learning technologies under consideration. There are two general categories: (1) Òtools for learningÓ and (2) Òlearner-centered learning environments.Ó

The first category Ð Òtools for learningÓ Ð involves systems that do not have an explicit teaching agenda or student model that dynamically drives the systemÕs behavior. Such tools might include those designed to facilitate collaboration between student and teacher such as chat forums, as well as programming languages like LOGO, hardware blocks such as Lego, or a simple browser to facilitate student research of a topic. In many cases the tools will have been designed to provoke specific affective reactions in their users. It should not go unnoticed that Lego blocks are bright colours, or that the looo(h) -1 (e3-3 (u (m)C4 0 0 -1 Ò(h) 1 (f) 1 (e(l) 3 Ó((h) -1 (o) -1 (f) 1 ((h) -1 ((h) -1 (v

Micro-adaptive Affective Technologies The third set of technologies along the continuum of adaptability are micro

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Take a moment to think of the ways in which designing for affect has impacted your lives. What comes to mind? Maybe an exciting

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Cognitive response to affect

Affective, cognitive and physiological states are intertwined (see e.g. Forgas, 2008). For instance, when a student tries to solve a problem that is proving challenging, the cognitive effort may also be reflected in feelings of fatigue, confusion or frustration, paralleled with signs of physiological stress. The extent of these feelings and ways of expressing them may depend on the individual.

Such responses are not necessarily negative. Indeed Forgas (2007) argues that certain kinds of cognitive activity are enhanced when someone i(e) 1 (d 2ecer Tf) -424 (s) 1 (o) -1 (m) -6 (eo) -1 (n) -

Non-technological design

Rosiek (2003) reports on examples of ways that teachers have organised and framed lessons so as to provide emotional scaffolding to students. These lessons were taught by human teachers and computers were not involved. The reason for including this case study is that it indicates future directions that the design process for learner-centered learning environments might go. Please note that the following is our interpretation of RosiekÕs work.

[redacted] Explicit	3. An effort is made to foster a constructive emotional response to the subject matter by drawing attention to it and offering students reasons why the effort to learn it is worthwhile	4. An effort is made to undermine an unconstructive emotional response to the subject matter by drawing attention to these emotions and making light of it or assuring students it is Òr as bad as it seemsÓ

Designing around goal orientation

The next case-study looks at issues around how collaboration between pupils can be affected by their individual goal orientations and how the technology supporting the collaboration can take that into account.

Creating contexts for productive peer collaboration: some design considerations

Amanda Carr (nee Harris)", Rosemary LUCKIN# and Nicola YUILL[3]

"School of Human and Life Science, Roehampton University, UK
#London Knowledge Lab, Institute of Education, University of London, UK
>CHaTLab, Department of Psychology, University of Sussex, UK

(adapted from Harris, Yuill, & Luckin, 2007)

task and individual perceptions of what might constitute success on that task.
On the other hand, the mastery-oriented child may find a collaborative context more appealin they are more likely to view peers as sources of information rather than as a threat competence beliefs (

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significantly more likely to use external help than children in the mastery group (x#(1) = 7
<0.01) but no difference between groups in use of task-focused help.

Discussion

In both studies, mastery goals were associated with behaviours more conducive to productive interaction and more likely to promote learning. In Study I, the stronger childrenÕs maste
were, the more they engaged in constructive disagreements and the less they tended s
submit to their partnerÕs suggestions. In Study II, mastery goals were associated with con
problem-solving which involved providing justifications and explanations for suggestion
both studies therefore mastery goals appeared to engender a willingness to engage in a f p

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Help-seeking: Children pursuing performance goals will tend to look for help that offers solutions and also provides reassurance.

Complex problem-solving: Children pursuing mastery goals tend to engage in more complex problem-solving in which they provide justifications and explanations for their suggestions. One approach which could be applied and which has been borrowed from asynchronous collaborative environments, is to provide sentence openers for participants to select in order to give the system an indication of the nature of the discussion (Robertson, Good, & Pain, 1998).

Disagreements: Mastery goals are more likely to be related to constructive disagreements. Recent developments in how collaboration is represented through technology, for example through interface design and hardware configuration (Kerawalla, Pearce, Yuill, & Harris, 2008), affords the possibility of monitoring both individual activity (through separate input devices) as well as the process of coordinating that activity (interface representations of agreements and disagreements).

Designing collaborative contexts

We identified earlier the difficulties many children have with engaging constructively in collaborative activity. In designing technology we need to be mindful of these difficulties and design in a manner that supports the *development* of collaborative skills. Our classroom observations suggest that mastery go

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The next case-study shows h

Figure 1. the Casey Learning Companion

The first step in proving tailored affective support is detection of users' affective states. To maintain as much as possible a natural interaction with the system, detection requires the use of non-obtrusive sensing devices. Such devices can obtain information about a user that is a natural by-product of that user's interaction with the computational system. Accordingly, the *Casey* agent is embedded in the Affective Learning Companion (ALC) platform (Burleson & Picard, 2004),

Tutorial interventions: affective vs. task-based. The agent generated one of two types of ve interventions (1) affect-based intervention (e.g., delivery of DweckÕs Òmind-is-like-a-muscleÓ message) or (2) task-based intervention, e.g., ÒAnother way to think about this is to think abo the small disks that are in the way. If you move these out of the way, you can move the you want to move.Ó

The evaluation corresponded to a 2x2 design with a total of four conditions (mirroring/af based intervention, mirroring/task-based intervention, pre-recorded behaviors/affect-based intervention, pre-recorded behaviors/task-based intervention), with participants assign randomly to the conditions. We now present the methodology and results. Here, we describe only the key aspects, full details may be found in (Burleson & Picard, 2007).

Methodology. During the study, the participants first completed a pretest to obtain inform on their theories of self-intelligence and goal-mastery orientation. Next, the Casey agent show slide show that introduced each participant to the study and to DweckÕs affective message using a script that Dweck has shown shifts childrenÕs beliefs about their own intelligence incremental self-theories. During the slide show, the agent either mirrored usersÕ behav relied on pre-recorded behaviors, depending on which condition the participant was assigne Following the slide show, the agent presented the Towers of Hanoi game, and instructed the participant to Òclick on a disk to start whenever you want, IÕll just watch and help if I can.Ó Each participant was given four minutes to engage with the activi142 (a4 (i) 4(h) 1 (o) 1 (4 (s)

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Toward addressing affective states with production rules

The next case-study looks at ways of both detecting and responding to studentsÕ affective states such as boredom, confusion and frustration as part of the family of tutors known as AutoTutor.

Casestudy: Affect-Sensitive AutoTutor

Sidney DÕMello
Institute for Intelligent Systems, University of Memphis, Memphis, USA

Introducing AutoTutor

AutoTutor is an intelligent tutoring system that helps learners construct explanations interacting with them in natural language and helping them use simulation environments (A.C. Graesser, Chipman, Haynes, & Olney, 2005; Arthur C. Graesser, et al., 2001). AutoTutor helps students learn Newtonian physics, computer literacy, and critical thinking skills by preser challenging problems (or questions) from a curriculum script and engaging in a mixed-initiative

feedback, tutor presents next question) and are used to predict the affective states of the
For example, boredom occurs later in the session, after multiple attempts to answer a questi
and when AutoTutor gives more direct dialogue moves (i.e. assertions instead of
Alternatively, confusion occurs earlier in the session, within the first few attempts to ans
question, with slower and shorter responses, low quality answers, when the tutor is less di
providing information (i.e. with hints instead of assertions), and when the tutor provides ne
feedback (DÕMello, Craig, Witherspoon, McDaniel, & Graesser, 2008).

Gross body language (posture features). We use the Body Posture Measurement System (BP
developed by Tekscanª, to monitor the gross body language of a learner during a tutorial s
with AutoTutor (see left panel of Figure 1). The BPMS consists of a thin-film pressure pads tha
are mounted on the seat and back of the learnerÕs chair. The system provides a real time
map of the spatial distribution of pressure exerted on the pads. The learnersÕ affective s

detecting boredom, confusion, flow, and frustration from neutral (chance=50%)

Evaluating the Affect-Sensitive AutoTutor

The affect-sensitive AutoTutor aspires to keep students engaged, boost self-confidence, and presumably maximize learning by narrowing the communicative gap between the emotional human and the emotionally challenged computer. In order to test whether an sensitive cognitive tutor is effective, we will compare two different versions of AutoTutor: o

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the text, tip-make-guess encouraged the use of guessing as part of a sophisticated meta-cognitive strategy, as a way of guiding guessing students to switch from gaming the system to more appropriate approaches. Students were addressed by their first name both in the messages accompanying the charts and the tips. Whether a student saw a progress chart or a tip, and which one, was a randomly-made decision.

Figure 1. Progress Charts show students their accuracy of responses from earlier in the session to recently

Figure 2. Tips in Wayang encourage good learning habits

Progress Tips: Study

Participants

Eighty eight (88) students from four different classes (10th grade students and some 11th graders) from an urban-area school in Massachusetts used Wayang Outpost for one week. Wayang Outpost was used in 4 class periods for about 2.5 hours of total tutoring (the rest of the time was spent doing pre-testing and post-testing). A second control group (called no-tutor control) consisted of matched classes of students who did not use the Wayang software at all, but were of the same grade level, [redacted] as possible to measure only the impact of progress charts and tips. Wang provided a fixed (not game) in the problem after the intervention than the control group, who did not see the intervention inwithout the interventions) and iii) No-

Survey question item	Tutor Interventions	Tutor Control

Designing to counter negative behaviours associated to boredom

This case-study describes a system that detects a specific learning behaviour During the system – that is indicative of a non-optimal learning strategy that has been shown to

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Figure 2. The Learning Gains Associated With Receiving Different Levels of Supplemental Exercises From Scooter

Figure 3. Left: The Learning Gains Associated With Receiving Different Levels of Supplemental Exercises From Scooter (Top Third versus Other Two Thirds). Right: The Learning Gains Associated With Different Levels of Harmful Gaming, in the Control Condition (Top Half of Harmful Gaming Versus O Students)

However, at the same time that Scooter was effective at reducing gaming, and a to increase some students' learning, there was evidence that students who re interventions from Scooter disliked the experience. Table 1 shows students' pre-post responses on questionnaire items relevant to their experience with Scooter (pre-test items are duplicates of post-test items, substituting the words "the tutor" for the "Scooter"). As can be seen, students generally thought Scooter was less smar regular tutor, and students who received more supplementary exercises or expres anger also

The earlier chapters in this book have set out some of the complexities of the emotional and affective dimensions of learning. These range from epistemological, psychological and neurophysiological issues about the nature of emotion and its relation to cognition, through to more social issues around the perception of self and others in learning situations. While build intelligent learning and teaching environments has a long history going back nearly half a century, taking affect directly into account in such systems has a much shorter pedigree.

This chapter has briefly categorised educational tools systems in te

3. HOW DESIGN INFLUENCE S EMOTIONS DURING TH E USAGE OF COLLABORATI VE LEARNING TECHNOLOGIES

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Ulises Xolocotzin Eligio[1], Shaaron E. Ainsworth[1] and Char

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Figure 3. A concept map showing the key features of concept maps (Cañas & Novak, 2006)

Concept-mapping environments are fairly generic, consisting of tools for the user to manipulate text boxes, lines and graphs. Other features might include functionalities to incorporate audio and video, and the possibility to collaborate at a distance. A typical concept-mapping tool can be employed to support learning in different domains (e.g., electricity, genetically modified organism), using with different tasks (e.g., free discussion of a topic).

A collaborative concept-mapping task usually consists of an open-ended discussion. For example,

with multiple mice for multiplayer co-located game play (Infante, et al., 2009) and handheld devices (Margolis, Nussbaum, Rodriguez, & Rosas, 2006)

Lastly, it is important to mention that some characteristics of computer games may also be counterproductive for collaboration. For example, the tempo of the game can be so fast that learners donÕt have time enough to discuss their strategies, or the amount and difficulty of the tasks to perform is so large that learners focus on playing a functional role rather than collaborating (Kiili, 2007).

How the task and technology might influence peopleÕs emotions during the usage of concept-mapping tools and collaborative educational games

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It is possible to speculate that, during the usage of a concept-mapping tool or an educational collaborative computer game, learnersÕ emotions might be influenced by the nature of the tasks that they are asked to perform.

During a typical collaborative concept

which depends on its appearance. The behavioural level refers to the feelings of control and understanding of a product, which depends on its functionality. The reflective level refers to aspects such as users' personal history and self-image. This level is not covered because is beyond the scope of this chapter. Finally, anthropomorphism refers to people's tendency to treat computers as if they were humans, which is a potential source of affective reactions.

Appearance

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The first level in Norman's (2004) model of emotional design is the visceral one. This level refers to how the perceptual properties of a product generate basic and automatic affective reactions in the user. This includes, for example, basic judgements such as good or bad, ugly and pretty. The perceptual properties of a product are mostly concentrated in its appearance. *Expressivity* and *aesthetics* a

Functionality
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was used to have dyadic data, easier to handle than data from triads. Table 5 compares the tasks

Table 5. Affective features and collaboration support the design of 2Connect and Astroversiy

	2Connect	Astroversity
	Underlying task	

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the quality of their interaction. Additionally some illustrative cases are presented to explore the relationship between emotional similarity and some qualities of collaboratorsÕ interaction.

Method

Participants

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50 unacquainted native English speakers participated in this study. Their mean age was 21.6 years. Recruitment and organization of participants was balanced to control for gender, although gender analysis was not an objective of the study. 60% of the participants were female and 40% male. They were randomly assigned to dyads in three configurations: female (11), male (6) and mixed (8).

less frequency and intensitythan other, more ÔpositiveÕ emot(o (e) -3tio

Table 6. Correlations between frequency and intensity in the Own Emotions questionnaire and the Partner Emotions questionnaire, during the use of 2Connect and Astroversity
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Results

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The results are sorted in three sections, one for each research question.

Effects of using 2Connect and Astroversity on collaboratorsÕ emotions

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To answer RQ1: How does using a concept-mapping tool and a collaborative educational game influence peopleÕs emotions?, analyses were made to test the emotional intensity of participants in 2Connect and Astroversity, as well as the differences in what participants attributed as sources of their emotions

Effects on emotional intensity

The analysis consisted of a doubly MANCOVA including the learning environment as within-participants factor with two levels (2Connect/Astroversity), counterbalance order as between

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Table 8. Means and SD of the intensity scores of the emotions happy, interested, challenged, hopeful, frustrated and bored

Table 10. Effects table for the 2 (Order) x 2 (Source) x 3 (Emotion) x 2 (Learning Environment) mixed ANOVA over the attribution scores

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Effect	$df_{(effect, error)}$	MSE	F	h_p^2
	Between-participants main effects			
Order	1,42	7.46		

Figure 6. Attribution scores for the partner, self and the activity as sources of emotions as a function of learning environment**.**

As for the Source x Emotion interaction, simple effects of source within emotions (i.e., attribution scores averaged across learning environments) indicated significant but relatively small differences between the participants' attributions to the partner, themselves and the activity as sources of hope [F(2,86)=19.47, MSE=.13, p<.001,h_p^2 = .31]. In contrast, participants made clearer differentiations between the sources of challenge [F(2.86)=60.19, MSE=.27, p<.001,h_p^2 = .58] and frustration [F(2.86)=49.18, MSE=.27, p<.001,

Table 11 shows the Means, Medians, SD's and Mean ranks of the affective similarity indexes of actual dyads and nominal dyads. As in the first analysis, the SD's are larger than the means and therefore, the data was analyzed with Mann-Whitney tests. There were no differences between the affective similarity indexes of the actual dyads and the affective similarity indexes of nominal dyads, neither in 2Connect ($Z=-.98$, $p=.32$) or Astroversity ($Z=-.91$, $p=.36$).

Table 11. Means, SD and Mean rank of the affective similarity indexes of actual dyads and nominal dyads in relation to the use of 2Connect and Astroversity

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	Actual (n=25)	Nominal (n=25)

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the use of 2Connect and sAdversity, they paid attention to aspects such as the emotional expressions of the partner, or that they accurately identified the events that affected their partnerÕs emotions.

Appendix A presents the extensive su

The relationship between collaborators' emotions and their interaction quality

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To answer RQ3: *What is the relationship between collaborators' emotions and the qualities of their interaction with a partner?* One analysis was made that assessed the correlations between

Illustrative examples of the relationship between emotions and interaction quality !

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The results presented above suggest that peopleÕs emotions are associated with their interaction quality. When partners reported mro happiness and less boredom they also rated their interactions more positively, regardless of the learning environment. Only in Astroversity, partners reported more frustration when they rated their interaction negatively. This complements other re7 (c) (te) -t

Table 15 shows the affective awareness indexes and the pseudonyms assigned to the members of the selected dyads.
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Laura:

High affective similarity

Low affective similarity

Intensity score: 0= not at all, 1 = slightly, 2= moderately, 3= a lot, 4 = extremely

Figure 10. Emotion profiles of dyads with high affective similarity (H1, H2) and low affective similarity (L1, L2) during the use of Astroversity

Interaction quality

Affective expressions. Partners in dyad L2 reported similar intensities of happiness and interest, but Sarah reported less interest and, in general, more negative emotions such as hope, boredom and frustration. Nevertheless, neither Sarah nor Sophie showed affective expressions. In Dyad L1, partners reported similar challenged and interest, but Arthur reported more happiness and negative emotions and showed more affective reactions than Armand.

Partners in dyads H1 and H2, who reported positive emotions similarly (e.g., more challenge and interest than boredom), frequently showed positive affective expressions. Partners displayed simultaneous affective reactions towards Astroversity, especially when animated characters gave them recommendations and feedback with expressive elements. For example, in H1, Peter and Paola made make jokes about the feedback of the game, as in the following extract:

> Peter: [reading the interface and smiling] *ok, brain damage but stable*
> Paola [smiling]: *but he's all right*
> Peter: [smiling] *what!?*

Sarah: [scanning] ok, so now this route is no longer safe
Sophie: [backchannel] mhh...
[É]
Sarah: the entrance is no longer safe
[É]
Sarah: where is the middle part?
Sophie: [backchannel] ermÉ
[É]
Sarah: [monologue, reacting to the interface] what?
Sophie: erm...

Coordination. Dyads H1 and H2 usually did the collaborative tasks of Astroversity with a clear role assignation, which helped them to coordinate their actions during the collaborative task of Astroversity. For example, in dyad H1, when Peter and Paola were scanning an alien presence, Peter

The partnersÕ response to one another also seemed to be related to the partnersÕ emotions Individuals whose partners showed little responsiveness (e.g., did not ask for, or elaborated on,

I "F"

The second methodological aim was to explore whether participants could differentiate between the intensity and the frequency of their emotions. That could have been useful to detail the collaboratorsÕ emotions more. However, the high correlations and small differences between the scores of frequency and intensity showed that participants did not differentiate between these aspects of their emotions. Therefore the study focused on intensity, as is common in emotion research.

How does using a concept-mapping tool and a collaborative educational game influence peopleÕs emotions?

!

The Introductio

Participants made a significant but small differentiation between the partner, themselves and the activity as sources of their challenge, hope and frustration whilst using 2Connect. The small differentiation is probably related to the fact that partners felt these emotions with low intensity, (lower than other emotions such as happiness and interest). In contrast, during Astroversity, participants made clear differentiations when rating t

What do collaborators understand about their partnersÕ emotions while using a concept mapping tool and a collaborative educational game?
!

It was found that in general, collaborators showed a tendency to ‘project’ their own emotion onto their partners. This suggests that collaborators based their understanding of their partner’s emotions on their own emotions. Probably collaborators did so to avoid effort at reporting the emotions of the partner. Or probably they did put effort at reporting the emotions of the partner but felt they lacked information to do so.

This is consistent with the bias in interpersonal perception known as the ‘false consensus effect’.

Appendix A. Regression analyses testing accuracy at reporting the partner's emotions

		Own				Partner			
		B	*SE*	*b*	*t*	*B*	*SE*	*b*	*t*
2Connect	Happy	0.52**	0.09	0.61	5.5	0.17	0.09	0.2	1.8
	Interested	0.40**	0.1	0.51	4.03	0.04	0.1	0.06	0.45
	Challenged	0.52**	0.11	0.55	4.54	0.003	0.115	0.004	0.03
	Hopeful	0.56**	0.14	0.5	4.04	-0.13	0.14	-0.11	0.92
	Frustration	0.33[1]	0.15	0.3	2.17	-0.07	0.15	-0.063	-0.45
	Bored	0.58**	0.12	0.55	4.7	0.20	0.12	0.2	1.68
Astroversity	Happy	0.36*	0.13	0.37	2.82	0.25	0.13	0.36	1.96
	Interested	0.30[1]	0.12	0.34	2.63	0.32*	0.11	0.36	2.8

ENDNOTE GENERATED REFERENCES FOR ALL CHAPTERS

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