

Addressing Affective States with Empathy and Growth Mindset

Ivon Arroyo

Worcester Polytechnic Institute
iarroyo@wpi.edu

Kasia Muldner

Carleton University
Kasia.muldner@carleton.ca

Sarah Schultz

Worcester Polytechnic Institute
sechultz@wpi.edu

Winslow Burleson

New York University
wb50@nyu.edu

Naomi Wixon

Worcester Polytechnic Institute
mwixon@wpi.edu

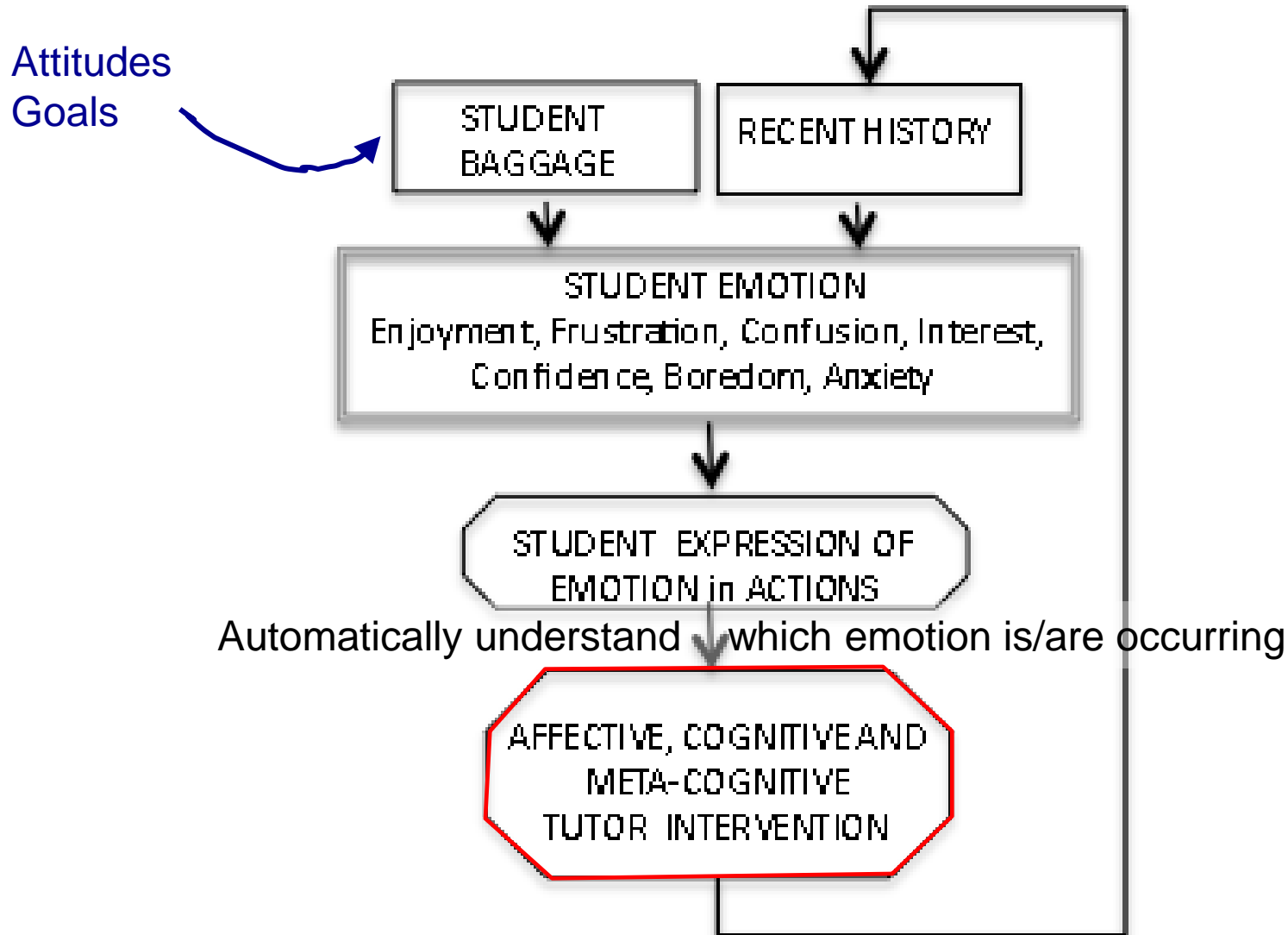
Beverly P. Woolf

University of Massachusetts Amherst
bev@cs.umass.edu



Emotionally Intelligent Tutoring Systems

NSF IIS/Cyberlearning: Collaborative Research: Impact of Adaptive Interventions on Student Affect, Performance and Learning. Arroyo (WPI), Burleson (ASU), Woolf (UMASS)



Affective Characters



Jane (Idea)



Jake (excited)



Jamal (confident)



Isabel (talking)



Luis (frustrated)



Latisha (interested)

Good vehicles for a variety of messages, students pay attention to them

MathSpring.org

Watch/listen to this example. Use 'Play Next Step' to move...

N=75 students in Southern California

What is:

$$\frac{4}{5} \div \frac{1}{3}$$

We can ask how many $\frac{1}{3}$ make $\frac{4}{5}$?

This is the same as asking how many $\frac{1}{3}$ are in $\frac{4}{5}$.

This is one of the meanings of division.

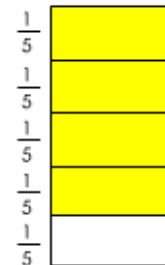
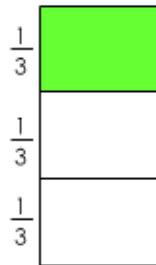
(A) $\frac{4}{3}$

(B) $\frac{1}{5}$

(C) $\frac{12}{5}$

(D) $\frac{4}{15}$

(E) $\frac{5}{12}$



Help



Read Problem



Hint



Replay Hint

Resources



Show Example



Show Video



Formulas



Glossary

Places



Preferences

Play next step

Done

What should characters say?

- We found positive results with general Growth Mindset Messages, and gender differences (Arroyo et al., 2013)
- D'Mello found successful results in Auto-Tutor with Empathy, in the second session (D'Mello et al., 2010).

Promoting
Learning/Mastery/Growth
Orientation (Dweck, 2002)

Did you know that when we learn something new our BRAIN actually changes?

It forms new connections inside that help us solve problems in the future.

Pretty Amazing, eh?



Main Question

Can we achieve positive results with empathic responses, contingent to frustration and anxiety (low confidence)?

- a) Middle School students in Public Schools
- b) We respond contingently upon the last reported emotion
 - **Self-reported** every 5 minutes
- c) Characters are less fancy than AutoTutor's:
 - 2-D and HTML based
- d) Are empathic better than growth mindset messages?

How to do it

- Positive Valence → reflect emotion
 - Visually, with a certain probability, at the beginning of each problem
- Negative valence → with a certain probability:
 1. Visually reflect negative emotion;
 2. Verbally report an empathy message such as “Sometimes these problems make me feel [frustrated]”
 3. a connector → “on the other hand”
 4. resolve with a growth mindset message : “I know that putting effort into problem solving and learning from the hints will make us learn and grow our intelligence”.

Ugh! I often get discouraged when struggling with a math problem

Although, I think that more important than getting the problem right is putting in the effort and keeping in mind the fact that we can all be good at math if we try.



Learning companion empathizing to self-reported anxiety in three stages: visual acknowledgement of anxiety (left); verbal acknowledgement (middle); connector and resolution via growth mindset message (right).

Experiment... and Results

Pre/Posttest data for N=37 only

Table 3. Means and Standard Deviations of total number of messages of different kinds, seen by students in each condition.

Condition	Total Empathy Messages Seen	Total Growth Mindset Messages Seen	Total Success/Failure Messages Seen
Empathy (N=14)	8.7 (3.0)	16.8 (7.4)	21.6 (12.1)
Growth Mindset (N=11)	0 (0)	20.9 (8.9)	28.8 (10.9)
Success/Failure (N=12)	0 (0)	0 (0)	33.7 (14.7)

Results

Table 4. Partial Correlations Between Specific Message Type and Post Test Measures for N=37 students, after accounting for the corresponding pre-test baseline, exposure to the tutor (time spent in tutor), and exposure to the characters (total messages heard of any kind delivered by the characters).

Variable Measured After Using MathSpring		Total Empathic Messages Seen ¹	Total Growth Mindset Messages Seen ²	Total Success/Failure Messages Seen ³
Learning	Math Post-Test Performance			
	Math Valuing Posttest			
Attitudes	Math Liking Posttest			
	Learning Orientation Posttest			
Goals	Performance-Oriented Goals			
	Frustration Posttest			
Emotions	Confidence Posttest			
	Anxiety Posttest			
	Interest Posttest			
	Boredom Posttest			
	Excitement Posttest			

+p<0.1, *p ≤ 0.05, ** p ≤ 0.01

But... why did that happen?

Behavior within Tutor Session

Variable Measured Within MathSpring (N=75)	Total Empathic Messages Seen	Total Growth Mindset Messages Seen	Total Success/Failure Messages Seen
% Probs. Solved on First Attempt			
# Problems Seen			
# Mistakes Made			
Hints seen / Total Problems			

+p<0.1, *p ≤ 0.05, ** p ≤ 0.01

Slow down more and be careful

Seek for hints and be careful

Be more Careless

Conclusions

- Characters who are empathic (to frustration and anxiety) are associated to higher learning
- Characters who are empathic help to reduce anxiety and boredom
- Characters providing a high proportion of success/failure messages induce boredom and anxiety.
- Characters who train Growth Mindset induce learning/mastery/growth orientation goals
- Mediating factor: a change in behavior
 - Slowing down in problem solving
 - Being careful
 - Seeking for hints

THANK YOU!

<http://tutor.mathspring.org/mathspring/mscontent/LearningCompanion/Jane/frustratedCombo1.html>

<http://tutor.mathspring.org/mathspring/mscontent/LearningCompanion/Jane/anxiousCombo2.html>

<http://tutor.mathspring.org/mathspring/mscontent/LearningCompanion/Jake/anxiousCombo1.html>

<http://tutor.mathspring.org/mathspring/mscontent/LearningCompanion/Jane/confidenceHigh.html>