

## Abstract

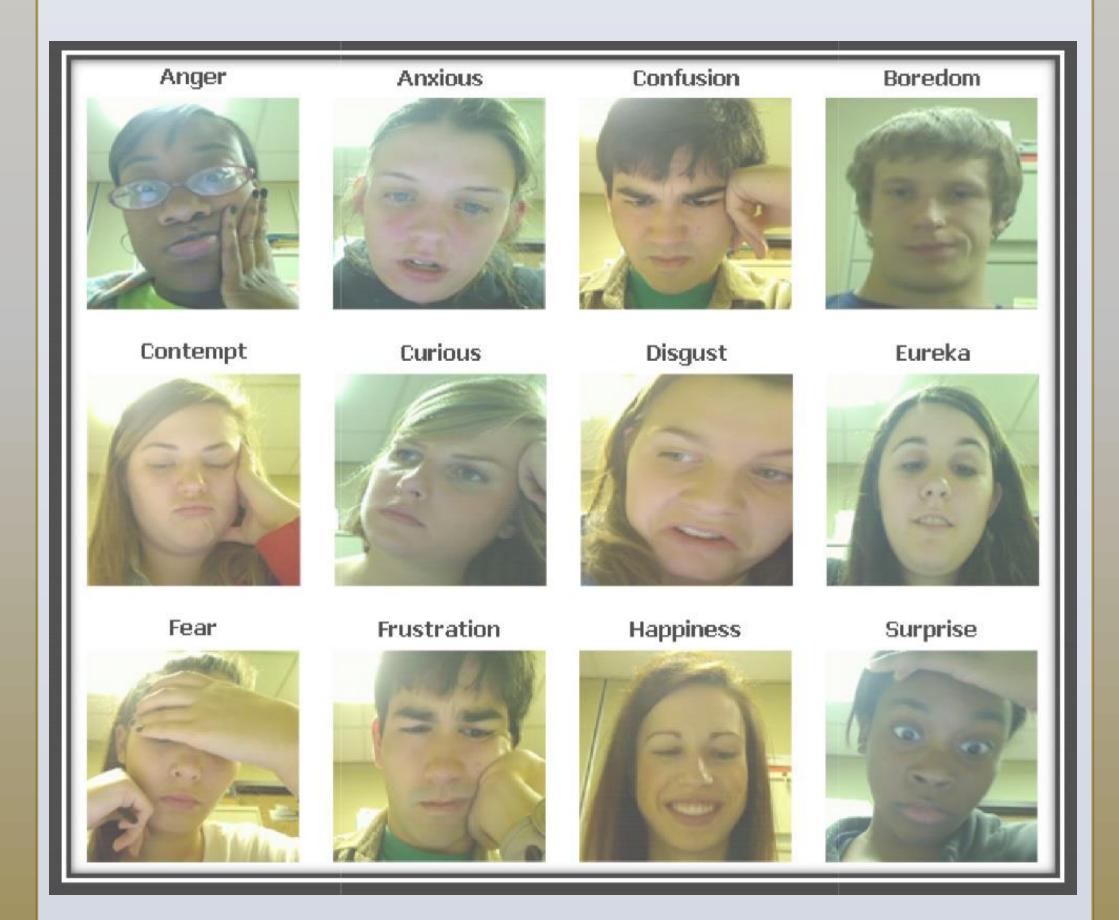
Research has shown that frustration and confusion are two of the most commonly occurring emotions during learning. The current study sought to explore any linguistic differences that exist between confusion and frustration. Computational linguistic analyses revealed differences in the characteristics between these two learning-centered emotions.

## Introduction

Until recently, most of what we knew about human emotion was a derivative of the pioneering work that had been conducted by researchers such as Charles Darwin (1872), Silvan Tomkins (1962), and Ekman and Friesen (1978). However, none of these works addressed anything beyond what we now refer to as the six basic emotions: anger, happiness, surprise, disgust, sadness, and fear.

Researchers are beginning to understand that emotions are not just motivational. It has now been suggested that emotions are inextricably linked to learning (D'Mello & Millis, 2014; D'Mello, Lehman, Pekrun, & Graesser, 2014). Researchers are now exploring what are called "learningcentered emotions" (Rodrigo & Baker, 2011). These learning-centered emotions consist of anxiety, boredom, confusion, curiosity, engagement/flow, frustration, happiness, and surprise.

The focus of this paper is on two specific learning-centered emotions: confusion and frustration. The reason that we are focusing on these two emotions is because research has suggested that both are prevalent in and important to learning (Baker et al., 2010; Craig et al., 2004; D'Mello & Graesser, 2011; Rodrigo & Baker, 2011a; D'Mello, Lehman, & Person, 2010; D'Mello, 2013).



## **Methodological Overview**

#### Data Subset #1

During a second larger study, an interpretative phenomenological analysis (IPA) of students' experience of frustration in the context of college-level science and engineering courses was used. Select portions of these interviews comprised our frustration corpus (N = 5) (Huff & Clements, under review).

# **A Computational Linguistic Analysis of Confusion and Frustration** Jeremiah Sullins, Ronnie Clements, Nicole Lemaster, & James Huff Harding University

## **Methodological Overview (cont.)**

#### Data Subset #2

Learners were given the goal of learning all they could about the human circulatory system in 40 minutes using Encyclopedia Britannica. During the session, learners were told anytime they experience confusion, they were to rate their confusion in real time on a 10-point Likert scale. For the current confusion analysis, we selected learners that ended the 40 minute session with a confusion score of 6 or higher. Learner posttest essay answers comprised our confusion corpus (N = 12).

## LIWC

LIWC reads a given text and counts the percentage of words that reflect different emotions, thinking styles, social concerns, and even parts of speech. LIWC indices addressing affective processes where chosen for the current analysis:

- Affective Processes: happy, ugly, bitter
- . Positive Emotions: happy, pretty, good
- 2. Negative Emotions: hate, worthless, enemy
- 3. Anxiety: nervous, afraid, tense
- 4. Anger: hate, kill,
- 5. Sadness: grief, cry, sad

**D** LIWC IOW IT WORKS COMPARE VERSIONS COMPARE DICTIONARIES INTERPRETING LIWC

> Your text sample is 68 words. The LIWC2015 analysis of the text sample you entered is below. If you entered more than 500 words, only were analyzed. Note that LIWC2015 actually produces about 90 different output dimensions. Always remember that the more text you have, the more trustworthy the results.

TRADITIONAL LIWC DIMENSION	YOUR DATA	AVERAGE FOR PROFESSIONAL CORRESPONDENCE
I-WORDS (I, ME, MY)	10.3	2.59
SOCIAL WORDS	16.2	9.42
POSITIVE EMOTIONS	5.9	3.91
NEGATIVE EMOTIONS	5.9	0.60
COGNITIVE PROCESSES	17.6	10.05
SUMMARY VARIABLES		
ANALYTIC	17.1	78.94
CLOUT	27.8	73.25

#### **Coh-Metrix**

An automated linguistic analysis tool used for computing computational cohesion and coherence metrics for written and spoken texts. The following indices will be used in the current analysis: Narrativity, Syntactic Complexity, Word Concreteness, Referential Cohesion, and Deep Cohesion. These indices are the focus of the current study because previous research has shown that these indices account for the majority of variability in text complexity.

Narrativity: Narrative text tells a story, with characters, events, places, and things that are familiar to the reader. Narrative is closely affiliated with everyday, oral conversation. This is highly affiliated with word familiarity, world knowledge, and oral language.

Syntactic Complexity: This component reflects the degree to which the sentences in the text contain fewer words and uses simpler, familiar syntactic structures, which are less challenging to process.

Word Concreteness: Texts that contain content words that are concrete. meaningful, and evoke mental images that are easier to process and understand

**Referential Cohesion:** A text with high referential cohesion contains words and ideas that overlap across sentences and the entire text, forming explicit threads that connect the text for the readers.

**Deep Cohesion**: This dimension reflects the degree to which the text contains causal and intentional connectives when there are causal and logical relationships within the text. These connectives help the reader to form a more coherent and deeper understanding of the causal events, processes, and actions within the text.

Created: September 1, 2012 Coh-Metrix 3.0 Last updated: June 02, 2014					
Title test	Save Data		Clear Data		
Genre Science -					
Source	No. Label	Label V2.x	Text 1 Full description		
Job Code 43 Descriptive					
LSA Space CollegeLevel	1 DESPC	READNP	1 Paragraph count, number of paragraphs		
re specialized to carry out different	2 DESSC	READNS	11 Sentence count, number of sentences		
asks. Red blood cells start their journey	3 DESWC	READNW	242 Word count, number of words		
n the right ventricle, and are pumped through arteries to the lungs where they	4 DESPL	READAPL	11 Paragraph length, number of sentences in a paragraph, mean		
re replinished with oxygen. Once the red	5 DESPLd				
lood cells are full of oxygen, veins arry them back to the left ventricle of		n/a	0 Paragraph length, number of sentences in a pragraph, standard deviation		
he heart. After that, the red blood cells	6 DESSL	READASL	22 Sentence length, number of words, mean		
re pumped once again out of the heart, nd this time, they travel through	7 DESSLd	n/a	9.033 Sentence length, number of words, standard deviation		
rteries and then smaller capillaries to	8 DESWLsy	READASW	1.55 Word length, number of syllables, mean		
ceplenish body cells with oxygen. In the same process, red blood cells collect	9 DESWLsyd	n/a	0.92 Word length, number of syllables, standard deviation		
arbon dioxide once they distribute their	10 DESWL1t	n/a	5.021 Word length, number of letters, mean		
xygen. They carry the carbon dioxide back to the heart, and the cycle begins again.	11 DESWLltd	n/a	2.443 Word length, number of letters, standard deviation		
hite blood cells also travel in the apillaries with the red blood cells and					
lasma (liquid portion of blood), and the		xt Easability Principle Component Scores			
hite blood cells help the body fight gainst diseases. White blood cells	12 PCNARz	n/a	-0.808 Text Easability PC Narrativity, z score		
igainst diseases. White plood cells lispose of harmful particles through the	13 PCNARp	n/a	21.19 Text Easability PC Narrativity, percentile		
process of phagocytosis. While the pirculatory system is composed of many	14 PCSYNz	n/a	-0.615 Text Easability PC Syntactic simplicity, z score		
ndividual parts that have specific	15 PCSYNp	n/a	27.09 Text Easability PC Syntactic simplicity, percentile		
unctions, they all work together to to ake sure that cells throughout the body	16 PCCNCz	n/a	2.521 Text Easability PC Word concreteness, z score		
re constantly supplied with oxygen, and	17 PCCNCp	n/a	99.41 Text Easability PC Word concreteness, percentile		
armful particles and waste is properly					
DataViewer Submit	18 PCREFz	n/a	2.433 Text Easability PC Referential cohesion, z score		
Data viewei	19 PCREFp	n/a	99.25 Text Easability PC Referential cohesion, percentile		
Reset	20 PCDCz	n/a	0.27 Text Easability PC Deep cohesion, z score		

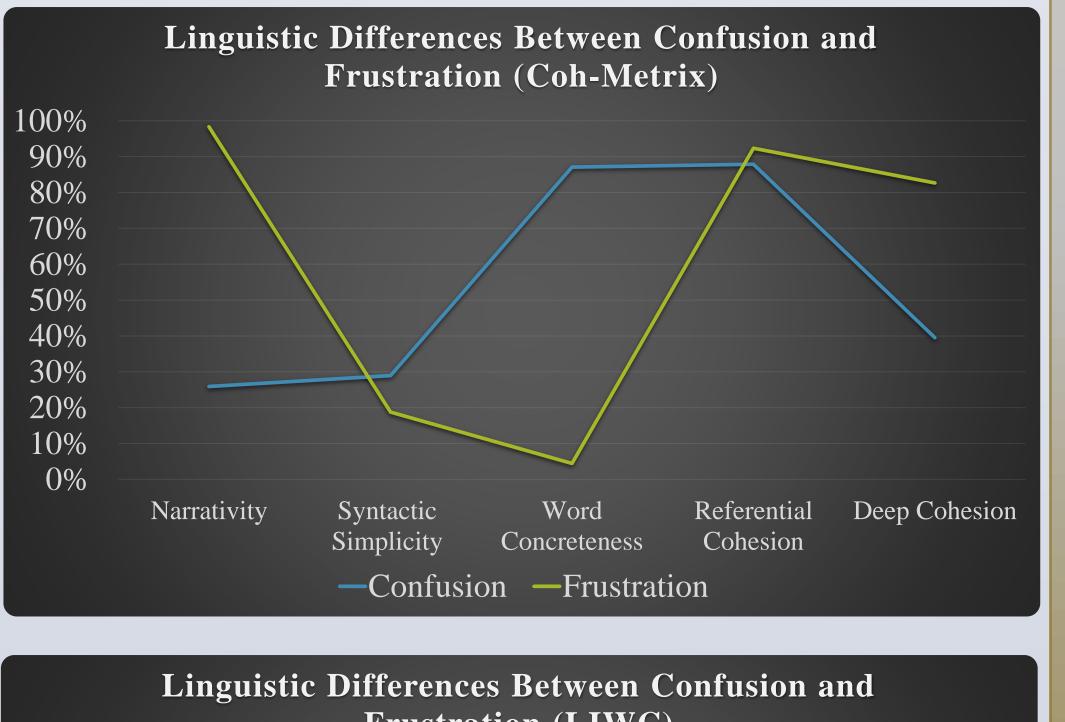


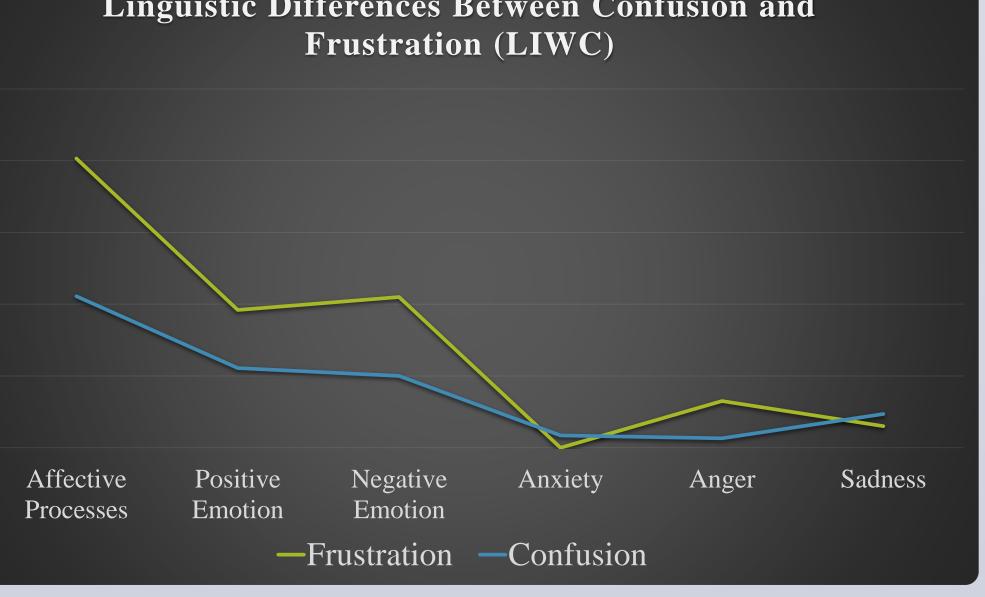
• Analyses revealed that frustration (M = 98.36) yielded significantly higher levels of narrativity compared to confusion (M = 25.90), t(11.218)=14.897, p=.000.

• There was a significantly higher amount of word concreteness found during confusion (M = 87.10) compared to frustration (M = 4.43), t(15) = -11.245, p = .000.

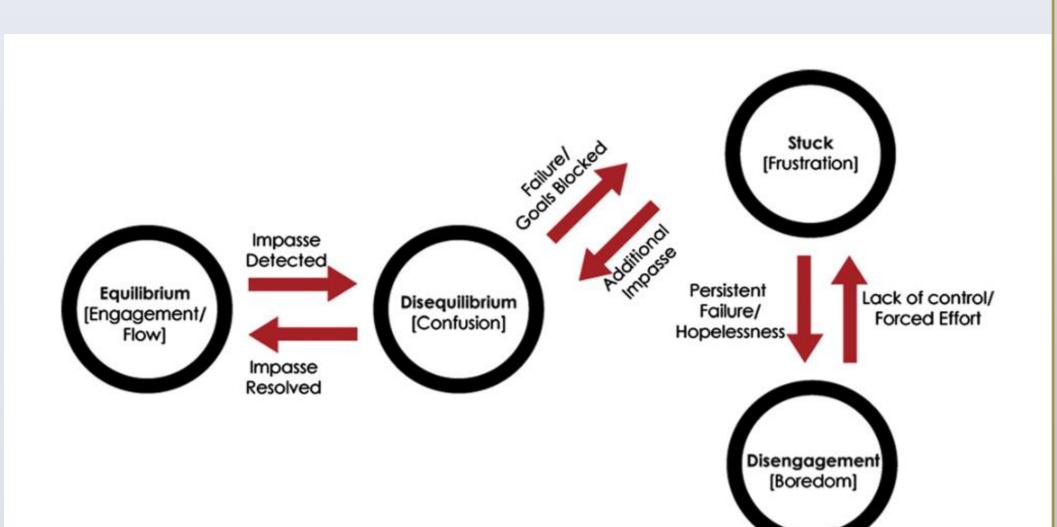
• Significantly higher levels of deep cohesion were seen during frustration (M=82.66) compared to confusion (M=39.52), t(14.97)=3.594, p=.003.

• No significant differences were discovered between confusion and frustration across the affective processes in LIWC.





- confusion.
- gains.
- being said.



*Emotion*, 25(7), 1299-1308. 38(1), 140-156. Instruction, 29(1), 153-170. Columbus, June 25-28, 2017.

Jeremiah Sullins, Ph.D. Associate Professor of Psychology Harding University 915 E. Market Ave. Box 12260 Searcy, AR 72149

Personal Website: http://sites.google.com/site/jeremiahsullins Lab Website: http://husaillab.wixsite.com/hucognitivestudies

# Center for Cognitive Studies HardingUniversity

## Conclusions

• There is an important distinction between "productive" and "hopeless"

• Simply placing a learner in a state of confusion may not be sufficient enough to promote deep conceptual change within the learner. In other words, more is not necessarily better.

• This lack of effectiveness could be due to cases of confusion being left unresolved therefore leading to a path of negative affect (e.g., frustration and boredom) which in turn could lead to negligible learning

• This important distinction between "productive" and "hopeless" confusion can largely be attributed to the presence of frustration.

• If an instructor is hoping to induce a state of productive confusion and believes that they have successfully done so through the manifestation of facial expressions, they are perhaps only seeing a partial picture of the learner's affective experience. The results from this study suggest that in order to rule out the unintentional presence of frustration, instructors need to look beyond just the presence or absence of behavioral manifestations and exam what is being said and how it is

#### References

Baker, R.S.J.d., D'Mello, S.K., Rodrigo, M.M.T., Graesser, A.C. (2010) Better to be frustrated than bored: The incidence, persistence, and impact of learners' cognitive-affective states during interactions with three different computer-based learning environments. International Journal of Human-Computer Studies, 68 (4), 223-241.

Craig, S., Graesser, A., Sullins, J., & Gholson, B. (2004). Affect and learning: an exploratory look into the role of affect in learning with AutoTutor. Journal of Educational Media, 29(3), 241-250.

Darwin, C. (1872). 1965. The expression of the emotions in man and animals. London, UK: John Marry. D'Mello, S. (2013). A selective meta-analysis on the relative incidence of discrete affective states during learning with technology. Journal of Educational Psychology, 105(4), 1082.

D'Mello, S. K., & Graesser, A. C. (2011). The half-life of cognitive-affective states during complex learning. Cognition and

D'Mello, S. K., Lehman, B. A., & Person, N. (2010). Monitoring affect states during effortful problem solving activities. International Journal of Artificial Intelligence in Education, 20(4), 361-389. D'Mello, S., & Mills, C. (2014). Emotions while writing about emotional and non-emotional topics. Motivation and Emotion,

D'Mello, S. K., Lehman, B. A., Pekrun, R., & Graesser, A. C. (2014). Confusion can be beneficial for learning, Learning &

Ekman, P., & Friesen, W. V. (1978). Manual for the facial action coding system. Consulting Psychologists Press. Huff, J. L., & Clements, H. R. (under review). The hidden person within the frustrated student: An interpretative

phenomenological analysis of a students' experience in a programming course. Proceedings of the 2017 ASEE Conference,

Rodrigo, M.M.T. & Baker, R.S.J.d. (2011) Comparing learners' affect while using an intelligent tutor and an educational game. Research and Practice in Technology Enhanced Learning, 6 (1), 43-66.

Tomkins, S. S. (1962). Affect imagery consciousness: Volume I: The positive affects (Vol. 1). Springer publishing company. VanLehn, K., Siler, S., Murray, C., Yamauchi, T., & Bagget, W. B. (2003). Why do only some events cause learning during human tutoring? Cognition and Instruction, 21, 209–249.

# **Contact Information**