A Computational Linguistic Analysis of Confusion and Frustration

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Abstract

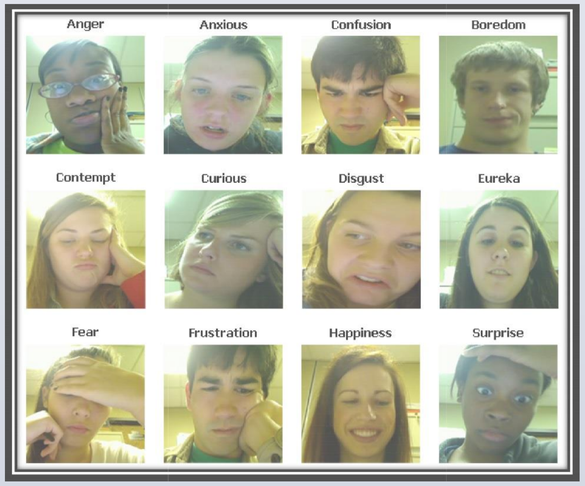
Research has shown that frustration and confusion are two of the most commonly occurring emotions during learning. The current study sought to explore any linguistic differences that exist between confusion and frustration. Computational linguistic analyses revealed differences in the characteristics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

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

1. 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

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.

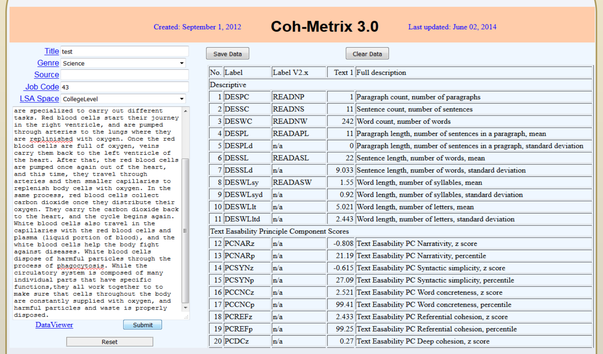
Narrativity: Narrative text tells a story, with characters, events, places, and things that are familiar to the reader. Narrative is closely affiliated with everyday, oral conversation. This is highly affiliated with word familiarity, world knowledge, and oral language.

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.

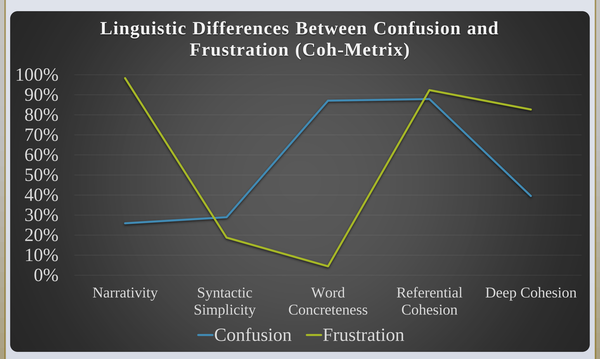
Referential Cohesion: A text with high referential cohesion contains words and ideas that overlap across sentences and the entire text, forming explicit threads that connect the text for the readers.

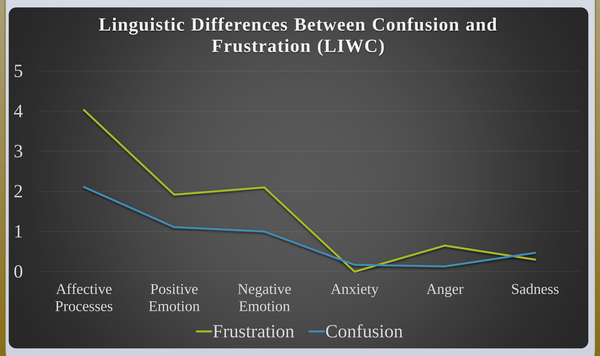
Deep Cohesion: This dimension reflects the degree to which the text contains causal and intentional connectives when there are causal and logical relationships within the text. These connectives help the reader to form a more coherent and deeper understanding of the causal events, processes, and actions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



Results

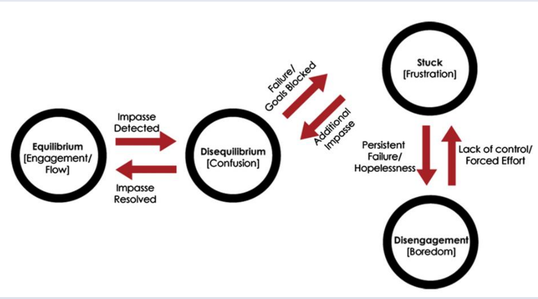
- Analyses revealed that frustration (M = 98.36) yielded significantly higher levels of narrativity compared to confusion (M = 25.90), $t(11.218)=14.897$, p = .000.
- There was a significantly higher amount of word concreteness found during confusion (M = 87.10) compared to frustration (M = 4.43), $t(15)=-11.245$, 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.





Conclusions

- There is an important distinction between "productive" and "hopeless" confusion.
- 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 gains.
- 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 being said.



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