The Relationship between Carelessness and Affect in a Cognitive Tutor

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Context of the Study

It has been hypothesized that a major factor driving carelessness is student affect, a hypothesis that accords with results showing links between affect and achievement goals [5]. Student affect has been shown to be associated with other behaviors indicating student disengagement. For instance, frustration [4] and boredom [3] were found to be associated with gaming the system, a disengaged behavior associated with poorer learning [2].

Objectives of the Study

- We study the relationship between student affect and carelessness, using two versions of Cognitive Tutor for Scatterplot generation and interpretation [2] – with and without an Embodied Conversational Agent (ECA) which responds to student gaming.
- We assess which affective states are associated with careless errors through correlational analysis.
- We examine whether the relationships between affective states and careless errors change over time.

Methods

- 126 public high school students in Quezon City, Philippines (PH), who used a Cognitive Tutor unit on scatterplot generation and interpretation [2] for 80 minutes. This topic was not previously covered in class. Student ages ranged from 12 to 14.
- The Cognitive Tutor had two versions: No-Scooter version (w/o ECA), and Scooter version (w/ ECA) [2].
- 64 students were assigned to Scooter Group, while 62 students were assigned to No-Scooter Group.
- Data on student carelessness from the Cognitive tutor, creating a carelessness detector [cf. 1].
- Data on student affect acquired from quantitative field observations [cf. 3, 7].

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Results and Discussion

Correlations of Carelessness and Affective State for Entire Tutor Usage.

	NoScooter group	Scooter group
Careless – Boredom	-0.29 (p = 0.02)	-0.41 (p = 0.001)
Careless – Confusion	-0.31 (p = 0.01)	-0.21 (p = 0.09)
Careless – Engaged Concentration	+0.47 (p < 0.001)	+0.49 (p < 0.001)
Careless – Frustration	-0.06 (p = 0.66)	-0.04 (p = 0.76)

- **Carelessness – Boredom: significant negative correlation.** This may be explained by a negative relationship between boredom and strategies that lead to learning (self-regulation, elaboration strategies, effort [6]). Boredom also has been found to be correlated with poorer learning in [6], so errors committed by frequently bored students may have stemmed from a lack of interest in pursuing knowledge, thus these errors were not committed out of carelessness.
- **Carelessness – Confusion: significant negative correlation.** This may be similarly explained by the students' lack of knowledge and his/her awareness of what he/she does not understand. Lack of knowledge is explicitly an implication that an error is not careless.
- **Carelessness – Engaged Concentration: significant positive correlation.** The more a student displays engaged concentration, the more likely he/she is to be careless, possibly due to overconfidence.
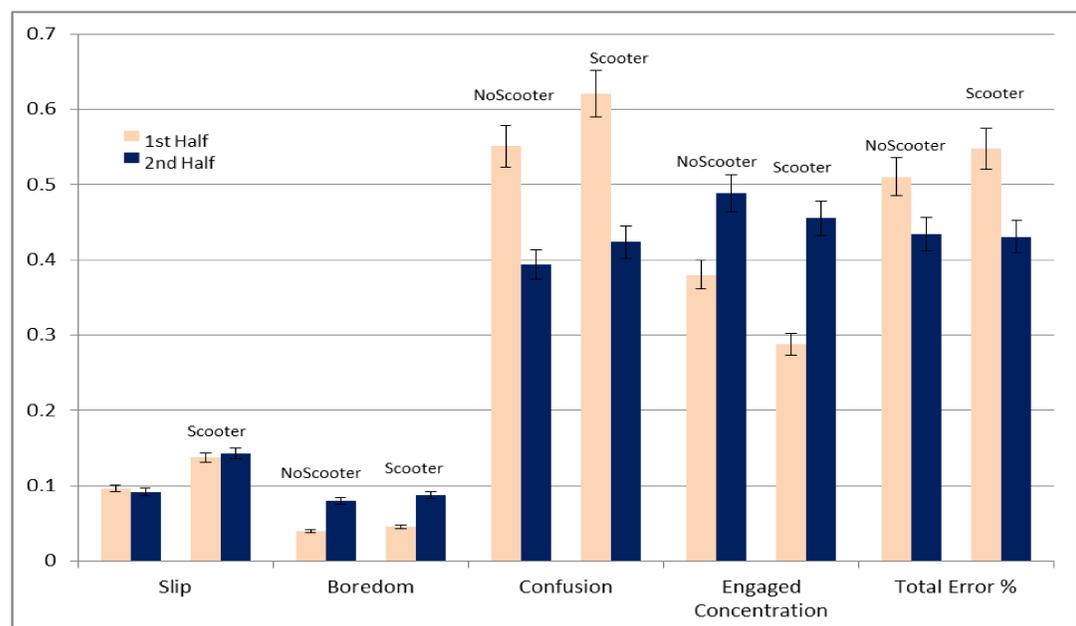
Carelessness, Affect, Error, By Time of Tutor Usage.

- Carelessness–Confusion correlation became significantly negative as students used the tutor more. But confusion decreased over time. Hence, the students who were struggling and remained confused even after tutor use for a substantial amount of time were less likely to become careless.
- Carelessness–Engaged concentration correlation became significantly positive as students used the tutor more. A student who is engaged most of the time may succeed, become over-confident, and then commit careless errors.

Affect and carelessness relations were stronger in the 2nd half of tutor usage than the 1st, possibly due to "honest" mistakes made during initial tutor usage in the Scooter condition, from genuine lack of knowledge and not out of carelessness.

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