A Motivated Look into Students' Affective Response to an Authentic Examination Experience

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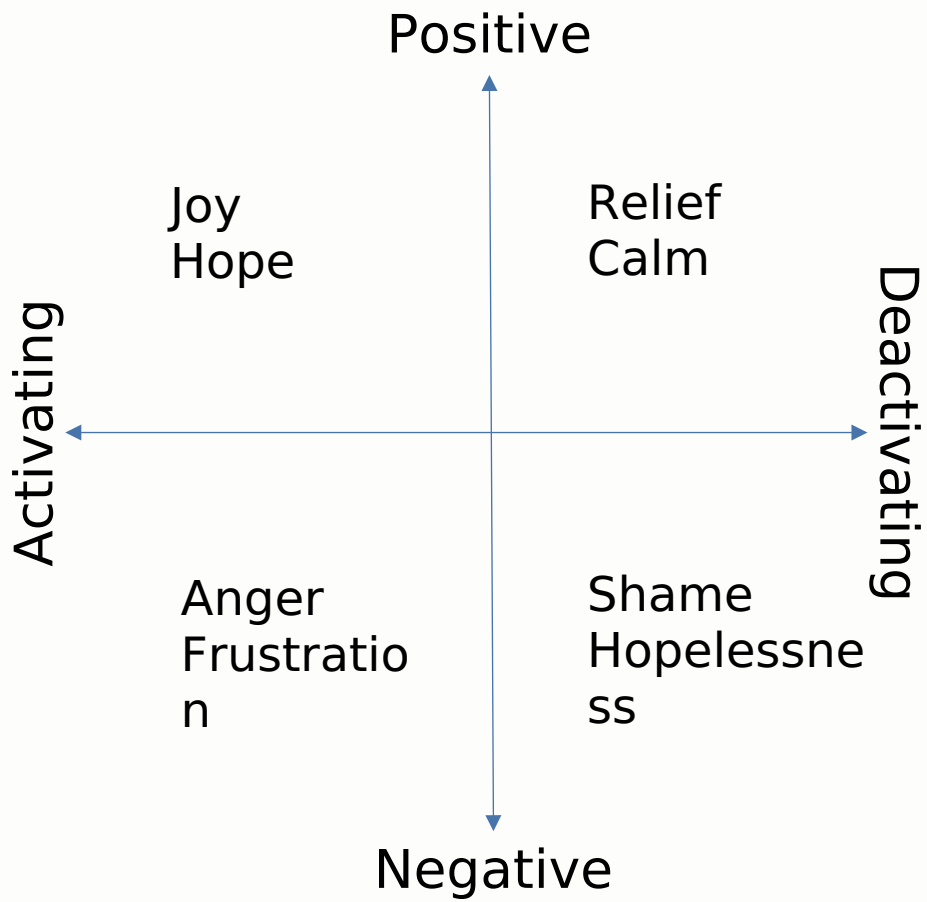
Brief Background

Pekrun suggests academic emotions are “multi-component, coordinated processes of psychological subsystems including affective, cognitive, motivational, expressive, and peripheral physiological processes” (Pekrun, 2006 p. 316)

- Valence (Positive/Negative)
- Activation (Activating/Deactivating)

Limited studies have attempted to tease out potential associations between these processes, particularly around authentic classroom experiences (e.g., exams)



Research Goal

The goal of this presentation is to discuss two exploratory studies attempting to triangulate Biological (salivary Alpha-Amylase or sAA) or Physiological (Electrodermal Activity or EDA) techniques with self-reported instruments

Research Question

In an authentic examination experience, does self-reported motivation associate with EDA measures and salivary sAA levels among students?

Study 1:

Salivary Alpha Amylase and academic achievement emotions while taking an Exam



Study 2:

Electrodermal arousal and positive/negative affect while taking engineering statics exams



Stress Hormones: Elevates upon Stress/Arousal

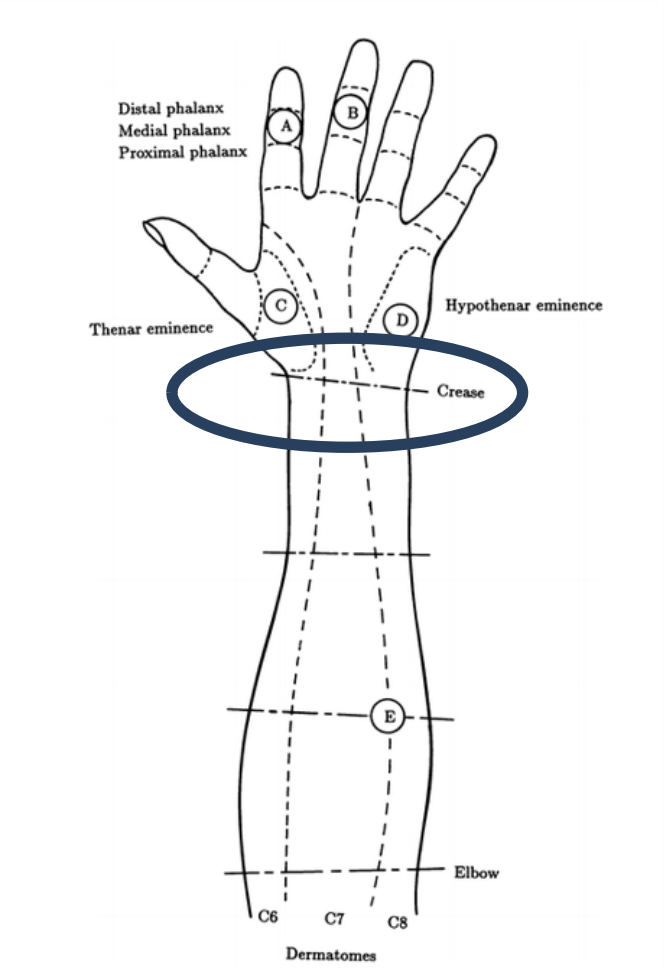
Saliva alpha amylase (sympathetic nervous system response or SNS)

Response quickly to challenge and is associated with adaptive coping responses to difficult situations.

sAA research has not typically been conducted in educational settings.

Electrodermal Activity: Indicative of Arousal

- When a person becomes nervous or anxious about a task, their palms become sweaty. Affective and cognitive processes, among other brain functions, can influence the control of sweating.
- Electrodermal activity (EDA) is widely considered as a proxy for quantifying stress level or cognitive load in the SNS.
    - Typically measured in locations where sweat glands are most dense (e.g., fingers) and whose region contains a greater number of innervated fibers



Study 1 Goal: Explore the relationship between sAA and academic achievement emotions.

Utilizing Pekrun's model of discrete academic achievement emotions we were interested in the association between biological markers of arousal and discrete test emotions in an authentic testing environment

Expectation is that a positive relationship would be found between positive emotions and sAA arousal

Positive relationships between self-efficacy and sAA are also expected

Methods

Participants

Two undergraduate engineering classes. On mid-term exam day, 29 of those provided pre, post, and 10-minutes after exam saliva samples.

65% of the sample was male; 58% of the sample was White; 17% of the sample was Asian/Pacific Islander.

Measures:

Achievement Emotions Questionnaire (Pekrun)

MSLQ - Self Efficacy (Pintrich)

	10min prior to exam	After exam	10min after exam
Procedures	AEQ: Saliva collection	AEQ & Saliva Collection	AEQ saliva collection

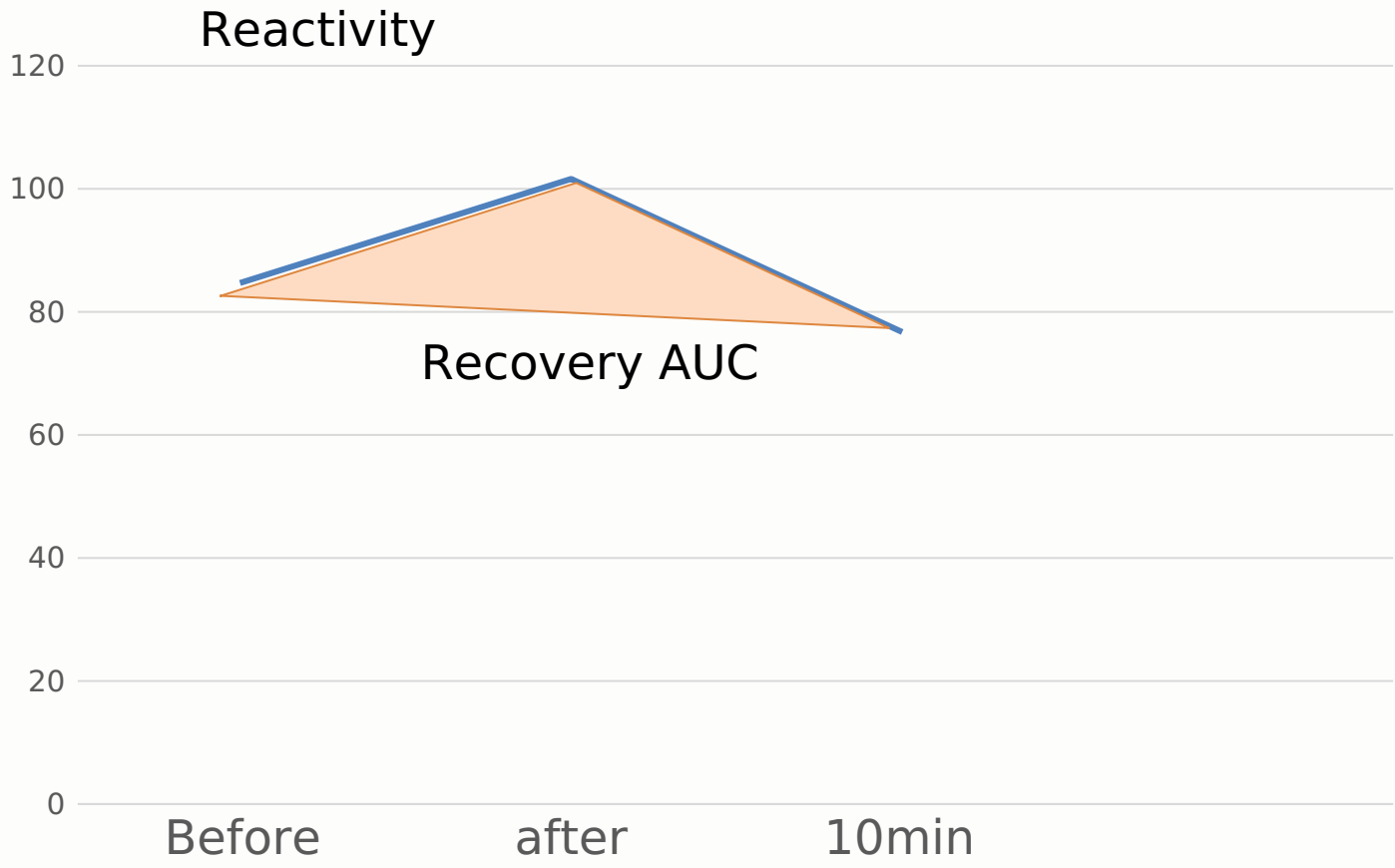
Saliva Alpha Amylase

Descriptive Statistics

	M	SD
Pre-exam sAA	86.14U/mL	75.43
Post-Exam sAA	96.12U/mL	77.59
10-min post exam	77.27U/mL	56.59

Quadratic GLM F(1,28) F=50.74 p< .01

Saliva Alpha Amylase



Study 1 Results – Positive emotions (Pearson r)

Pre-exam Emo	Happy	Pride	Relief	Hope	Efficacy
Reactivity	.32+	.371*	.43*	.39*	.65**
Recovery	.15	.19	-.06	.12	.386+

Post-exam Emo	Happy	Pride	Relief	Hope	Efficacy
Reactivity	.03	.15	.16	.15	.372*
Recovery	.41*	.42*	.37+	.08	.08

Note: $+p<0.10$, $*p<.05$, $**p<.01$.

Study 1 Results – Negative emotions (Pearson r)

Pre-exam Emo	Anxiety	Boredom	Hopelessness	Shame	Anger	Nervous
Reactivity	-.13	.07	-.12	.04	.18	-.02
Recovery	-.001	.15	.07	-.21	-.10	.02

Post-Exam Emo	Anxiety	Boredom	Hopelessness	Shame	Anger	Nervous
Reactivity	-.10	.15	-.12	-.08	.23	.05
Recovery	-.07	-.01	-.73	.05	.08	-.15

All correlations are non-significant (n=29)

Study 1 Discussion

sAA is a Sympathetic Nervous System pathway response to stressful environments

sAA not only is an indication of arousal, it is evidence of a coping response to stressful environments

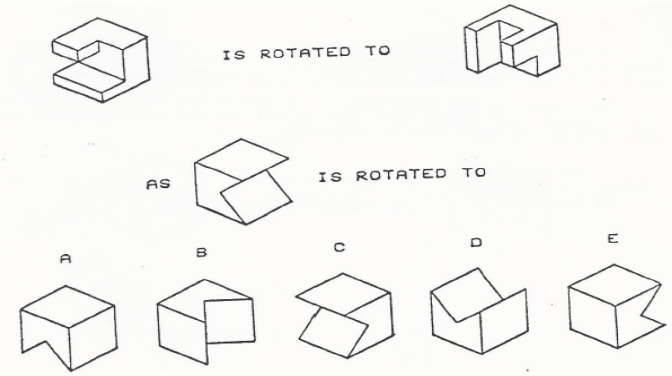
The study, cross-sectional and correlational in nature, provides evidence of the positive relationships between positive activating and positive deactivating emotions expected based on prior laboratory work (primarily with toddlers and very young students)

Future research examining the directionality of these relationships is needed

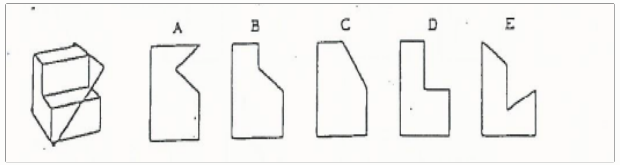
Study 2 Goal: Explore the relationship between EDA and affect

- Participants
  - Undergraduate Engineering students (N=7) at a western institution in the US
  - Sophomore/Junior Students
  - First Filter “engineering” course
- Materials/Instruments
  - Electrodermal Sensor, Empatica E3
  - Positive Affect Negative Affect Scale (PANAS)
  - E-Prime Software and Video to track timed events
- Three authentic engineering exam problem types
  - Plane Example
  - Spatial Example
  - Combined Example

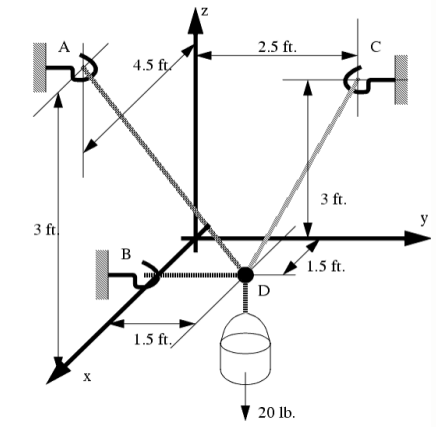
Plane Example



Spatial Example



Combined Example



Study 2: Methods

EDA sensor Installation	Pre-PANAS	Spatial Problems (5 items)	Break	Plane Problems (5 items)	Break	Combined Exam Problems (5 items)	Post-PANAS	EDA Sensor Removal

- An EDA sensor was placed in the non-dominant wrist of the participant.
- An E-Prime program was pre-programmed with exam problems and PANAS survey questions.
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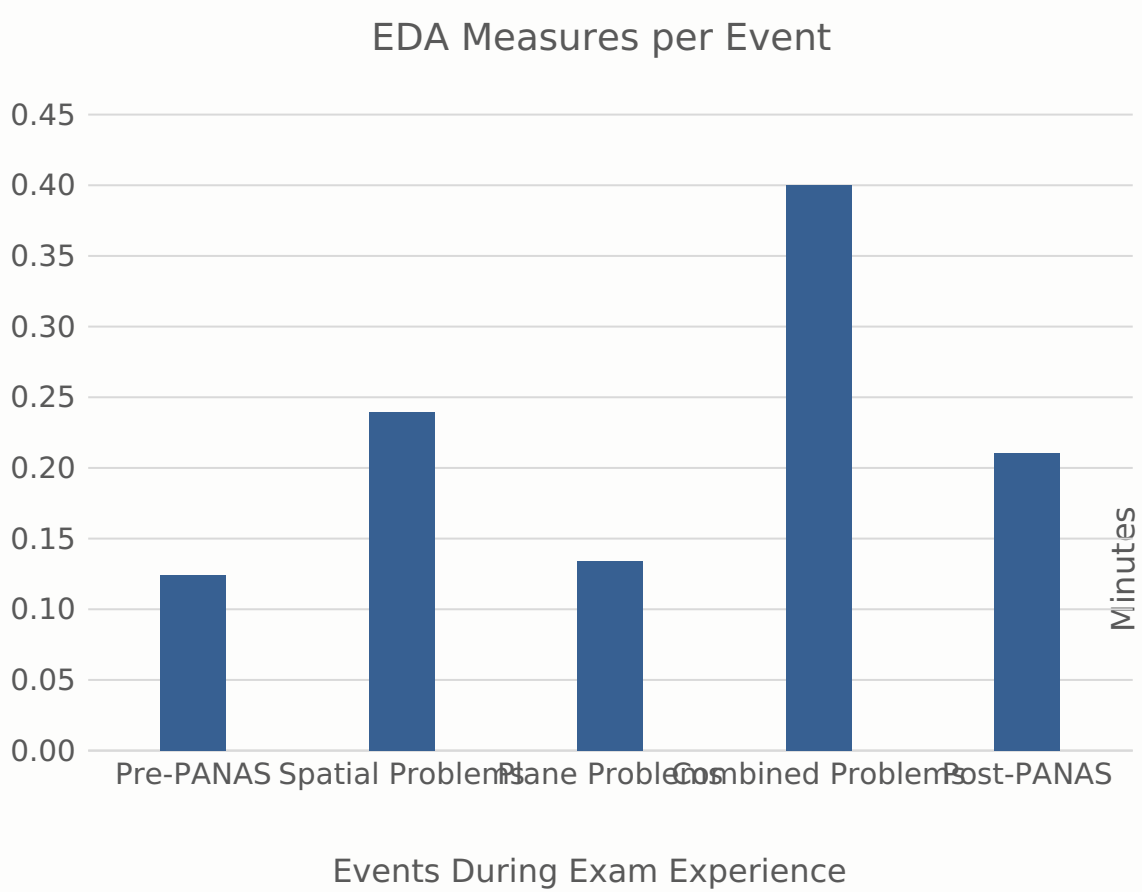
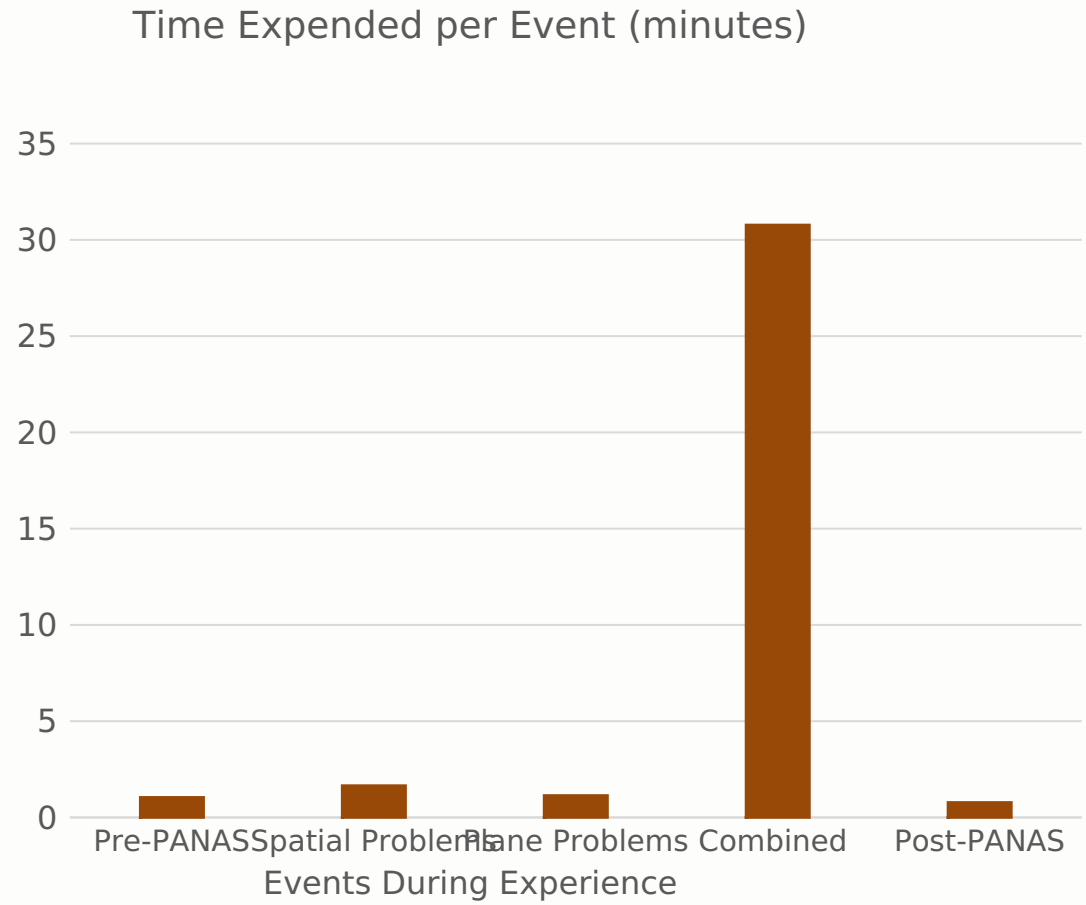
- As student entered their responses, the keyboard strike was timestamped. Video Recording was timestamped to confirm data findings.
- A 5 minute calibration period was done before the study to ensure that EDA baseline levels were acquired.

Study 2 Results





Duration of timed events may influence the EDA measures

Study 2 Results

EDA Measurements between Exam Types-

	Mean Normalized EDA (SD)			P-values
	Spatial	Plane	Combined	
Spatial vs. Plane	0.75(0.57)	0.95(1.12)		P=0.842
Spatial vs. Combined	0.75(0.57)		0.18 (0.17)	**P<0.001**
Plane vs. Combined		0.95(1.12)	0.18 (0.17)	**P<0.001**

Correlations between Exams and EDA Measures-

- p<0.05

Pre-PANAS (Pearson r)

	Positive Affect	Negative Affect
Spatial Problems	-0.128	**0.540** *
Plane Problems	0.245	**0.530** *
Combined Problems	0.079	0.298

SHAME

Post-PANAS (Pearson r)

	Positive Affect	Negative Affect
Spatial Problems	0.008	0.008
Plane Problems	0.129	0.093
Combined Problems	0.209	0.134

Methodological Limitations & Considerations

Study 1

- Suggests that while sAA can be an effective method to collect “macro-events”, we risk losing power in our samples
- Limited to a 10-minute window from the onset to the offset of an event; this limits sampling and isolation of “micro-events” during the exam experience

Study 2

- Indicates the need to define and quantify “micro-events” during examination experiences particularly when using triangulating methods (e.g., video recording and EDA sensor) are used
- EDA for a single participant and session can result in millions of data points so restricting participant sizes and collapsing data is ideal; however, this may compromise the sampling power needed for other multi-modal techniques (e.g., sAA)

Methodological Limitations & Considerations

Collectively, Studies 1 and 2:

- Provide two ways to show a “window” into students’ authentic examination experiences
  - EDA and sAA are indicative of SNS response to arousal and stress
  - sAA provides insight into the regulatory response students’ bring to environments typically considered “stressful”
  - EDA provides insight into the magnitude of students’ arousal
- Small data collected for sAA during macro-events and small participant numbers collected for micro-events in EDA may limit generalizability of findings
  - A balance between the two approaches are needed
- Neither sAA or EDA provide insight into the specific motivational students’ experience
  - Adding surveys assists in providing a more holistic picture of what is happening prior to and after the examination experience

Instructional Implications

The emotions students bring to an exam are important

- Although both study findings are correlational, they point to a need to consider students' affective state **prior** to an exam

Study 1 provides a further confirmation of the importance of Self-Efficacy. As predicted but not previously tested, a significant relationship exists between students' confidence in their course success and their adaptive emotional regulation

Study 2 confirms that the selection of sequencing and type of exam problem may assist in adaptive mechanisms for negative affect as students enter an exam which may impact their performance during the exam

Research techniques combining surveys, sAA or EDA, could be applied to secondary education high stakes testing situations to better understand the authentic effects of these testing situations on students' motivational experiences

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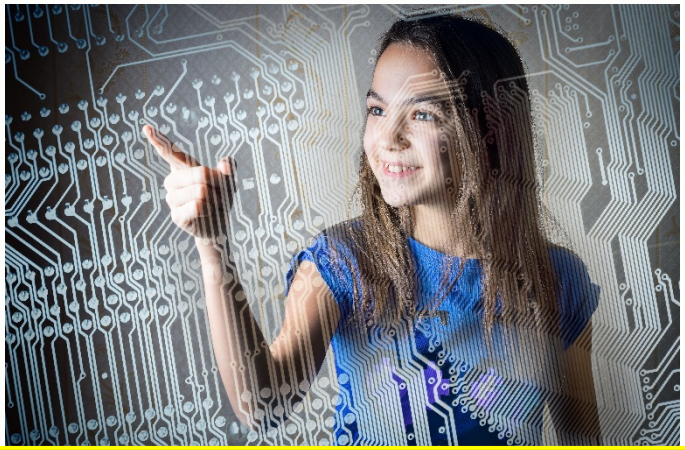

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Pre-to-Post PANAS

Positive	Negative
Interested Excited Strong Proud Alert Inspired Attentive Active	Upset Scared Hostile Ashamed Jittery