Affective and Behavioral Assessment for Adaptive Intelligent Tutoring Systems

Luis Marco-Giménez, 2016

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Introduction (I)

- Adaptive ITS purpose ➔ Help students to reach a resolution path of a given problem, according to:
  - ✓ Desired outcomes
  - ✓ Intrinsic capabilities of the student
  - ✓ Particular context in which the exercise takes place

Introduction (II)

- One major worry in ITS is related to the most adequate level of help that should be provided to the student to optimize his/her learning

- In this sense, we accomplished an experiment reporting the effect of an intensive scaffolding in the learning of algebraic word problem solving, with a significant increase of the competence in solving problems

Introduction (III)

- Additionally, researches have provided solid evidences that emotions strongly affect motivation, playing an important role in learning

- Our goal ➔ Improve the students' learning outcome and satisfaction by adding to our ITS student's affective recognition capabilities

Reacting to emotions

- Necessity to design methods to simultaneously improve learning and affective variables, taking into account information such as:

  - ✓ Current student knowledge
  - ✓ Difficulty of the problem at hand
  - ✓ Affective information (*e.g. provided by the user via SAM tests*)

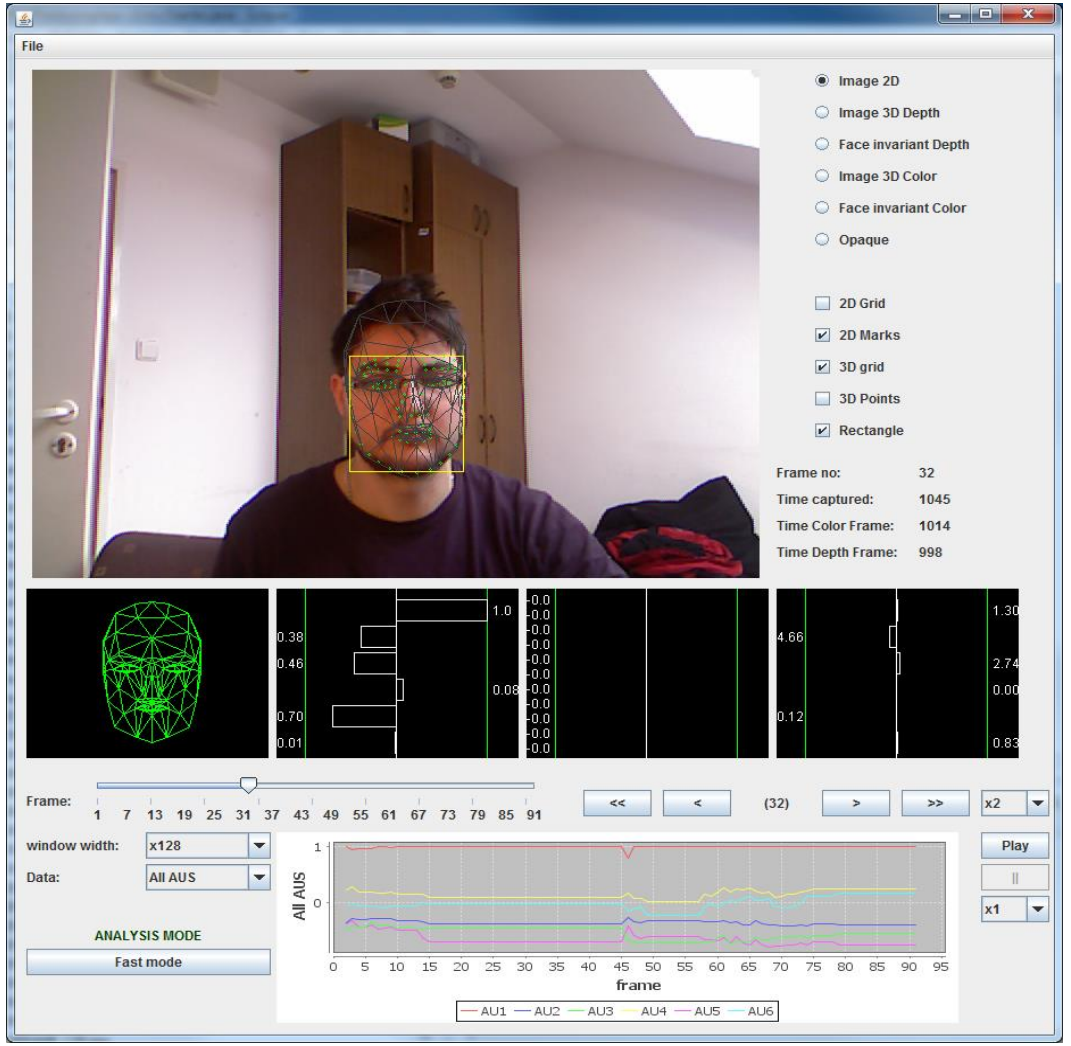
Previous works (I): Vision analysis

- **Eigenexpressions:** Based on Eigenfaces method, creating one subspace for each expression (6 basic ones) and then computing the reconstruction error of a new sample in each subspace:

Previous works (II): AUs, rotation

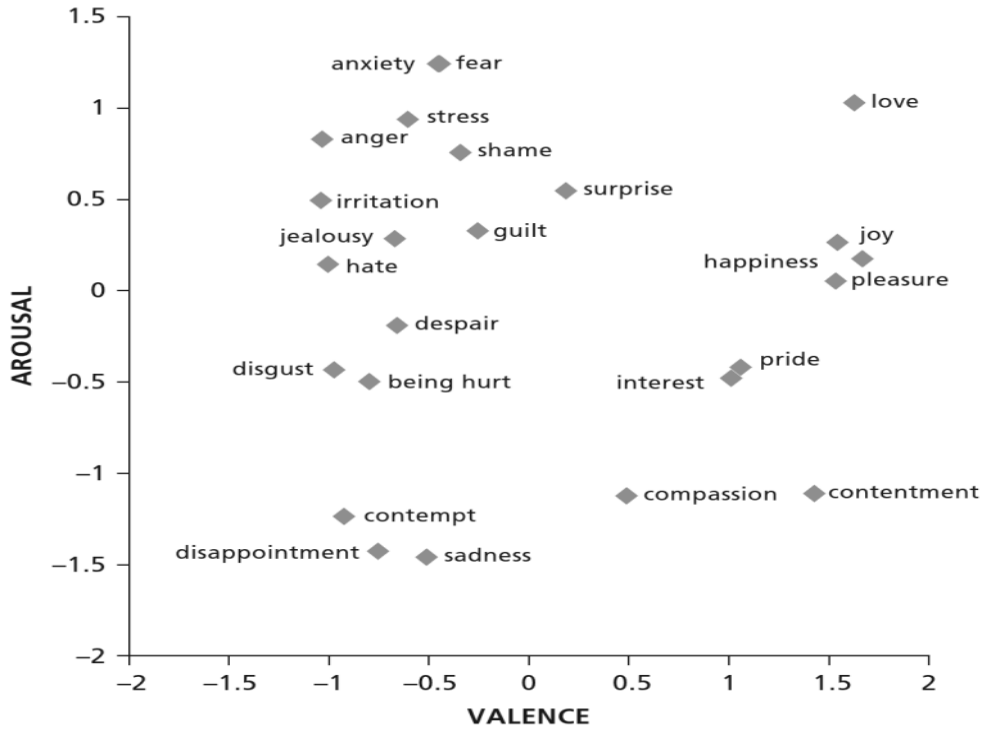
- **Extension to FEEDB**, affective and multimodal database

We contributed to the extension of FEEDB by providing data information in text files format, allowing data analysis without the need of a having a Kinect Sensor and processing proprietary XED files



Previous works (III): EEG analysis

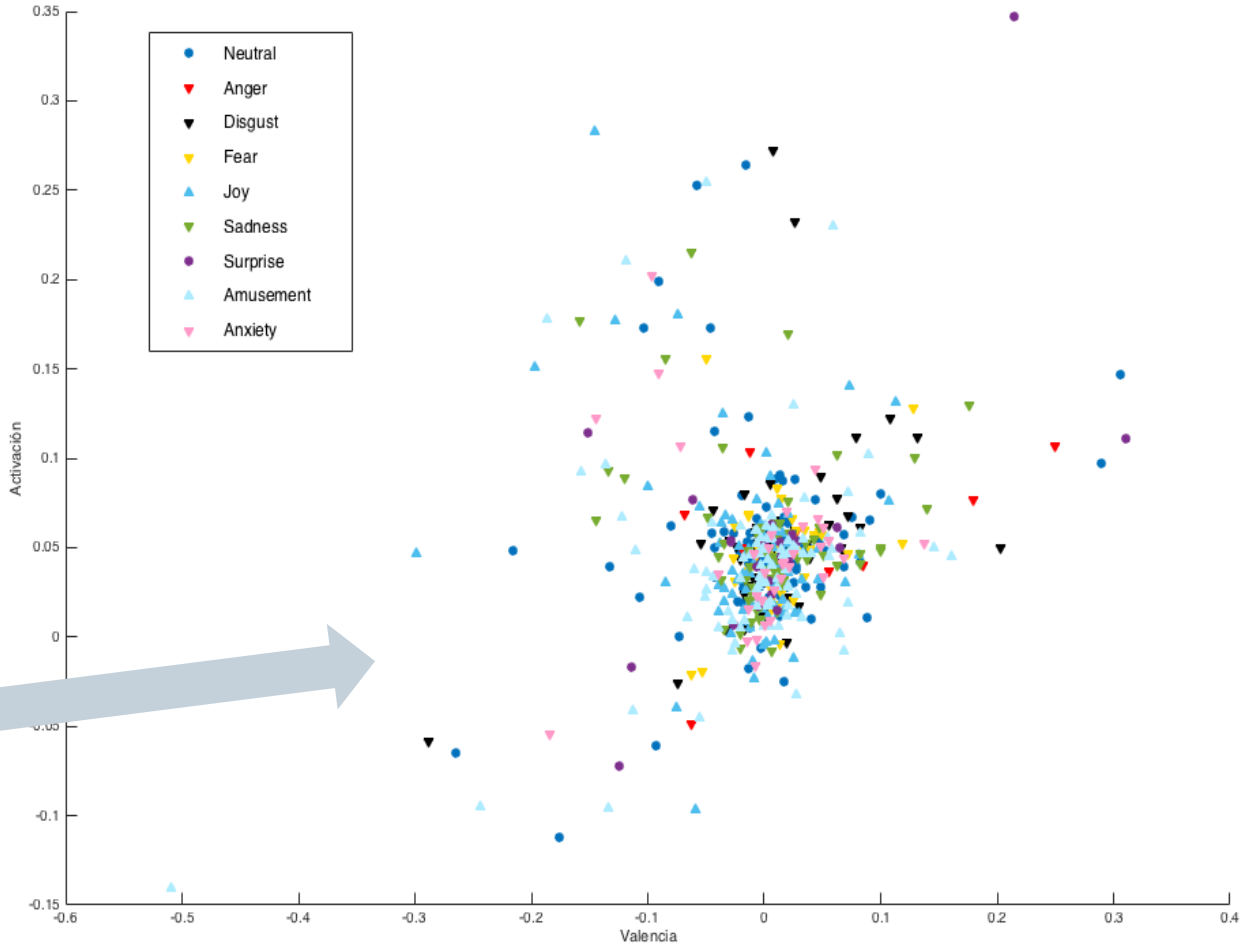
- **EEG analysis on MAHNOB-HCI DB**, based on 24 emotions value of GRID project, on Valence and Activation dimensions (*Johnny Fontaine, 2013*)



Previous works (III): EEG analysis

- Values from EEG were obtained by regression methods

EEG samples couldn't be classified into 9 emotion classes



Current work

- We are currently accomplishing a study to observe the impact of intensive scaffolding on variables other than learning:

  - ✓ Valence (pleasantness)
  - ✓ Activation (intensity of emotion)
  - ✓ Autonomy (the degree of control)

Implementing predictors (I)

- Using the data collected by our ITS in previous experiments, we trained a set of classifiers to predict the most adequate help level for every problem in terms of:
  - ✓ Valence
  - ✓ Activation
  - ✓ Autonomy
  - ✓ Knowledge

Implementing predictors (II)

- Classifiers characteristics:
  - ✓ Implemented SVM with RBF kernel
  - ✓ Using Python with scikit-learn library
  - ✓ Optimized with an exhaustive Grid Search procedure to estimate the optimum C and G parameters
  - ✓ Used a leave-one-out cross-validation method to validate the model

Implementing predictors (III)

- The parameters found for each classifier and the accuracy in terms of recall and ROC areas are shown below:

Classifier	C	G	Accuracy	ROC	Samples
Valence	100	0.01	70%	0.747	171
Activation	10	0.01	62%	0.643	179
Autonomy	10	0.01	64%	0.683	234

Experimentation (I)

- Experiments have been carried out with Secondary school students to test the performance of the classifiers in a real environment

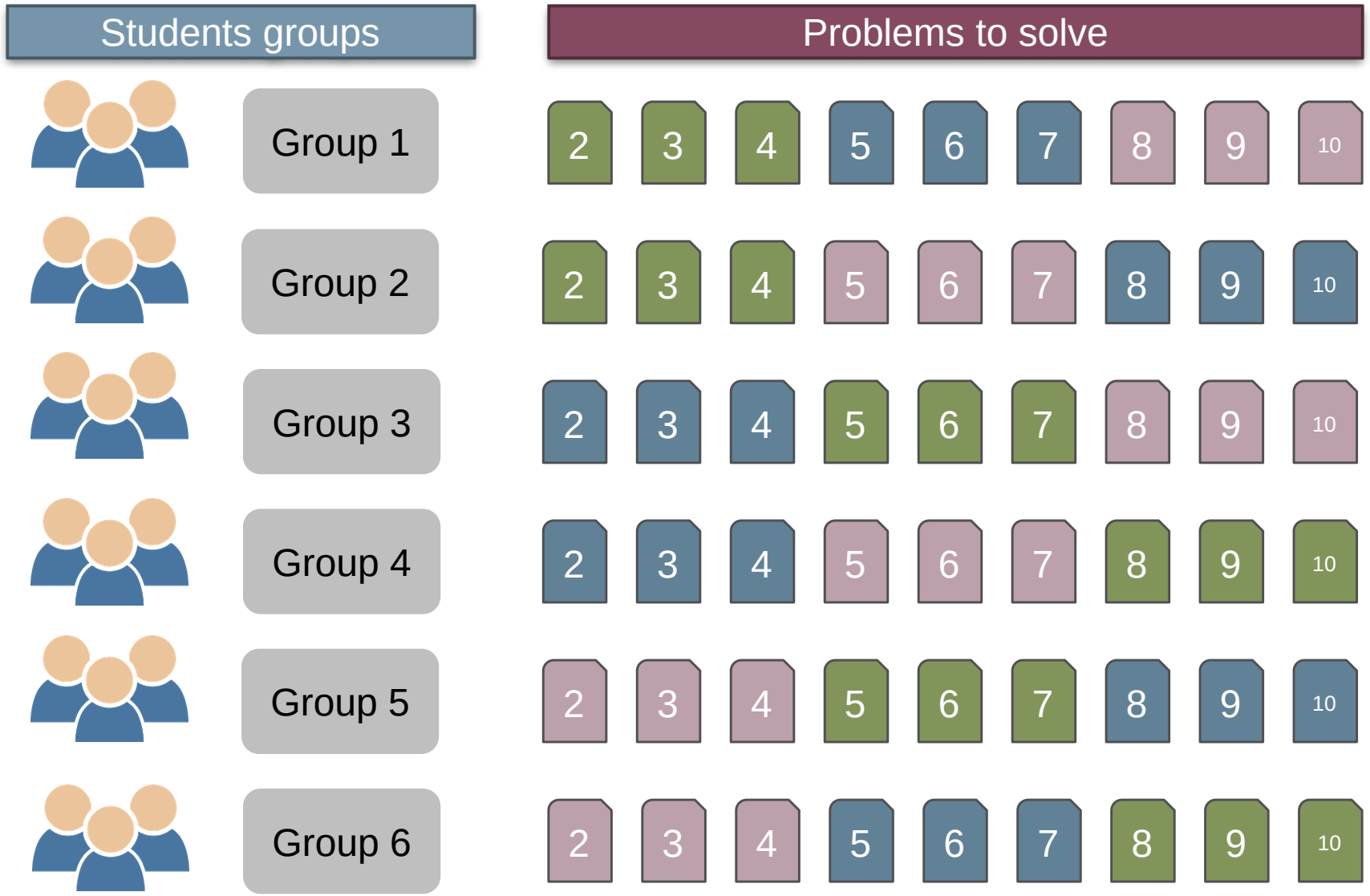
- For these experiments we created a specific Ubuntu Linux live distro with a Xfce desktop with data persistence capabilities, with the necessary tools to run the ITS with the implemented classifiers

Experimentation (II)

- Our ITS was configured to solve 10 algebra problems

- Students were randomly split into 6 groups in order to decide which sequence of maximization strategy should be applied to every group when solving the problems:

S1: Valence + Activation // S2:Autonomy // S3: Knowledge



All the maximization strategies were applied to every problem

Strategies to maximize

S1 *Valence + Activation*

S2 *Autonomy*

S3 *Knowledge*

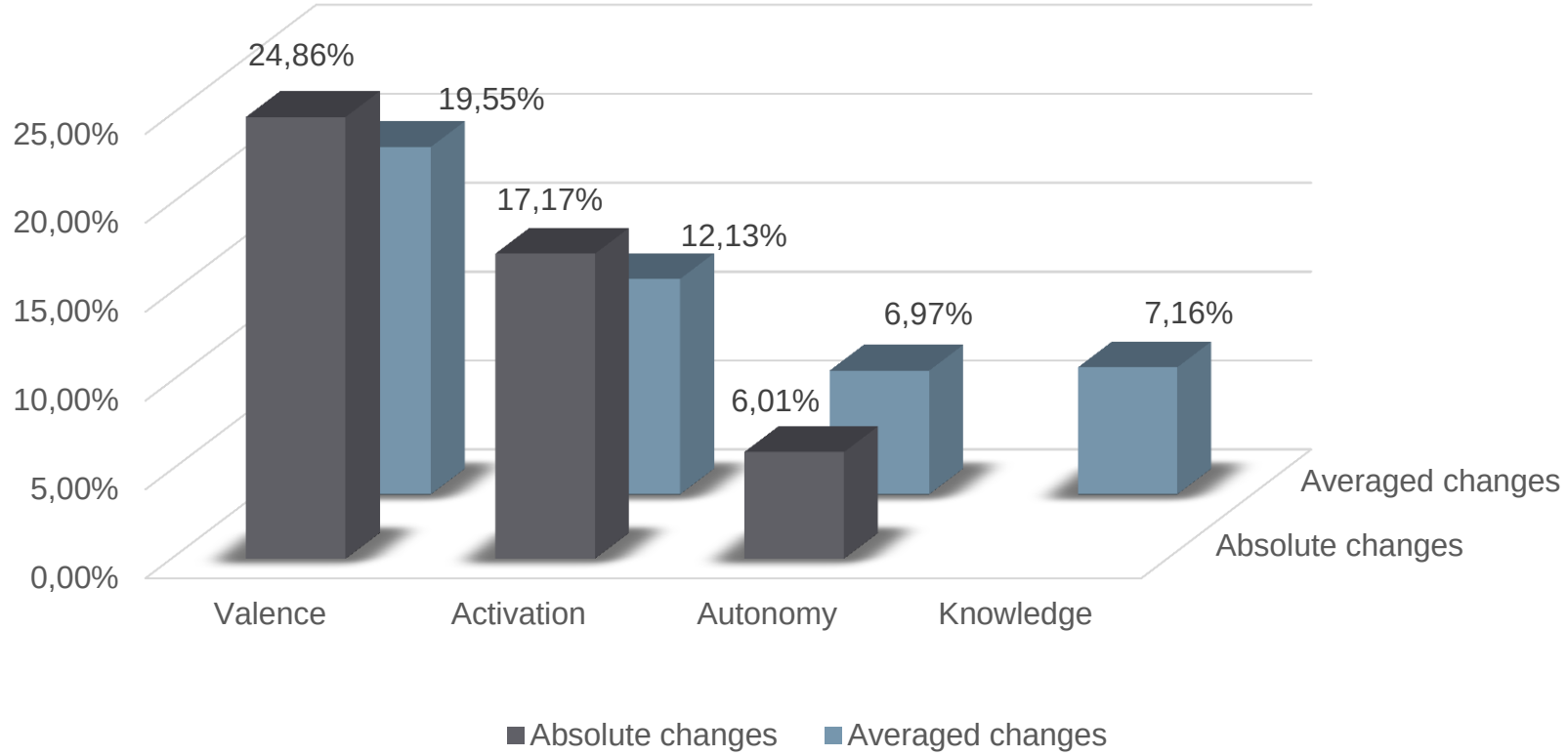
Results (I)

- We are currently analyzing the collected data

- Preliminary results have shown a significant improvement on the three affective dimensions, and considerable gains in knowledge

Results (II)

- Comparing each maximization strategy to the others, our results show significant gains:

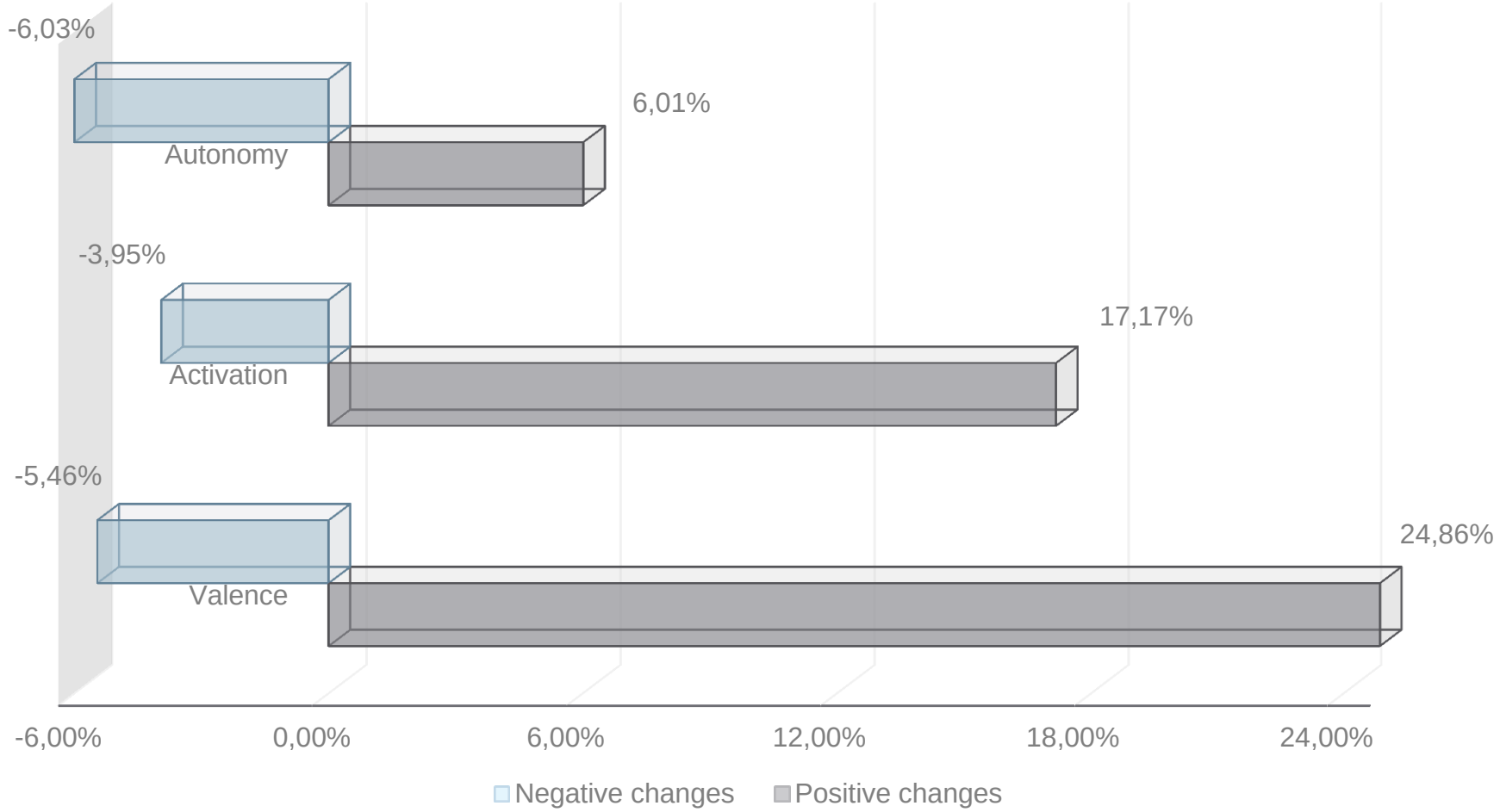


Results (III)

- Additionally, our study suggests that an increase on positive values of Valence results in a considerable decrease on negative values of Valence

- Similar results found for Activation and Autonomy

Results (IV)


-6,03%
6,01%
Autonomy
-3,95%
17,17%
Activation
-5,46%
24,86%
Valence
-6,00%
0,00%
6,00%
12,00%
18,00%
24,00%
Negative changes
Positive changes

Future work

- Our next goal is to analyze the correlations among Valence, Activation, Autonomy and Knowledge, and the influence that each variable exerts on one another

Questions

- Thank you for your attention

- I will be glad to answer any specific questions you might have