# The Simulation of Affective Retrieval
## using the Self-Organizing Map with Temporal Context


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## INTRODUCTION

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Our work aimed to experiment with the a new component of an existing model of working memory[1] is mainly related to Baddeley's concept of episodic buffer[2].

The main assumption of the current model of WM is that events are experienced through structured sensorimotor routines which allow to record them with participants structured as **agent**, **patient** and **action**. We extended the architecture with affective component represented by two separate neurons active for positive and negative affective values, which also allows representing ambivalent (both active) and neutral (none active) events.

## METHODS

We used Merge SOM architecture for our cause[3]. This architecture uses context which refers to fusion of characteristics of the previous winner neuron: the weight and the context of the last winner unit. Such properties allow to consider previous episodes which were presented to the network (memorized context).

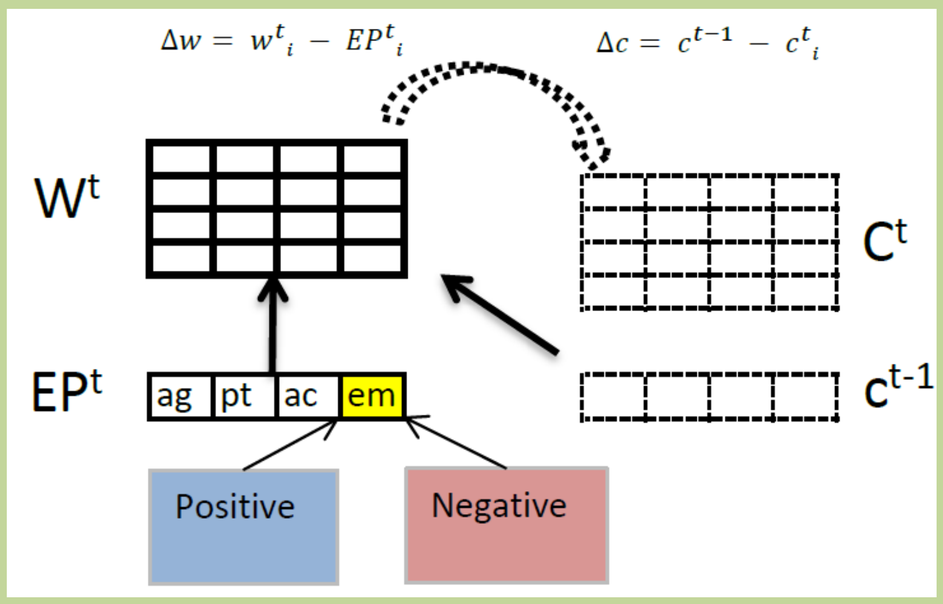


Fig. 1 Visualization of the Merge SOM architecture .

**W^t** – weights of the SOM in time $t$ ('regular' weights)

**EP^t** – Current episodes consists of AGENTS | PATIENT | ACTION + EMOTIONAL AFFECT (**positive** or **negative** valence)

**C^t** – merge context of the previous learning process (context weights)

**C^t-1** – context descriptor , which is the linear combination of the properties of BMU (Best Matching Unit or winner neuron) in the last time step

Resulting equation of finding the BMU is:

$$d_i = [\eta\,(1-\alpha)\,\|\,w^t{}_i\_x_i\,\|^2 + \alpha\,\|\,c^t - c_i\,\|^2] + (1-\eta)\,\|\,EP^t - EP_i{}^t\,\|^2$$

Where $\alpha$ and $\eta$ are parameters which allow to vary the importance of context and emotional component.

Examples of episodes:

| | | | |
|---|---|---|---|
| Teacher | \| Smiles | (Positive) | \| Student |
| Worker | \| Holds | (Neutral) | \| Tool |
| I | \| Eat | (Ambivalent) | \| Spicy |
| Brother | \| Fights | (Negative) | \| Me |

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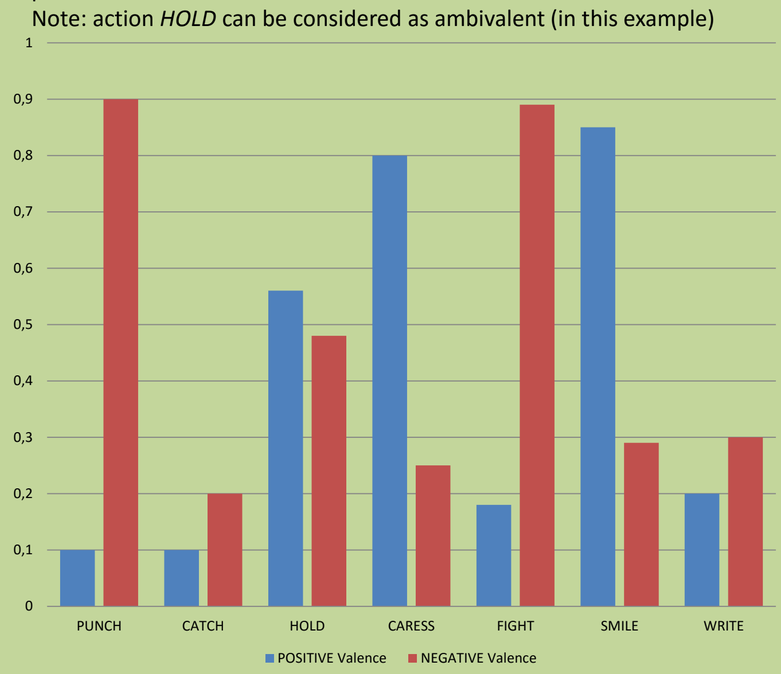
## RESULTS

In our experiment we biased the actions in the episodes presented to the network by increase or decrease positive or negative valence. Therefore, the exposed episodes could be perceived in positive/ neutral/ ambivalent or negative mode.

Fig 2. Example of affective component of the episodes with particular perceived action.
Note: action *HOLD* can be considered as ambivalent (in this example)




The positive and negative fragments of affective component of episode are remembered explicitly in the weights of the MSOM neurons $((W, C) \in \mathbb{R})$[3].

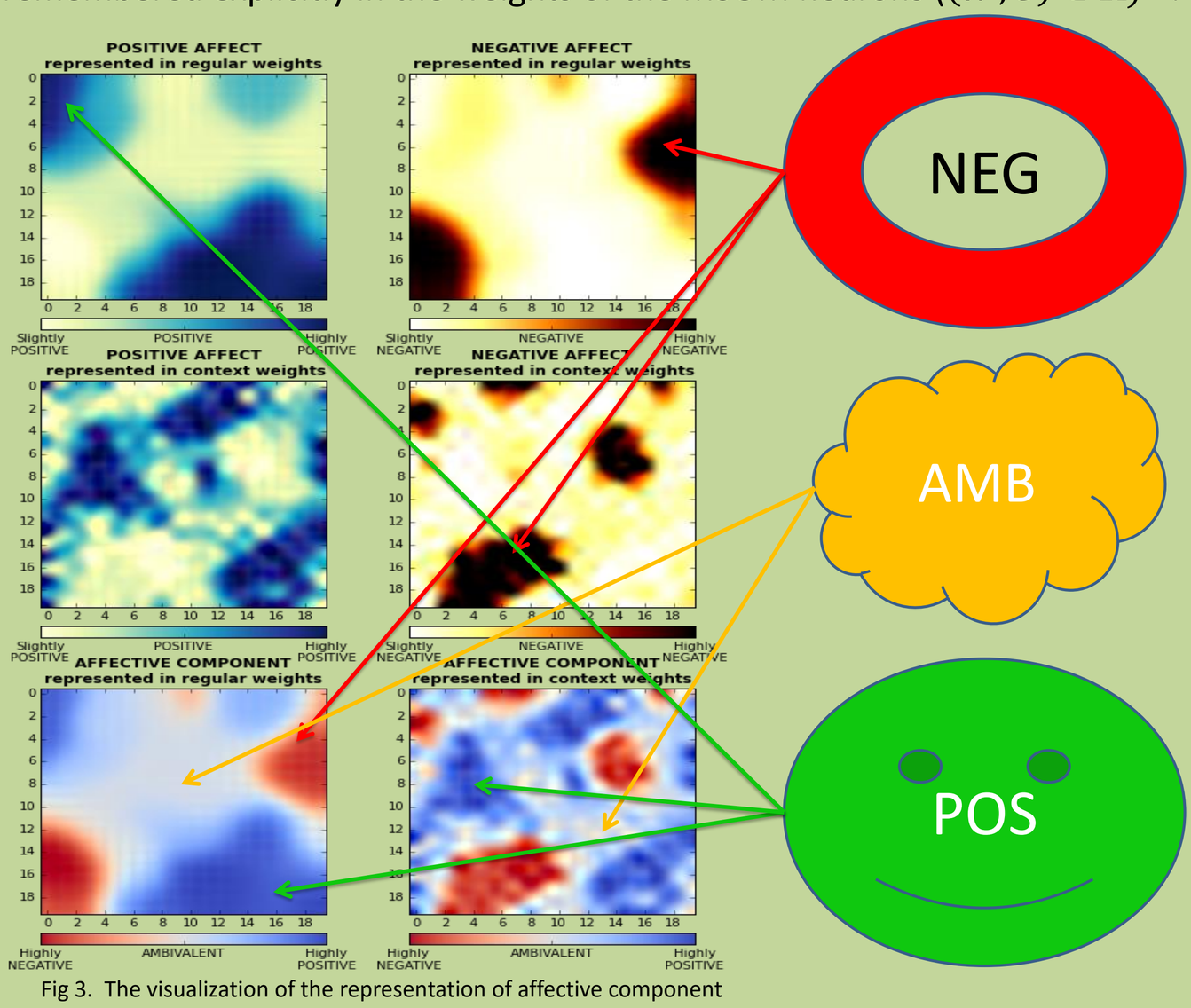



Fig 3. The visualization of the representation of affective component in MSOM

We can see (Fig. 3) the different representations of the affective component in our network. There are some distinct clusters of neurons representing different amount of positive|negative valence of affective component. The darker areas should be considered as more stained emotionally. In the 3rd row complete affective component is visualized in the combination of both weights (regular and context). The lighter areas should be considered as ambivalent representation of the episodes learned .

**Conclusion**

**We have demonstrated and proved that the properties of the MSOM network could be a good alternative of the architecture for additional affective component of existing WM model. Our next goal is to enhance the model of WM[1,4] by presented architecture.**


**References**:

[1] M. Takac and A. Knott, "A Neural Network Model of Episode Representations in Working Memory," Cogn Comput, vol. 7, no. 5, pp.509-525, 2015

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[3] M. Strickert and B. Hammer, "Merge SOM for temporal data," Neurocomputing, vol. 64, pp. 39-71, 2005

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