

Exploring the relation between olfaction and affective states using artificial intelligence algorithms

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Introduction

Aim: To examine the relation between smells and human emotions using an AI approach

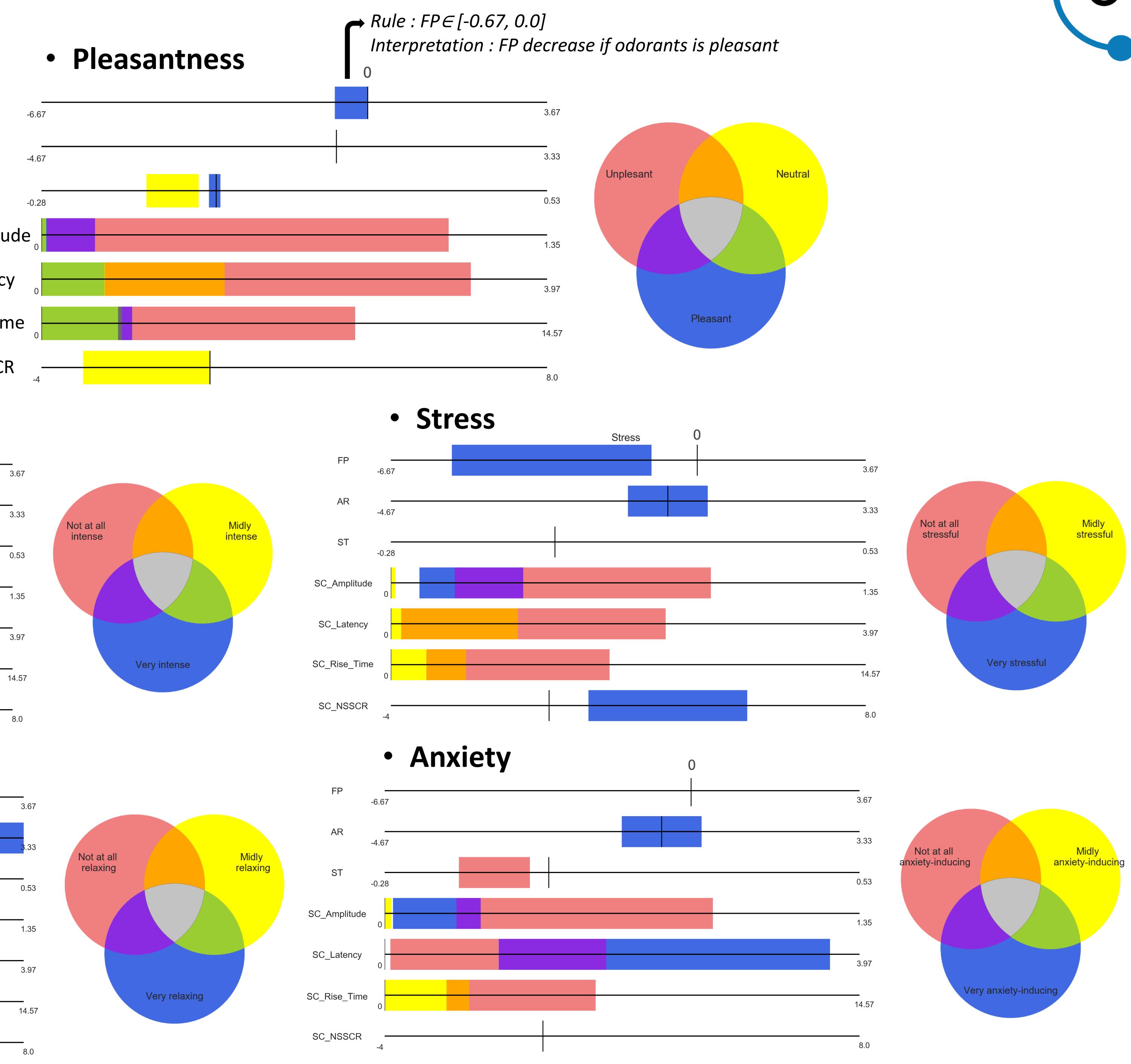
Hypothesis: Subgroup discovery (SD) algorithms will enable description and identification of the physiological patterns associated with a specific affective state induced by a particular smell.

Experiment¹:

- 105 odorants were smelled by 22 participants.
- Different psychophysiological parameters were recorded: finger pulse frequency (FP), skin conductance (SC), skin surface temperature (ST) and abdominal respiration (AR).
- For each odor, participants had to rate five affective dimensions on a scale from 1 (not at all) to 9 (extremely): pleasantness, intensity, relaxation, stress and anxiety.

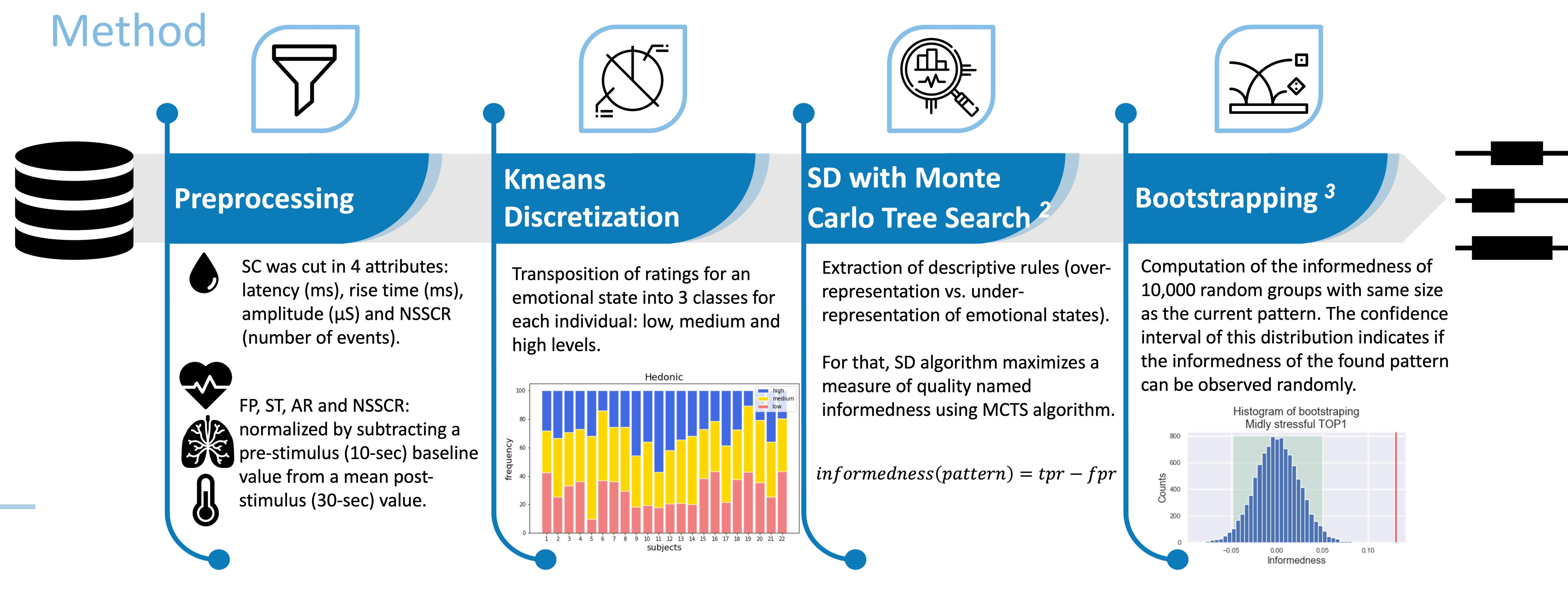
Results

Summary of patterns
(only one interval in the rule)



References:

- C. C. Licon, C. Manesse, M. Dantec, A. Fournel, and M. Bensafi, "Pleasantness and trigeminal sensations as salient dimensions in organizing the semantic and physiological spaces of odors," *Sci Rep*, vol. 8, no. 1, p. 8444, Dec. 2018, doi: 10.1038/s41598-018-26510-5.
- R. Mathonat, "Rule discovery in labeled sequential data: application to game analytics," University of Lyon, France, 2020.
- C. B. Efron and R. Tibshirani, "Bootstrap Methods for Standard Errors, Confidence Intervals, and Other Measures of Statistical Accuracy," *Statistical Science*, vol. 1, no. 1, pp. 54–75, 1986.



Discussion

Results for **intensity** and **pleasantness** confirm what is known in neuroscience:

- Strong emotional states (pleasant or unpleasant) induce a skin conductance response greater than neutral states.
- Pleasant emotional states decrease pulse frequency.
- The more intense the odorant, the higher the peak of skin conductance.
- Abdominal respiration decreases when the smell is perceived as weak.

These findings provide new information:

- The higher the latency of the skin conductance, the more unpleasant the odor
- The finger temperature is rather stable when the smell is pleasant and decreases when the smell is neutral.

Results for **relaxation**, **stress** and **anxiety** are more difficult to interpret. For instance, past investigations showed that anxiety induces an increase in pulse frequency, abdominal respiration, and electrodermal response which is not in line with the current finding.

Note that the 3 classes (low, medium, high) of these 3 affective dimensions were very unbalanced, because the mark "1" (not at all) was used more widely than the other marks. These emotional states were not perceived in a strong enough way to carry out this analysis.

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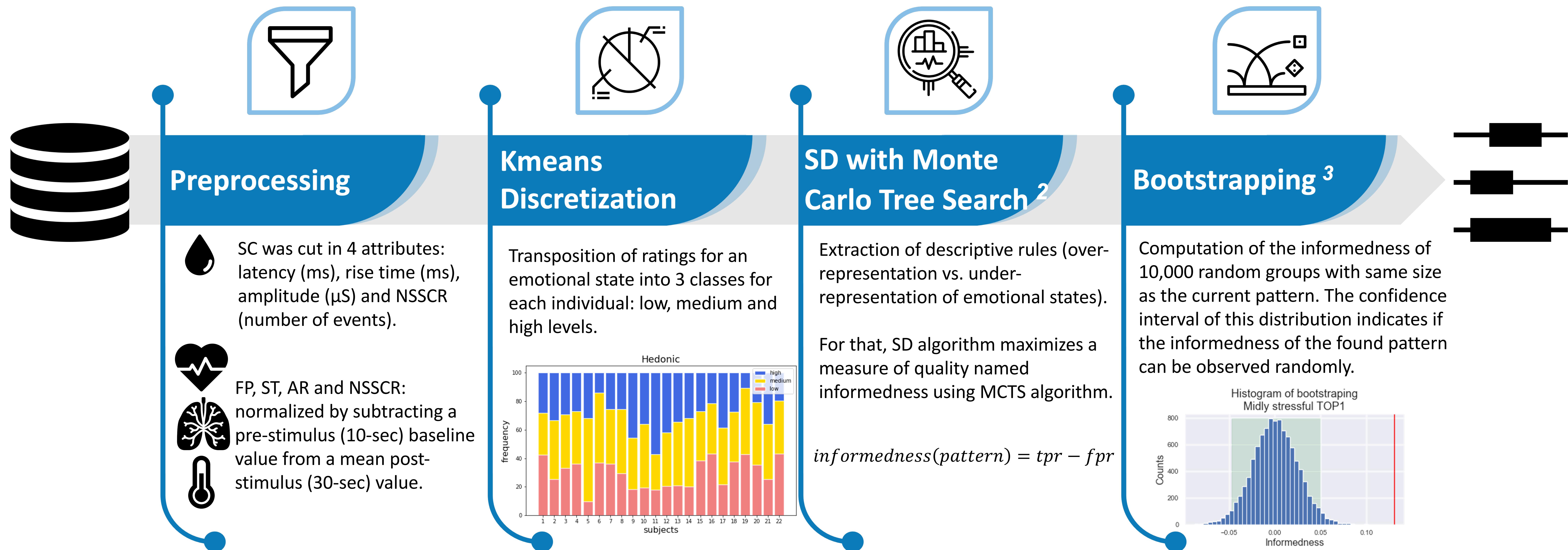
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2 Method



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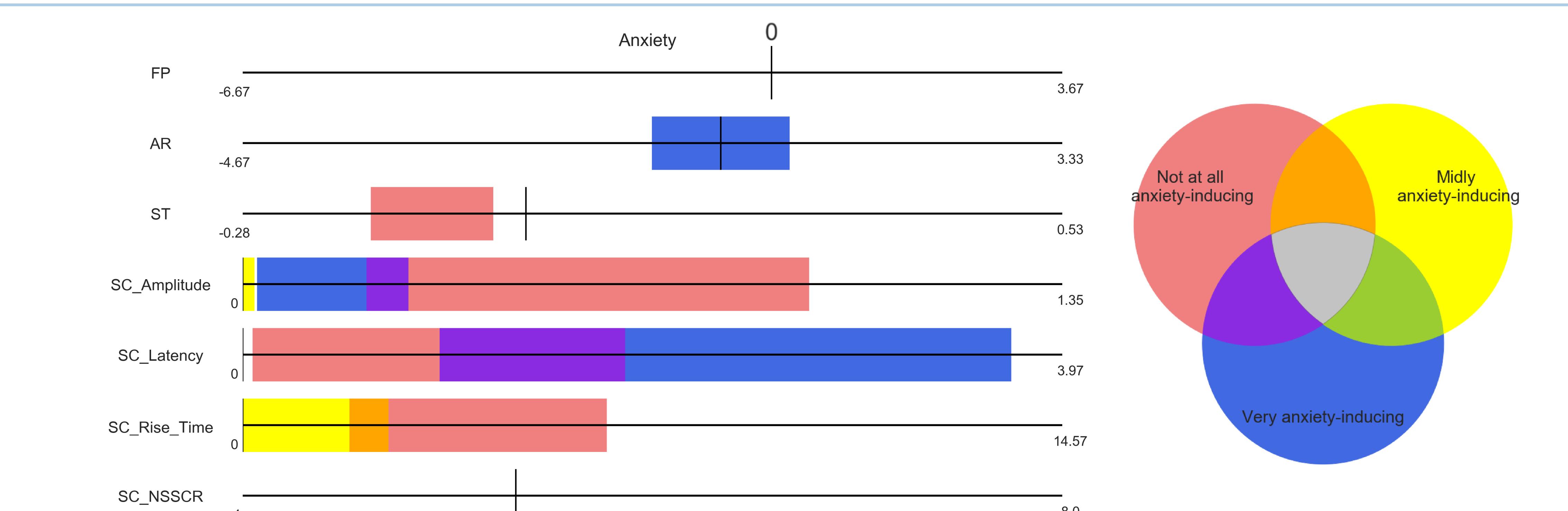
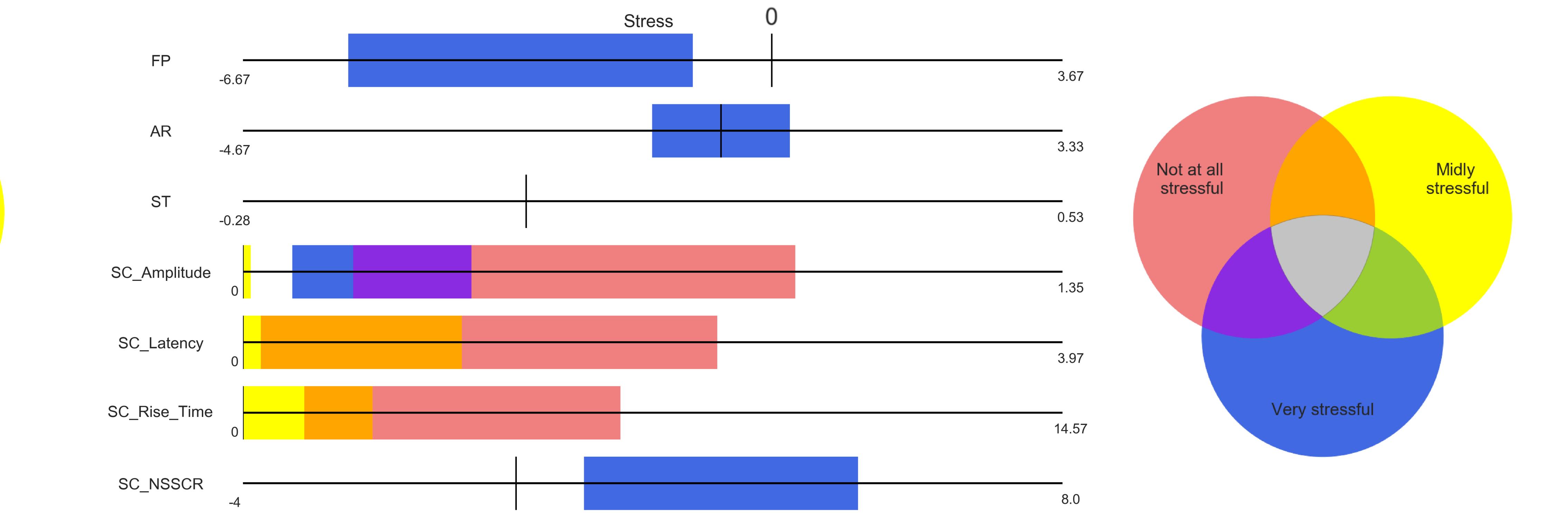
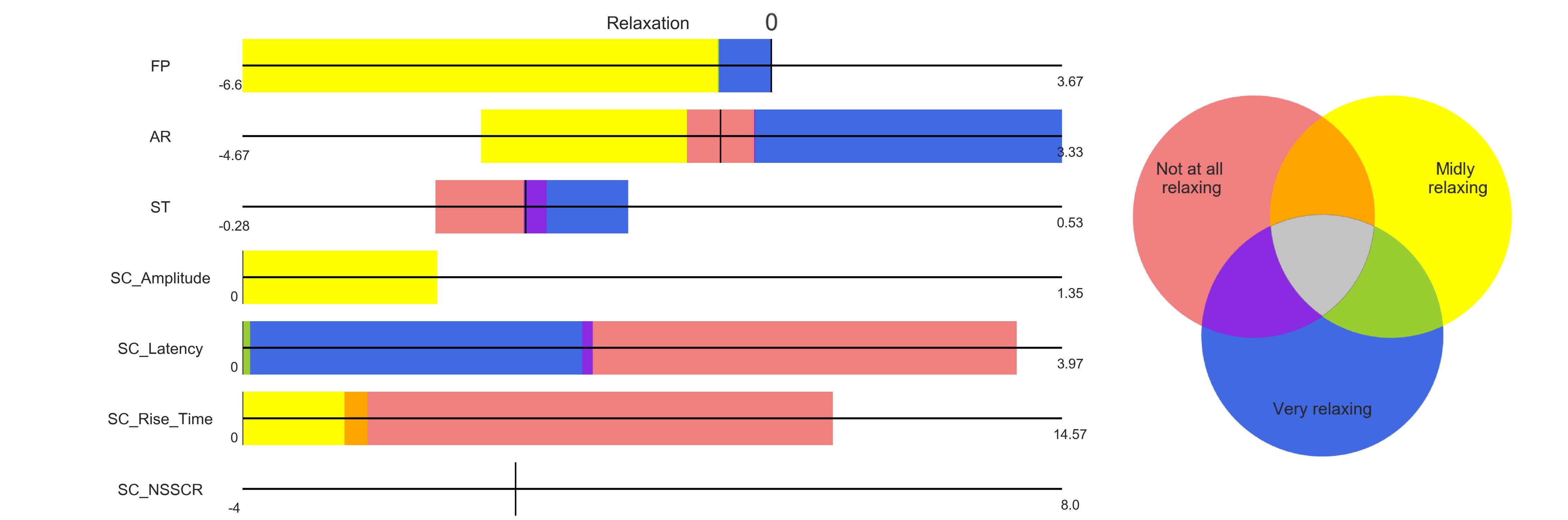
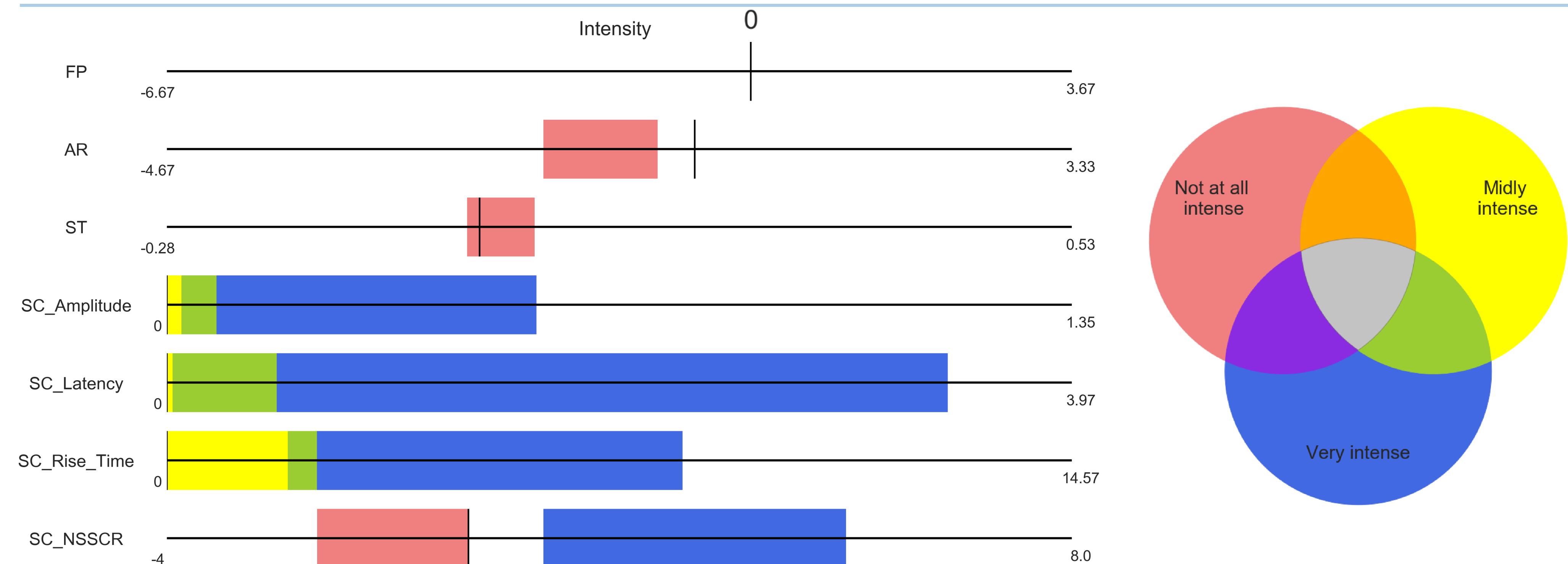
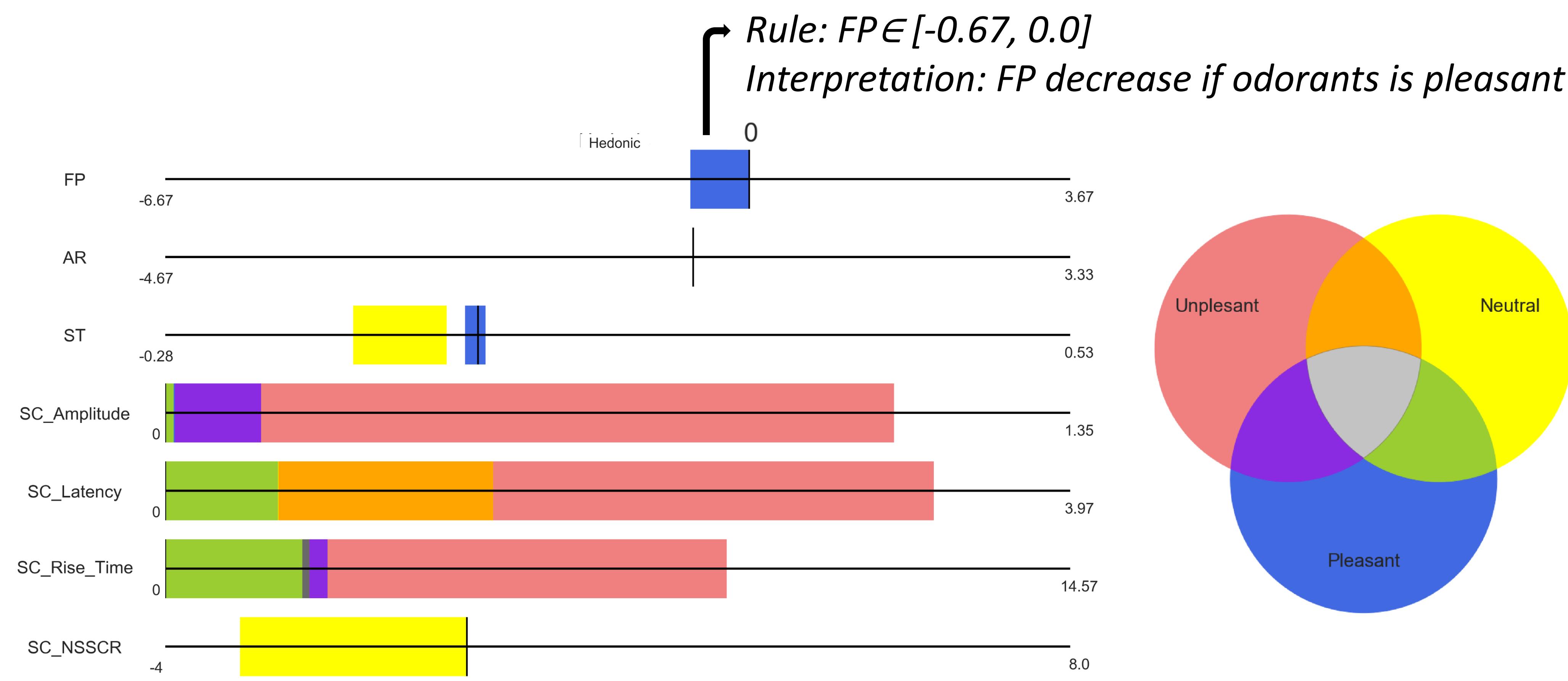
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3 Results

Summary of patterns with only one interval in the rule:



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