

# Influence of activational and attentional state factors on prepulse inhibition

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## Introduction

Prepulse inhibition (PPI) of the startle reflex is the reduction in startle reactivity that occurs when a startle stimulus is preceded by another stimulus, called the prepulse, that usually is unable to elicit a startle reflex. PPI is considered an automatic attentional mechanism that gates cortical information processing resources. PPI reduction is regarded a trait marker for schizophrenia and schizophrenia related illnesses. This assumption is substantiated by the facts that, on the one hand, PPI is reduced in schizophrenia spectrum disorders and, on the other hand, PPI can be reduced by dopaminergic stimulation in animals. Due to these relations PPI is used as an operational measure of attentional disturbances in schizophrenia. PPI can be increased if attention is directed to the prepulses, indicating that gating mechanisms may be temporarily strengthened when stimulus processing is psychologically significant for an individual. In general, however, little is known about the influence of psychological state factors, as activation or attention, on PPI. Especially, it is unknown whether state factors as high activation or attentional distraction may reduce PPI. Effects of momentary state on PPI become an important question when subjects from different experimental groups experience different unspecific state factors, i.e. state factors which are not controlled by the experimental design.

## Methods

### subjects:

29 healthy subjects. 9 excluded due to EMG-artifacts.  
Final sample: N=10 each group (total: N=20), mean age: 28 years.

### independent variables:

- attention (repeated measures): free running (FR) vs. focused on a task (FOC; maze task)
- instructed activation (repeated measures): stress (high activation) vs. relaxation (low activation) during task
- consistency of activation (group factor): activational factors (AF) consistent vs. AF inconsistent.  
AF consistent: stress instruction during first experimental section with adaptation to experimental setting low, relaxation instruction during second experimental section with adaptation to setting consolidated  
AF inconsistent: relaxation instruction during first experimental section with adaptation to setting low, stress instruction during second experimental section with adaptation to setting consolidated

### dependent variables:

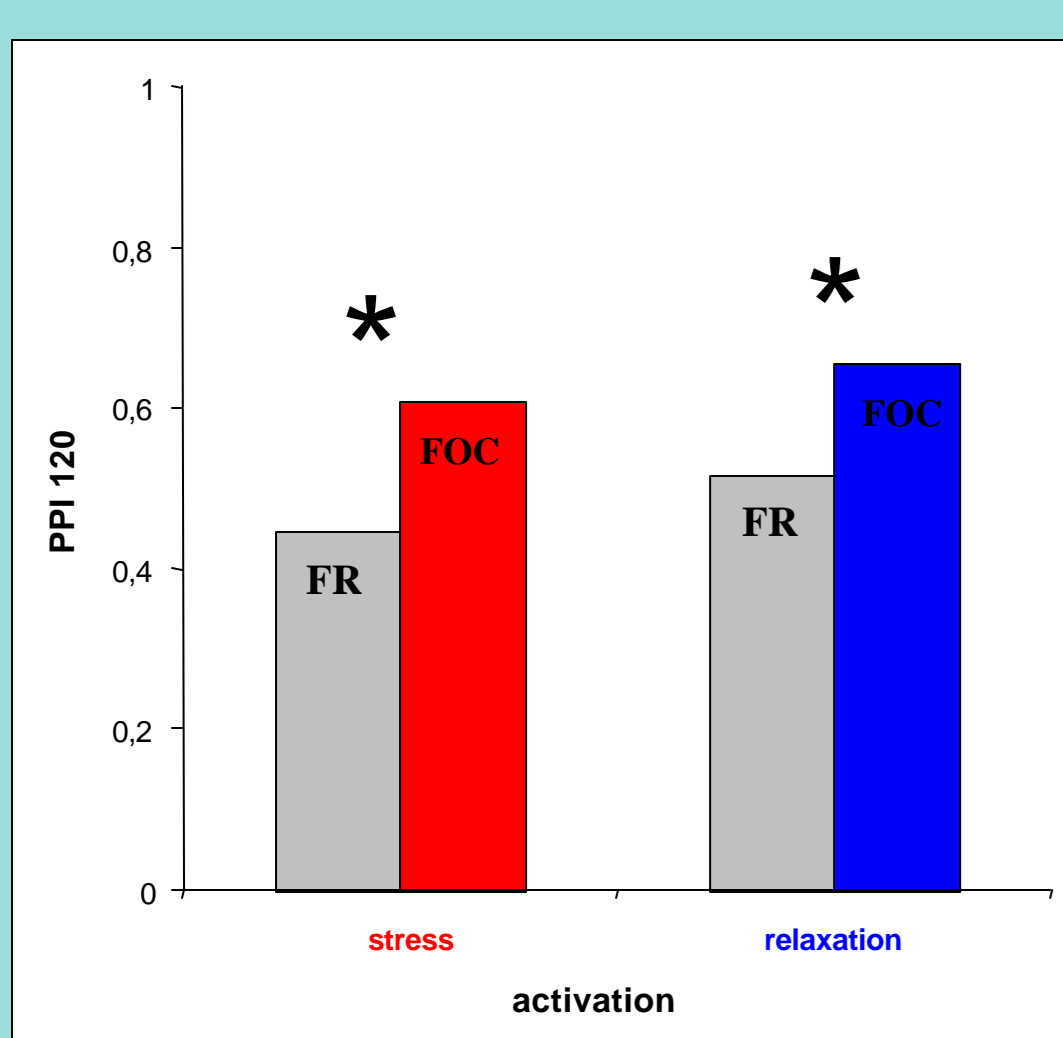
startle reactivity (amplitude), PPI - 30ms prepulse interval, PPI - 120ms prepulse interval (EMG m.orbic.occ.)

### statistics:

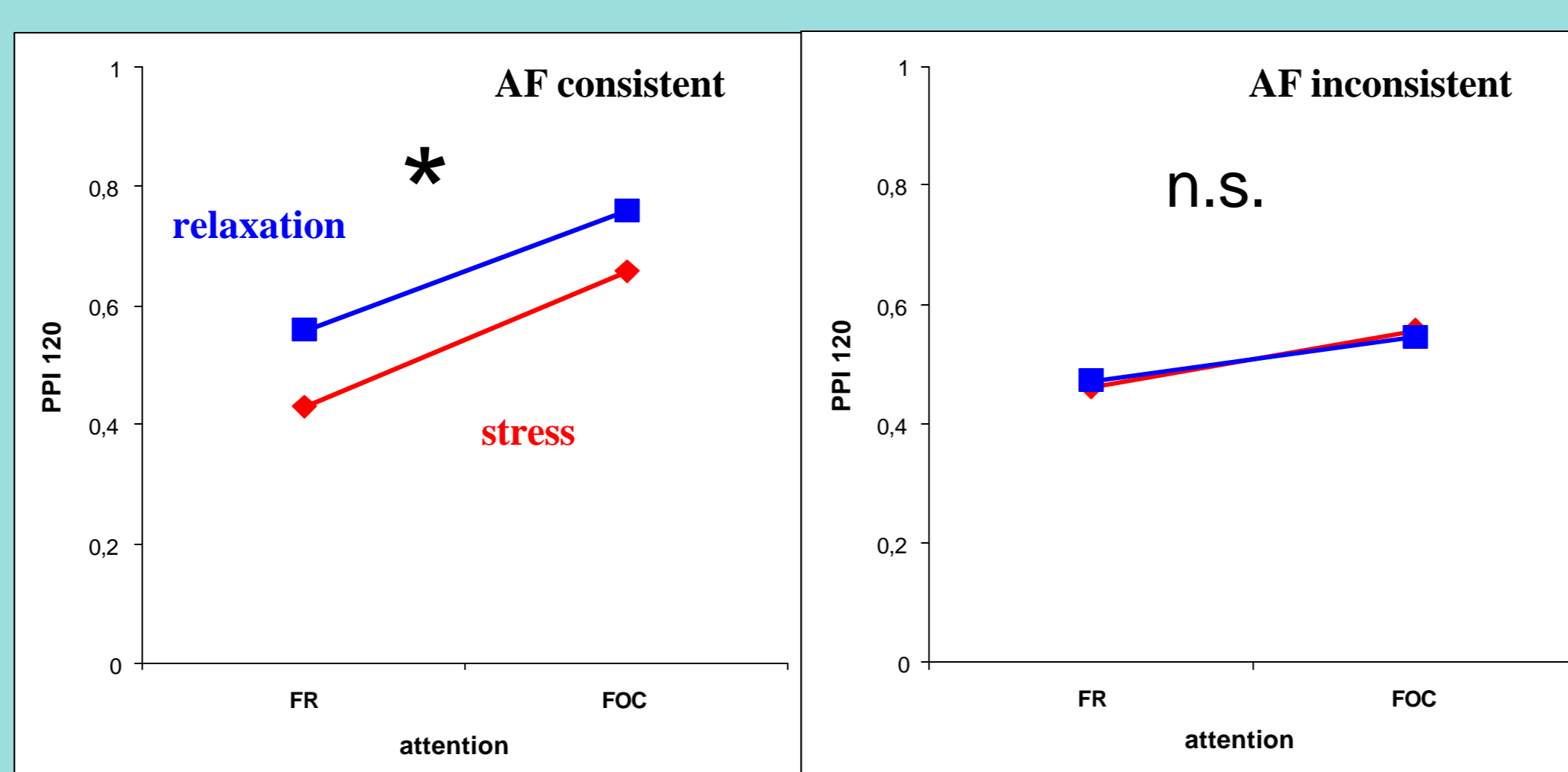
3-factorial ANOVA, posthoc tests.  
Confirmation by non-parametric analyzes if requirements for parametric testing violated.

## Results

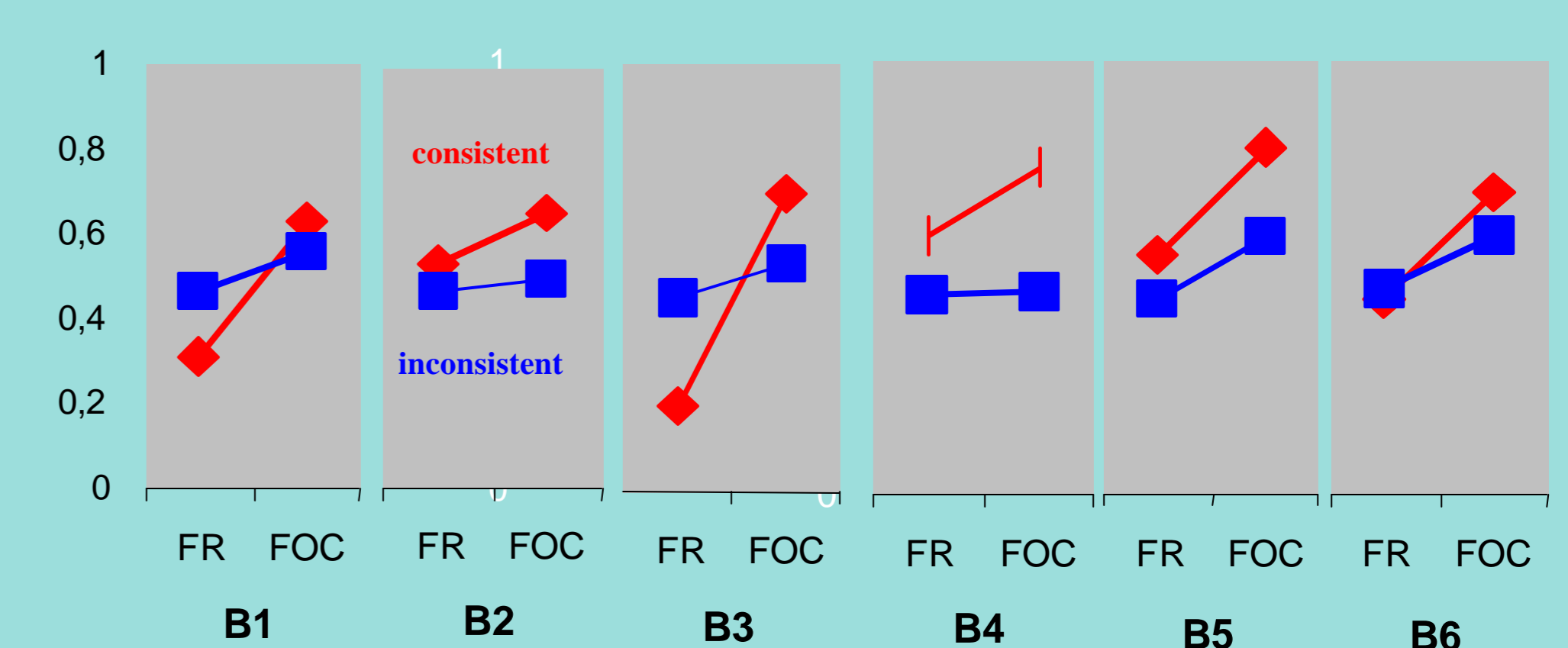
### attention



### activation



### time course of PPI across blocks



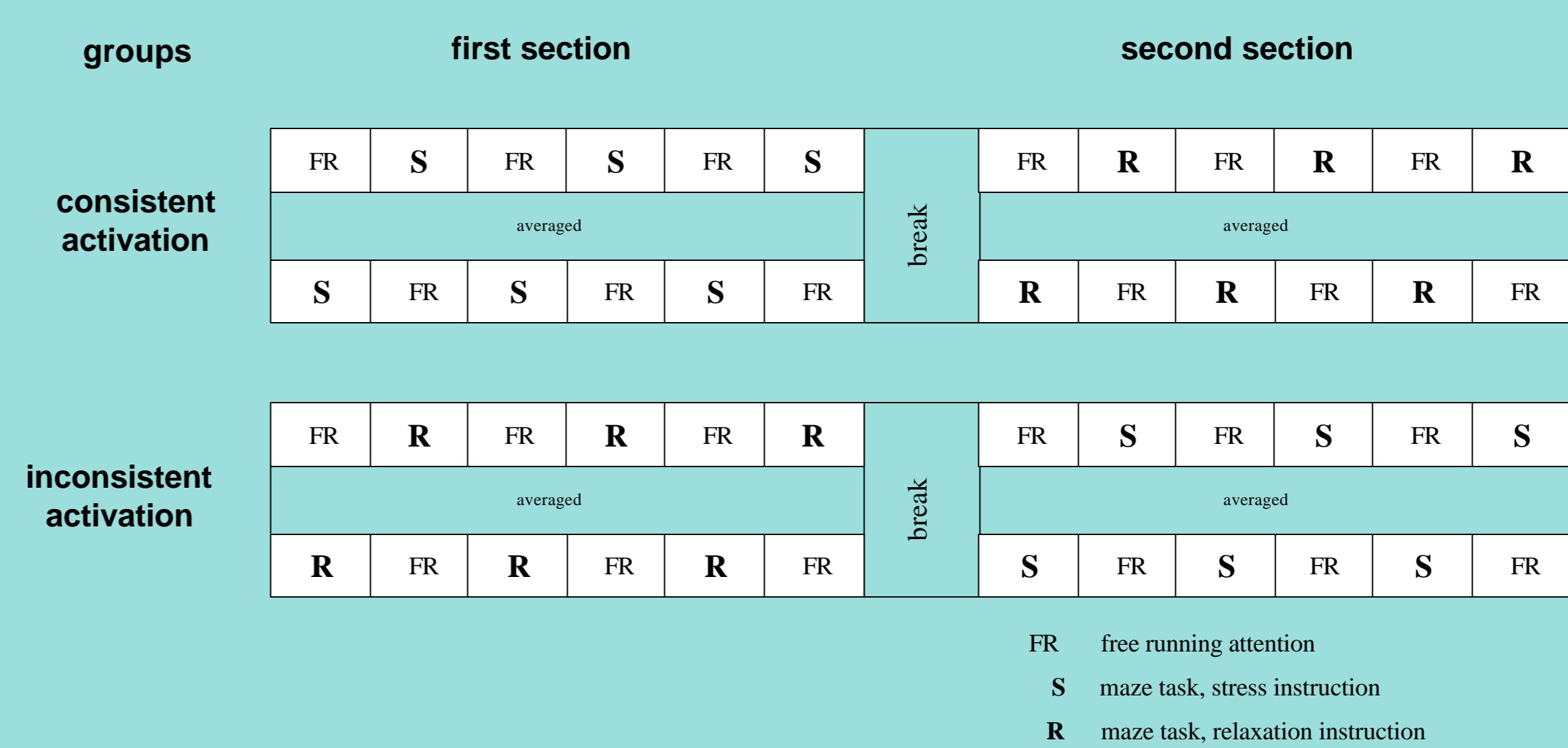
## Summary

- PPI is decreased during free running attention (factor 'attention':  $F(1,18)=21.4$ ,  $p<0.001$ )
- PPI tends to be decreased during stress (factor 'instructed activation':  $F(1,18)=3.2$ ,  $p<0.09$ )
- Effects depend on consistency of activation: significant within group effects occurred only when subjects were exposed to consistent activational factors:  
factor 'attention':  $F(1,9)=16.7$ ,  $p<0.004$ ; factor 'instructed activation':  $F(1,9)=7.4$ ,  $p<0.03$ .  
No significant effects occurred within the group exposed to inconsistent activational factors
- In particular, PPI was low during free running attention combined with consistent high activation, i.e. within first section during free running attention after task performance with stress instruction

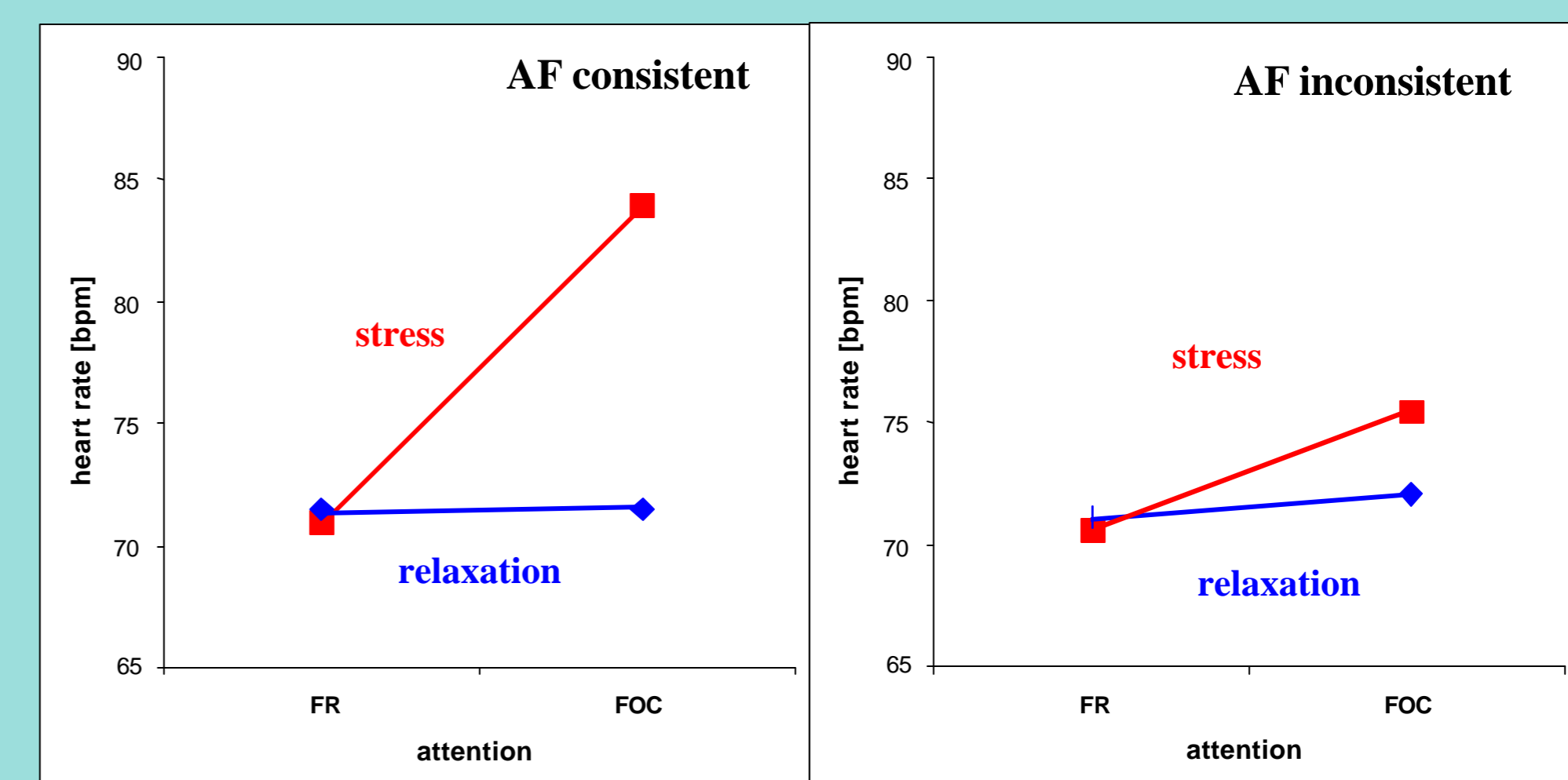
## Aims

This study explores activational and attentional state factors that may influence PPI of the acoustic startle reflex in healthy subjects. Two attentional states were repeatedly induced by a) focusing attention of subjects to a task not related to stimuli of the PPI paradigm (maze task), and b) leaving subjects in a state of free running attention, i.e. subjects were instructed to discontinue task execution and to do nothing. Activation of subjects was manipulated by instruction for task execution: a) stress instruction resulting in high activation ("perform task as quick as possible"; video recording of subject during task execution using a camera in front of subject), b) relaxation instruction resulting in low activation ("speed of performance is unimportant", "being relaxed is the best way to perform task correctly"; camera removed from visual gaze of subject). Consistency of activation was varied by combining activational instruction with adaptation of subjects to the experimental setting (low adaptation during first section of session associated with increased activation; consolidated adaptation during second section of session associated with decreased activation).

### sequence of experimental conditions



### induction of activation: heart rate



## Discussion

The results demonstrate a systematic influence of psychological state factors on PPI. PPI can be modulated by temporary changes of activation and attentional state. Such short-term changes of PPI may superimpose level changes of PPI caused by trait factors. Consistency of activational factors appeared to be an important prerequisite for modulation of PPI by attentional or attentional factors. If several factors concurrently influence the activation of subjects systematic modulation of PPI by state factors seems to occur only if the former factors affect activation in the same direction. Antagonistic activational effects seem to prevent PPI modulation. PPI turned out to be sensitive to the overall state of subjects. A striking effect was observed in the first experimental section when adaptation to the experimental setting is low: during free running attention after task execution under complex stress, PPI was reduced to a level which can be expected for schizophrenic patients. This observation points to temporary disruption of gating mechanisms, as indicated by PPI, after complex stress.