

## Objectives

A physiological reaction to a presented stimulus is influenced by stimulus novelty, significance and intensity [1]. This orienting response consists of multiple components, including respiratory and autonomic changes, and shall ensure an optimal perception of the stimulus [2].

**Anomalous stimulus discrimination** refers to significantly different orienting responses to stimuli with the same degree of intensity, novelty and significance for the subject at that time.

This effect occurred for the heart rate in a **forced-choice guessing task** (see Method) [3,4]. During a serial presentation of 4 similar objects (10 seconds each), subjects had a higher heart rate during the presentation of the object which was randomly chosen by the computer later (target) than during the presentation of the objects which were not chosen (nontargets).

## Aims of the study

### 1. Replication analysis

A replication of the effect was intended by using the same forced-choice guessing task and the same analysis of heart rate as in previous studies [3,4], but with a different set of stimuli.

### 2. Multi-channel analysis

It was investigated whether the effect occurs in peripheral physiological measures other than heart rate.

### 3. Correlation analysis

Correlations of behavioral and physiological data with personality traits were investigated.

## Method

### 1. Forced-choice guessing task with physiological measurement

“Can you foresee pure chance: Which object will the computer randomly choose as target?”

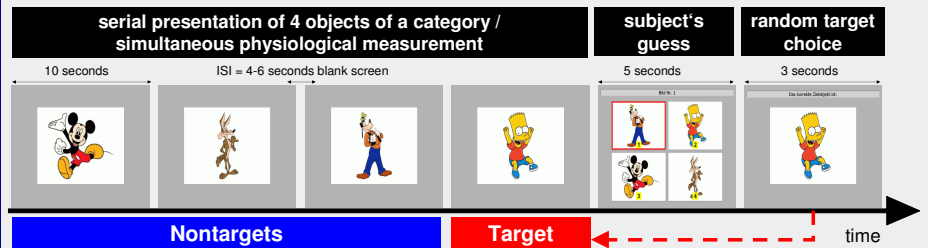


Fig. 1: Sequence of a block in the forced-choice guessing task (category “cartoon characters”)

### 2. Participants and Design

48 healthy subjects (18 male, 30 female; mean age  $24.4 \pm 2.86$ ). Categorical within-subject design with balanced object categories and balanced object positions across subjects, but random target choice. 14 blocks x 4 objects = 56 trials → physiological data of 42 nontargets & 14 targets per subject.

### 3. Physiological / behavioral measurement

Electrodermal activity (EDA), tonic and phasic heart rate (tHR, pHR), thoracic and abdominal respiration line length (RLL1, RLL2), finger pulse waveform length (FPWL), rate of correct guesses (RCG) and reaction times (not analyzed yet).

### 4. Personality scales

Tellegen Absorption Scale (TAS), Australian Sheep-Goat Scale (ASGS), Openness for Experiences (Openness, NEO-FFI).

### 5. Data reduction and statistics

Replication analysis	Multi-channel analysis	Correlation analysis
a) Analysis of correct guesses (binomial test for proportions, 2-tailed, $\alpha=.05$ ).	Z-transformation of raw data for each subject. Analysis of EDA, pHR, RLL1, RLL2 and FPWL, averaged for each subject (effect size Cohen's d, paired t-test, 2-tailed, $\alpha=.05$ ).	Correlations of scores on personality traits with behavioral and physiological response differences to targets and nontargets (2-tailed, $\alpha=.05$ , Bonferroni-adjusted).
b) Analysis of tHR with second-per-second values (effect size Cohen's d, paired t-test, 2-tailed, $\alpha=.05$ ).		

## Results

### 1. Replication analysis

- The rate of correct guesses was at chance level (correct=172, proportion=0.26,  $p=.46$ ).
- Analysis of tHR for targets and nontargets during 10 seconds after stimulus onset (Fig. 3). Following visual inspection of second-per-second values (Fig. 2), an explorative analysis of tHR for the first 5 seconds after stimulus onset was conducted (Fig. 3).

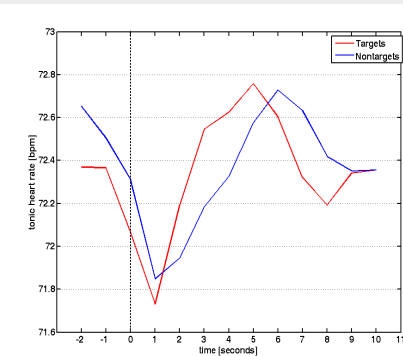


Fig. 2: Second-per-second values of tHR following trial onset (dashed line at 0 seconds) for targets and nontargets, averaged across all trials and all subjects.

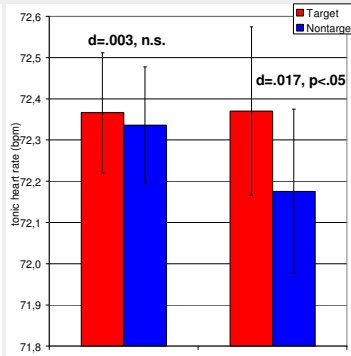


Fig. 3: Mean tHR for targets and nontargets during 10 seconds and 5 seconds (explorative) after stimulus onset.

### 2. Multi-channel analysis

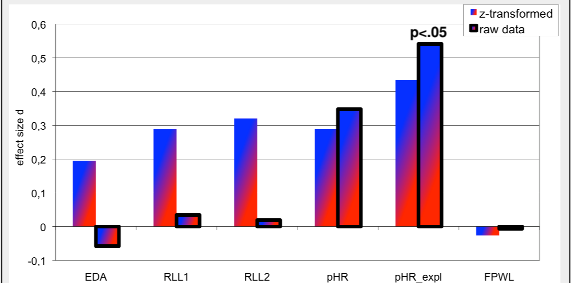


Fig. 4: Effect sizes (Cohen's d) for differential responses to targets and nontargets: raw scores and z-transformed scores for EDA, RLL1, RLL2, pHR [10 s], pHR\_expl [5 s] and FPWL.

### 3. Correlation analysis

	RCG	dRLL1	dRLL2	dpHR	dpHR_expl	dEDA	dFWPL
RCG	1	-0.21	-0.24	0.05	-0.08	0.15	-0.25
ASGS	-0.03	0.10	0.09	0.02	-0.07	0.35	-0.23
TAS	-0.13	0.13	0.16	0.00	-0.06	-0.05	0.00
Openness	-0.11	0.23	0.19	0.05	0.05	-0.02	-0.03

Table 1: Correlation coefficients between behavioral data (RCG), scores on personality scales (ASGS, TAS, Openness) and physiological response differences to targets and nontargets (z-scores of dRLL1, dRLL2, dpHR, dpHR\_expl, dEDA, dFWPL).

## Discussion

- Replication analysis:** No significant response difference of tHR for 10 s after stimulus onset to targets and nontargets occurred. An analysis of the first 5 seconds revealed a significantly higher tHR for targets than for nontargets, but this analysis has to be seen as explorative.
- Multi-channel analysis** revealed no significant differences in physiological responses to targets and nontargets. However, the explorative analysis of 5 seconds after stimulus onset showed a significantly higher pHR (raw data) for targets than for nontargets.
- Correlation analysis:** No significant correlations of physiological and behavioral response differences to targets and nontargets with scores on personality scales occurred.

**Methodical remark:** Because of unbalanced target positions across subjects, a habituation of physiological responses within the categories could have influenced the results. A statistical control for the distribution of target positions would be important for a concluding interpretation of the results.

## References

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