University of Economics in Prague
Faculty of Informatics and Statistics
Department of Information Technology

# „Freedom of choice“

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Diploma thesis reviewer: ? MUDr. Oldřich Vyšata, PhD.

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- Topic selection
- Thesis goals
- Thesis structure
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# Topic selection

- Special philosophical interest since HS, deeper interest recently
- General interest in scientific exploration of philosophical problems
- Importance for mankind
- Opportunity to conduct own experiment using EEG

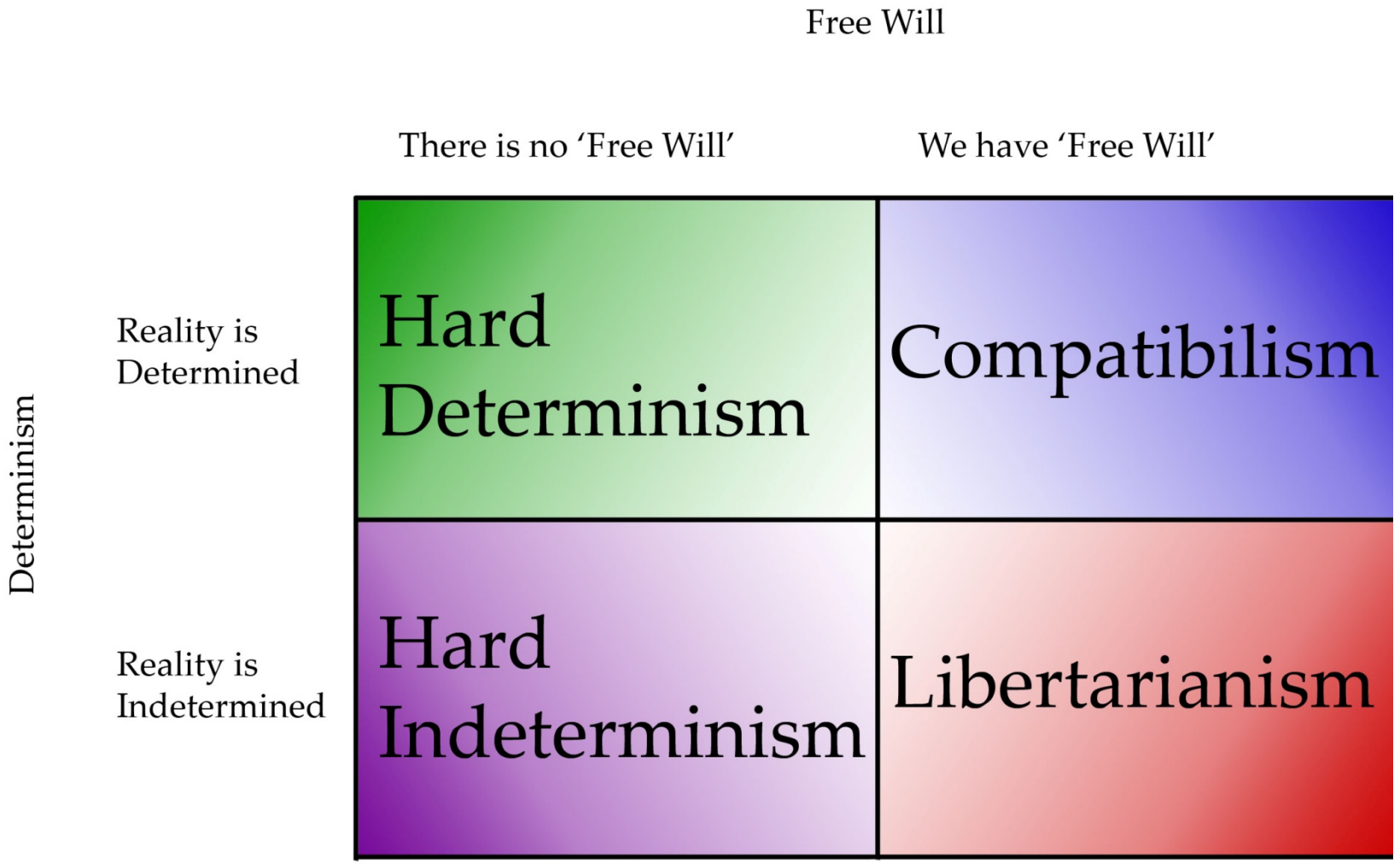
# Thesis goals

- Offer a historical overview of philosophical enquiries into the free-will problem and the most important scientific findings
- Conduct own empirical research
- Interpret previous and new results
- Propose a coherent conceptual framework
- Analyze the possible implications

# Thesis structure

- History  of philosophical enquiry
- Current scientific findings
- The experiment and interpretation of results
- Analysis of the concepts
- Implications for law and morality

# Philosophical enquiry

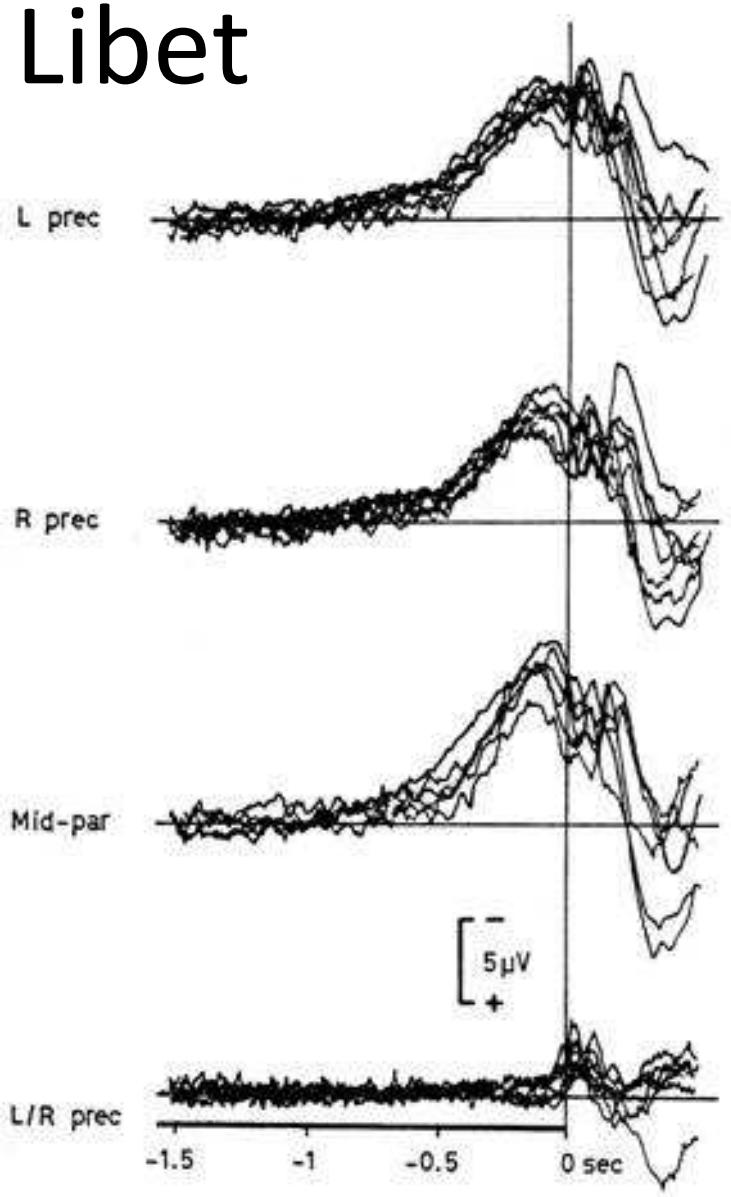


# Current scientific findings

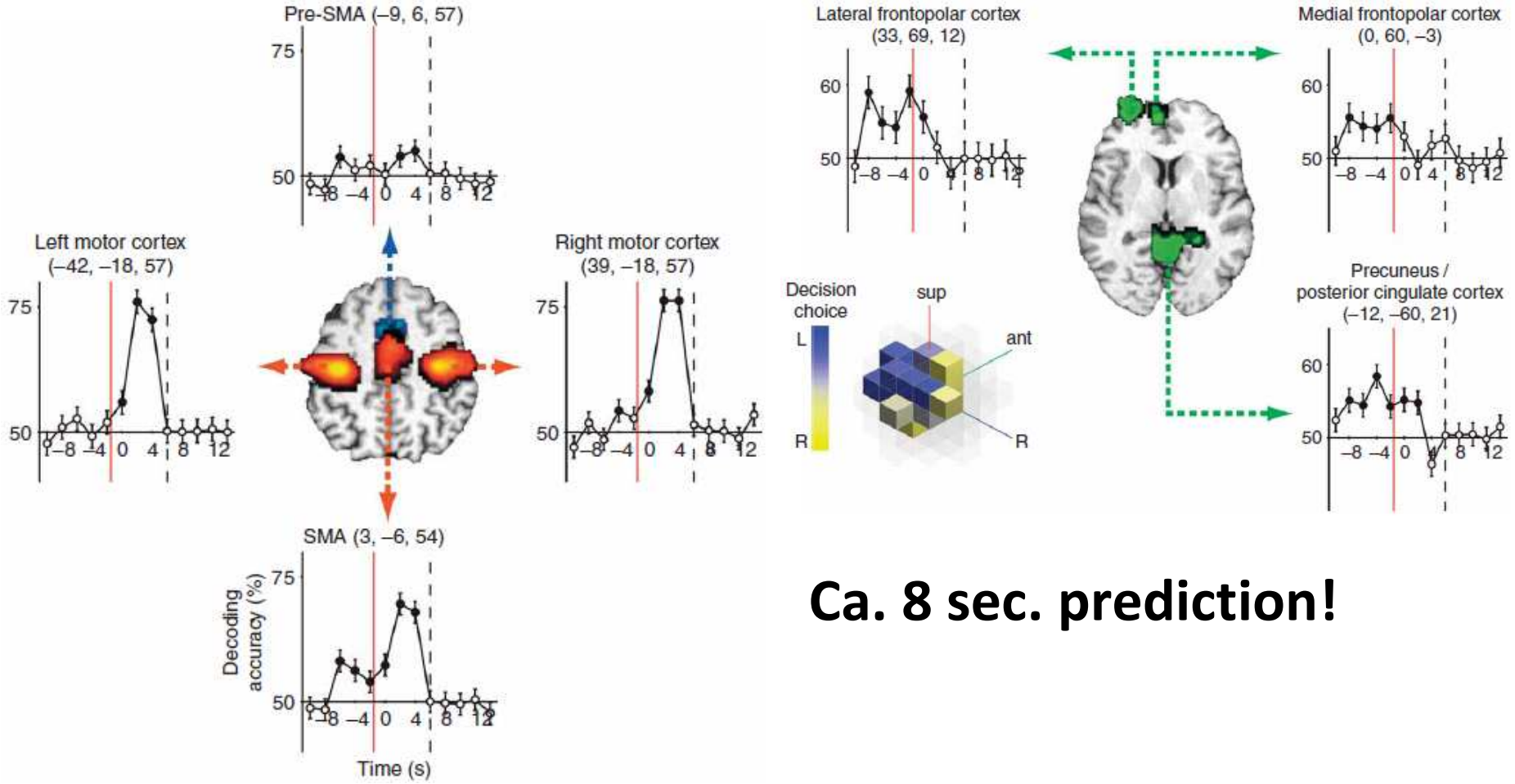
- Experiments
  - Behavioral
  - EEG
  - fMRI
  - TMS…
- Building hypotheses (models) based on the data

# Benjamin Libet

- Actions initiated unconsciously and can be predicted before we ourselves report conscious intention to act



# fMRI results

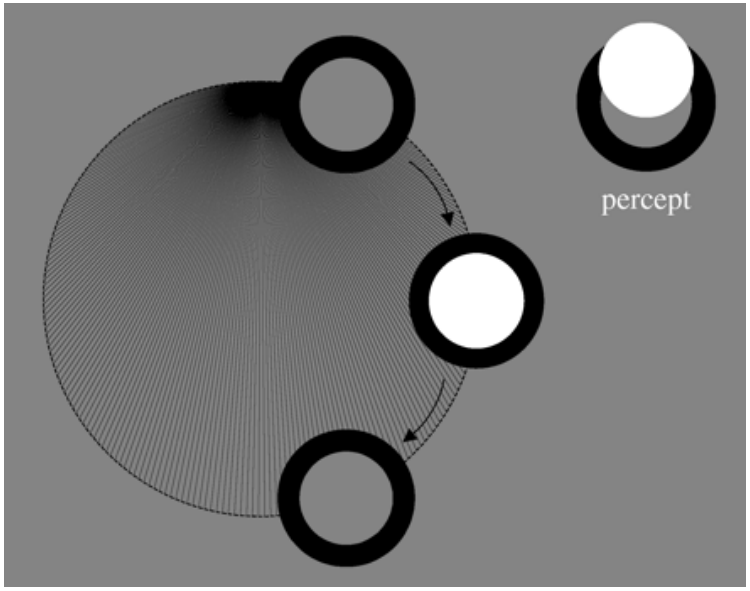



**Ca. 8 sec. prediction!**

Soon CS, Brass M, Heinze H, and Haynes J. Unconscious determinants of free decisions in human brain. *Nature Neuroscience 2008 11:543-545.*

# Prediction or postdiction?

- Neural prediction
- vs. Conscious postdiction
  - Flash-lag




# Wegner: Magical thinking

- "We are enchanted by the operation of our minds and bodies into **believing that we are "uncaused causes," the origins of our own behavior**. Each self is magic in its own mind."

- People can be led to experience conscious will over behavior they have in fact not caused
- And conversely to experience a lack of will over behavior they have caused

Wegner, D. (2008). Self is Magic. In J. Baer, J. Kaufman, & R. Baumeister, (Eds.), *Are we free? Psychology and free will*, pp. 226-47. New York: Oxford University Press.

# Wegner: Magical thinking

- “[P]eople experience willing their actions when they draw causal inferences relating their thought to their action”
- **Consistency**: [T]he thought should be consistent with the action…
- **Priority**: …occur just before the action…
- **Exclusivity**: …and not be accompanied by other potential causes.

- But: Can it be inferred just from the performed action? Or in a different way, e.g. “on the fly” from some neural processes?

# My experiment

- Kühn, S., Brass, M. (2009). **Retrospective construction of the judgment of free choice.** Consciousness and Cognition, 18, 12-21.
- Replication & modification

Consciousness and Cognition 18 (2009) 12–21

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## Retrospective construction of the judgement of free choice

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ABSTRACT

The problem of free will lies at the heart of modern scientific studies of consciousness. Some authors propose that actions are unconsciously initiated and awareness of intention is referred retrospectively to the action after it has been performed [e.g. Aarts, H., Custers, R. & Wegner, D. M. (2005). On the inference of personal authorship: Enhancing experienced agency by priming effect information. *Consciousness & Cognition, 14*, 439–458]. This contrasts with the common impression that our intentions cause those actions. By combining a stop signal paradigm and an intentional action paradigm we show that participants sometimes indicate to have intentionally initiated an action while reaction time data strongly suggest that they in fact failed to stop the action. In a second experiment we demonstrate that the number of trials in which participants misattributed their awareness of intention varied with the intentional involvement during action planning. Our data support the retrospective account of intentional action. Furthermore, we introduce an experimental approach that objectifies introspective judgments of awareness of intention.



### 1. Introduction

Although Sigmund Freud (1917) declared we are not "der Herr im eigenen Haus" (master of our own house), we still feel as if we were. We might have arranged with the knowledge of unconscious motives we do not have access to, but this does not seem to have influenced our self-conception of having primary access to our intentions and action plans. We might have heard about the experiments of Benjamin Libet claiming that actions are unconsciously initiated and are already predictable from external electrophysiological measures before we ourselves report consciousness of the intention to act (Libet, Gleason, Wright, & Pearl, 1983). This implies that the feeling of being in control of an action has to be a reconstructed experience (often called "subjective back-referral").

An alternative hypothesis to this retrospective reconstruction assumes a predictive mechanism of phenomenal experience of intention. Wolpert assumes that a forward model makes predictions about the behavior of the motor system and its sensory consequences (Wolpert, Ghahramani, & Jordan, 1995). Those predictions are used to compare the actual outcome of a motor command with the desired outcome enabling rapid error correction before sensory feedback is available. In line with that model sensory attenuation has been shown to result from these kinds of predictive mechanisms. When a motor command is generated, an "efference copy" of this command is used to predict the sensory consequences of the action and this predictable component is removed from the incoming sensory signal, thereby causing the attenuation (Bays, Flanagan, & Wolpert, 2006).

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# Abstract


- The problem of free will lies at the heart of modern scientific studies of consciousness. Some authors propose that **actions are unconsciously initiated and awareness of intention is referred retrospectively to the action after it has been performed** [e.g. Aarts, H., Custers, R., & Wegner, D. M. (2005). On the inference of personal authorship: Enhancing experienced agency by priming effect information. Consciousness & Cognition, 14, 439–458]. **This contrasts with the common impression that our intentions cause those actions.** By combining a stop signal paradigm and an intentional action paradigm we show that **participants sometimes indicate to have intentionally initiated an action while reaction time data strongly suggest that they in fact failed to stop the action**. In a second experiment we demonstrate that the number of trials in which participants misattributed their awareness of intention varied with the intentional involvement during action planning. **Our data support the retrospective account of intentional action.** Furthermore, we introduce an experimental approach that objectifies introspective judgments of awareness of intention.

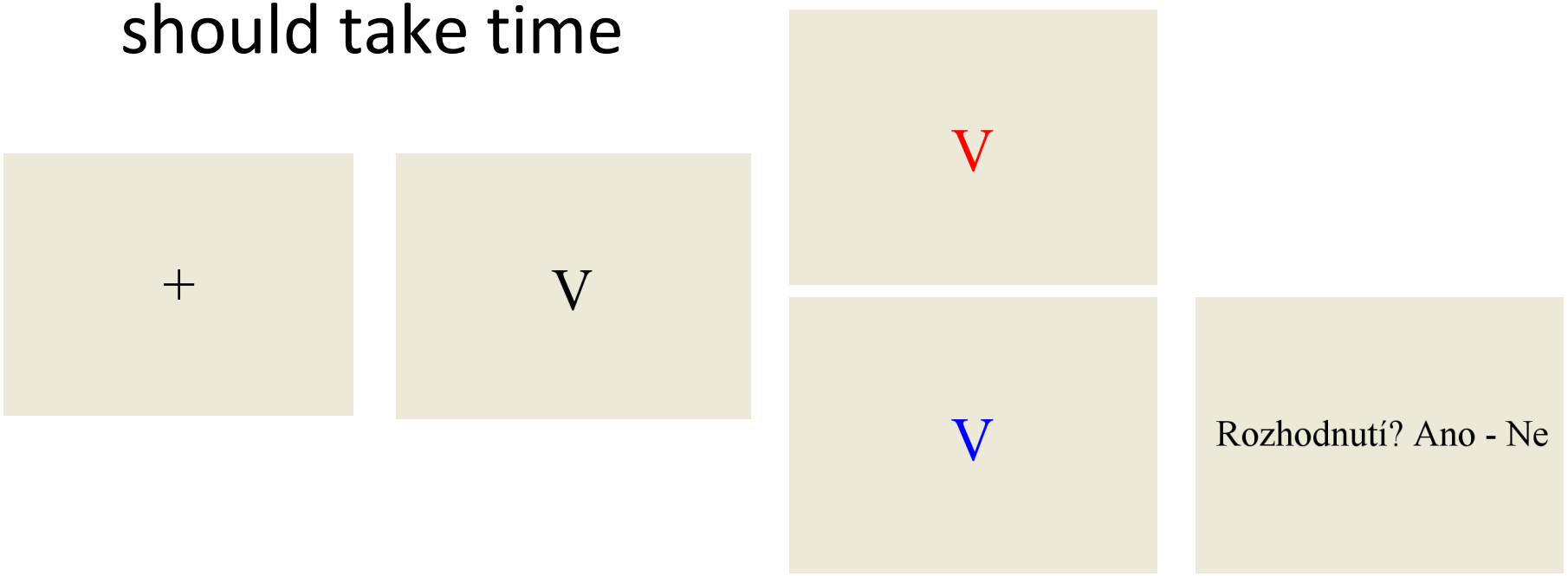
# Hypothesis

- **The conscious feeling of a voluntary decision is a reconstructed experience**
  - Subjective backwards-referral, postdiction
  - "awareness of intention is referred retrospectively"

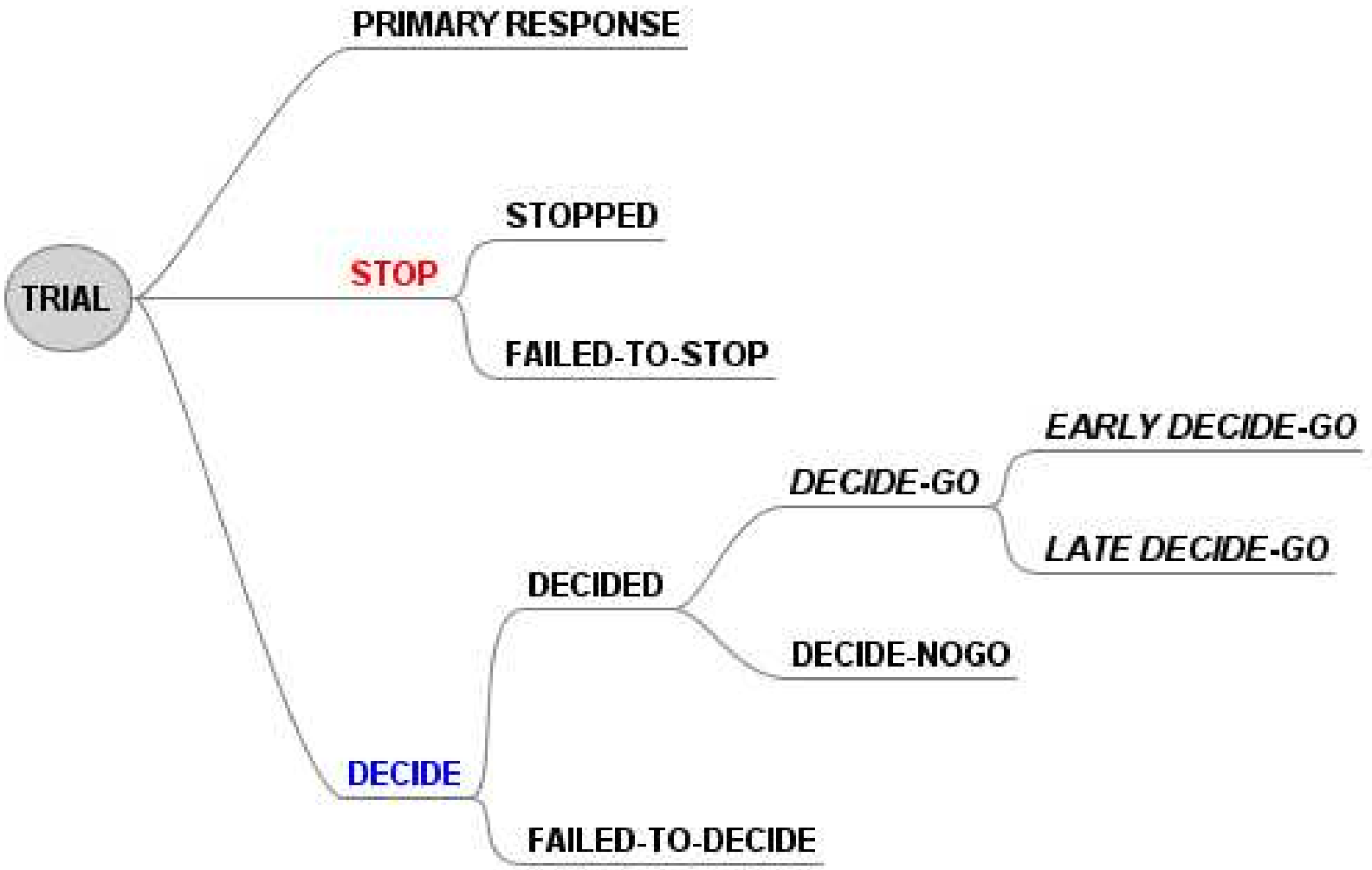
- "Are subjects able to tell the difference between a *voluntary decision to resume* an ongoing action and an *inability to stop* an ongoing action?"

# Method

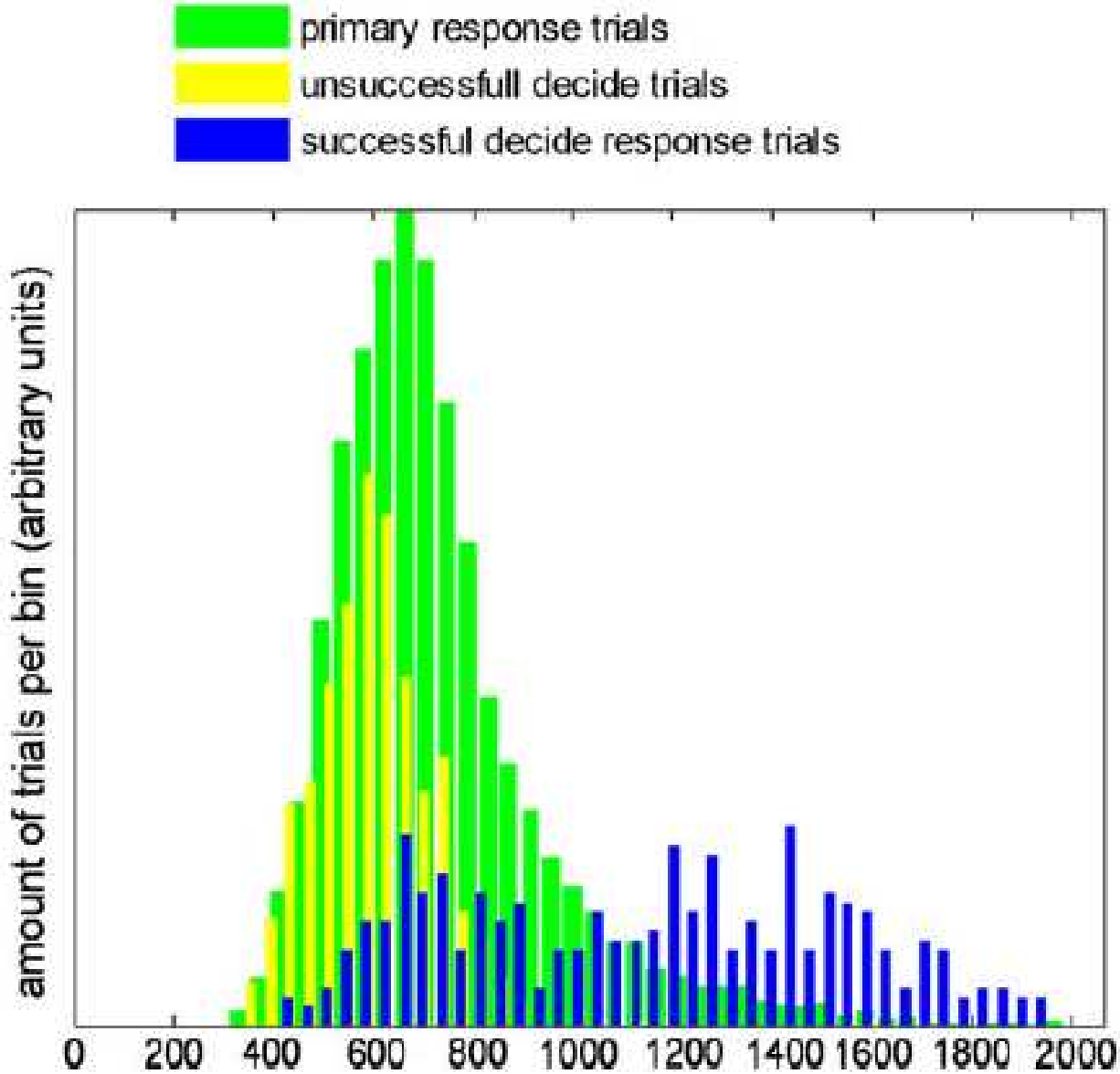
- Combination of a stop signal paradigm and intentional action paradigm
- RT measurement: The process of stopping an ongoing action and reinitiating it voluntarily should take time



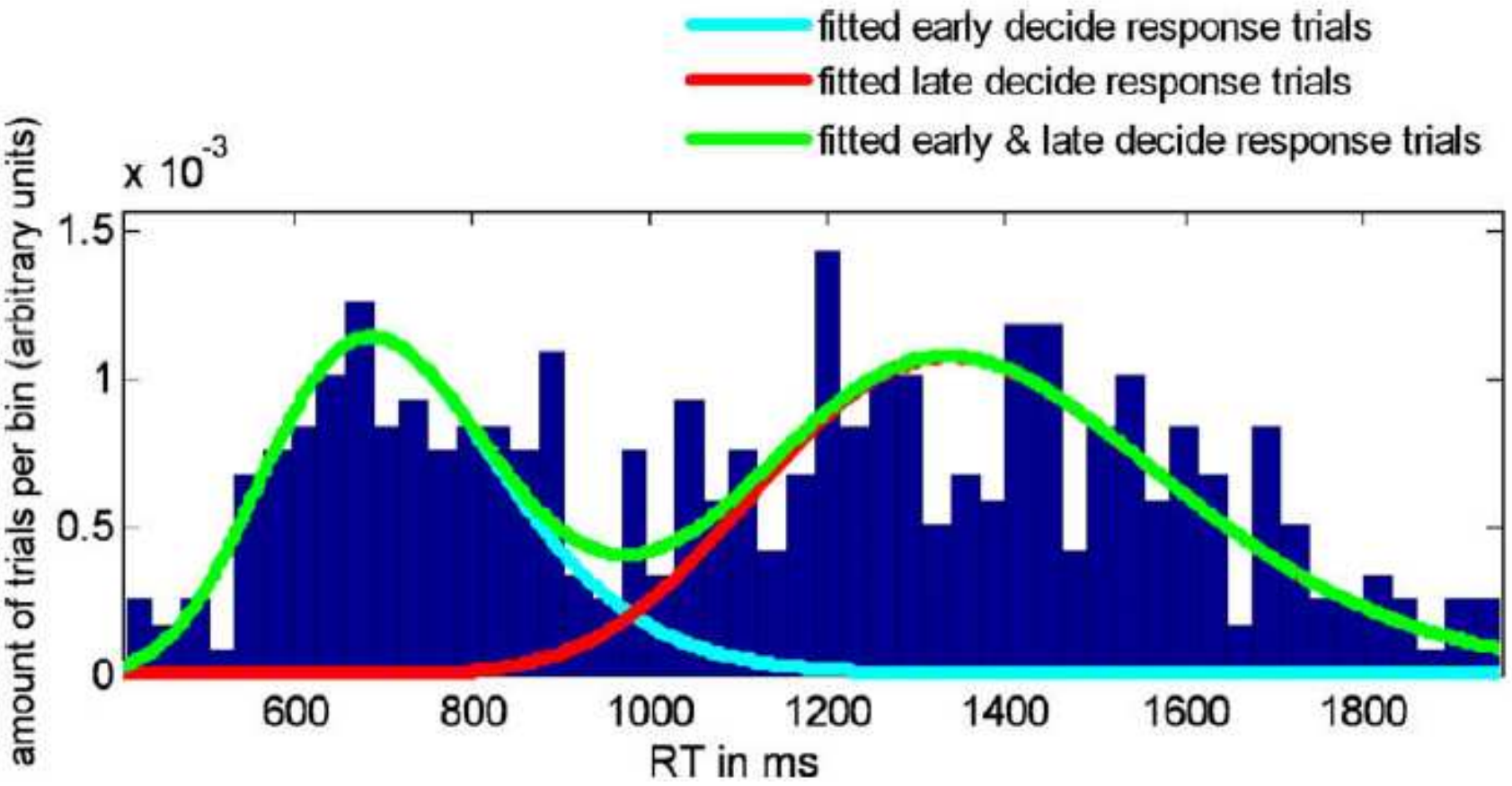
# Schema of trials



# Reaction time distribution



# Decide-go trials



# Original conclusion

- "…participants reported a substantial amount of trials as being intentionally decided that were actually in the reaction time range of the primary response time. This finding strongly suggests that they **falsely attributed an intentional decision to act when they were actually not able to stop.**"
- "…**retrospective construction of the feeling of free choice <u>can</u> occur**, presumably especially in cases when we are uncertain about the degree of deliberateness of an action."

# {Issues, Concerns, Problems, Questions}

- What is the reason that in some cases the feeling of intention is illusory and in some isn't?
- Assumption that early decisions must be unconscious and late consciously intended
  - Correlate with EEG recordings
- Time pressure to introspect
  - What if the time limit is removed?
- Need for a replication
  - We want more data

# Our experiment

- Location:
  - Department of Computing and Control Engineering, Institute of Chemical Technology in Prague (VŠCHT)
- Supervisor:
  - Oldřich Vyšata M.D., PhD.
- The Team:
  - Ondřej Havlíček
  - Michal Hájek
  - Martin Schätz

# Current challenges

- Technical problems
  - Noise, Latency
- We need a large amount of data
  - Ca. 30 participants (or 2x15) x 60 minutes of recording
- Methodological problems
  - Important events are very rare
  - 1/64 -> 1/48
- Statistical and mathematical processing

# Achievement of the goals and personal contribution

- After we obtain and process (!) the results…

# Questions of the supervisor and reviewer

- After I actually write and submit the thesis…

# We need more volunteers!

Thank you for you attention!

Questions?

Suggestions are most welcome!