

*RacLab*

**The neural computation of human  
prosocial choices in complex  
motivational states**

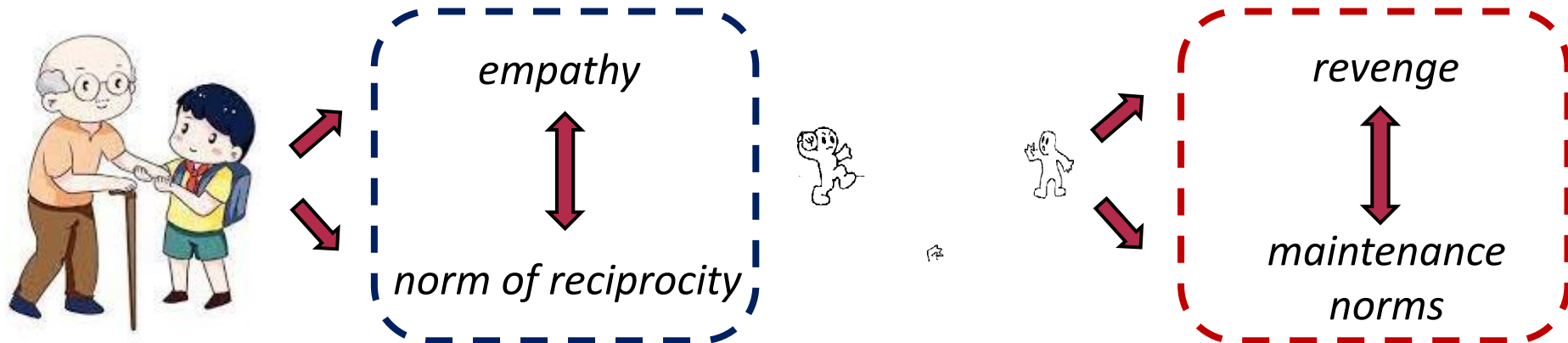
*Neuroimage, 2022*

Yang Ziyang

2025.1.17

# Introduction

most human behaviors are **driven by multiple motives** that are active at the same time, and affect each other

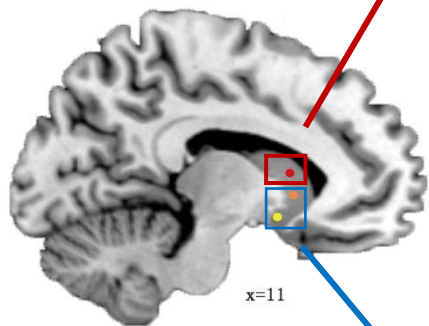


cannot be explained by one  
“motivational force” alone.



**multiple simultaneously  
activated motives** affect  
behavioral choice processes

# Introduction



**dorsal**

initiating and optimizing choices  
based on these encoded values



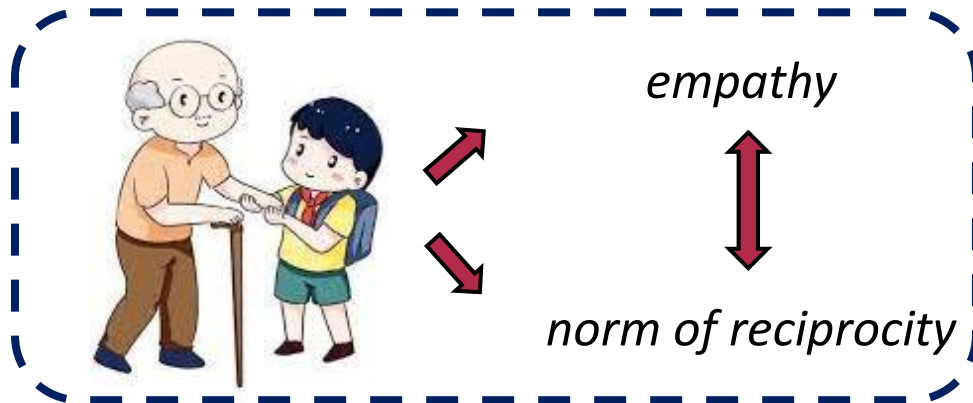
**ventral**

learning and encoding of values and  
the predictions of future rewards



the neural computation of behaviors that are  
driven by different motives **remains unclear.**

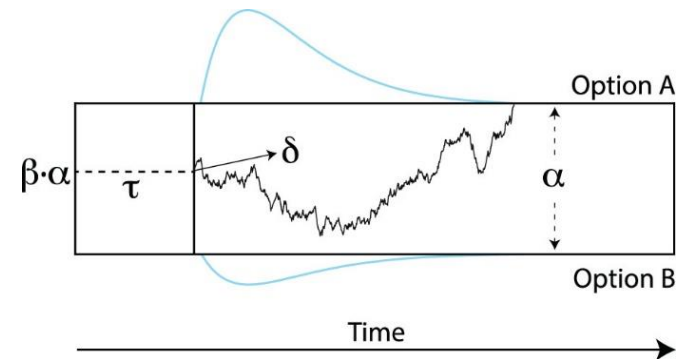
# Introduction



*affective response to another person's misfortune*

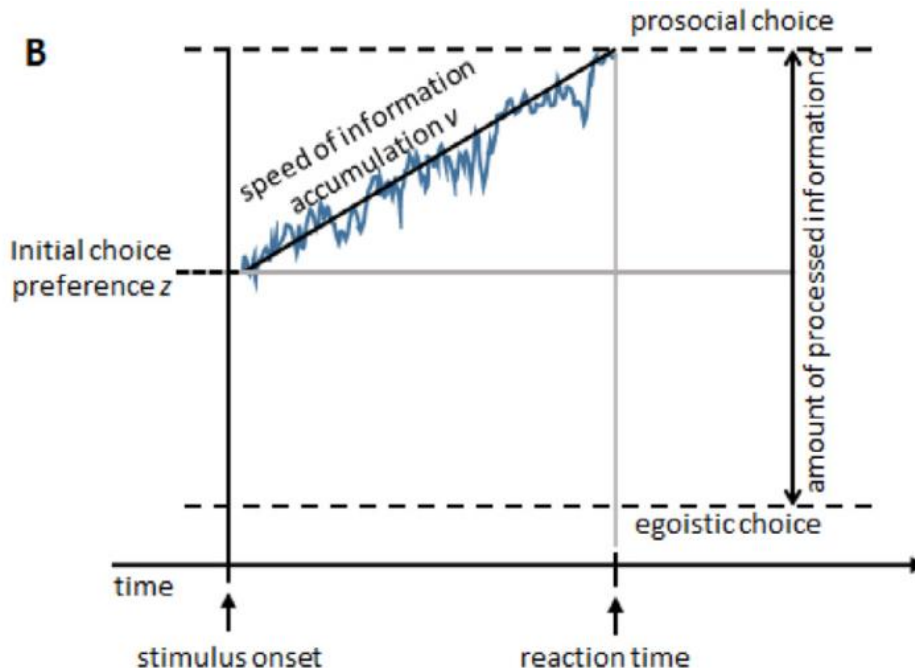
*desire to reciprocate perceived kindness with a kind behavior*

# Introduction



- The  $v(\delta)$ -parameter describes the speed at which information is accumulated in order to choose one of the options
- The  $z(\beta)$ -parameter reflects the initial choice bias
- The  $\alpha$ -parameter quantifies the amount of relative evidence that is required to choose one of the options.

(Johnson et al., 2017)



**initial  
bias**



*\*starting point*

# Introduction

empathy and reciprocity both drive prosocial behavior



*Behaviour*

## **Hypothesis:**

In the present paradigm this means that computation of the prosocial choice option should be facilitated



*DDM* ( $v/z/\alpha$ )

an increased speed of information accumulation



enhancement of participants' initial bias to choose the option

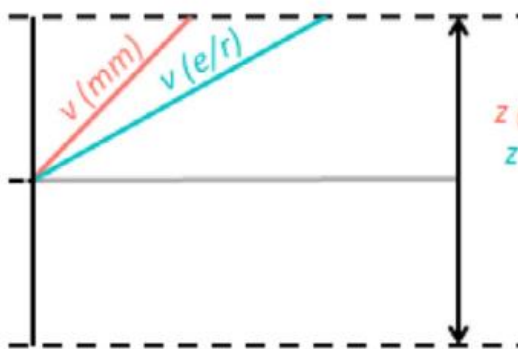


additional motive-related information

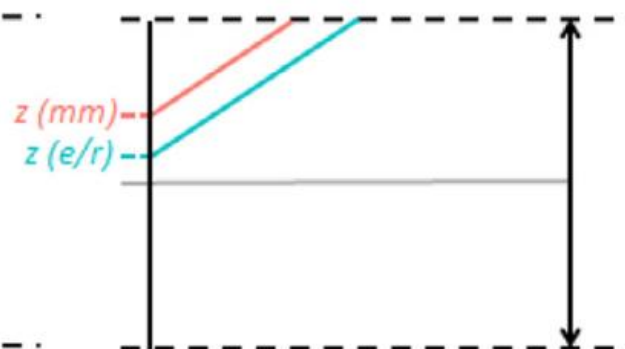


$mm$  = multi-motive  
 $e/r$  = empathy/ reciprocity

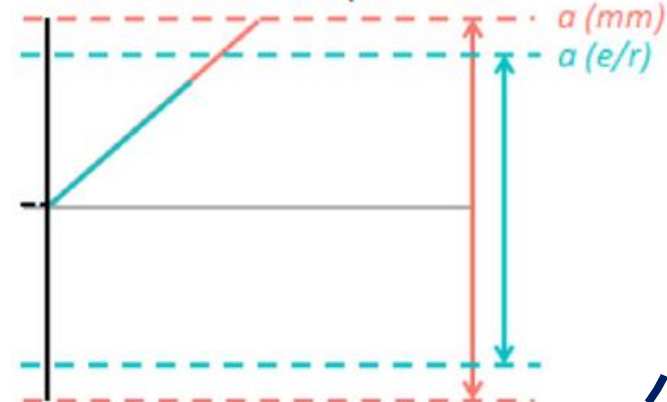
modulation of the  $v$ -parameter



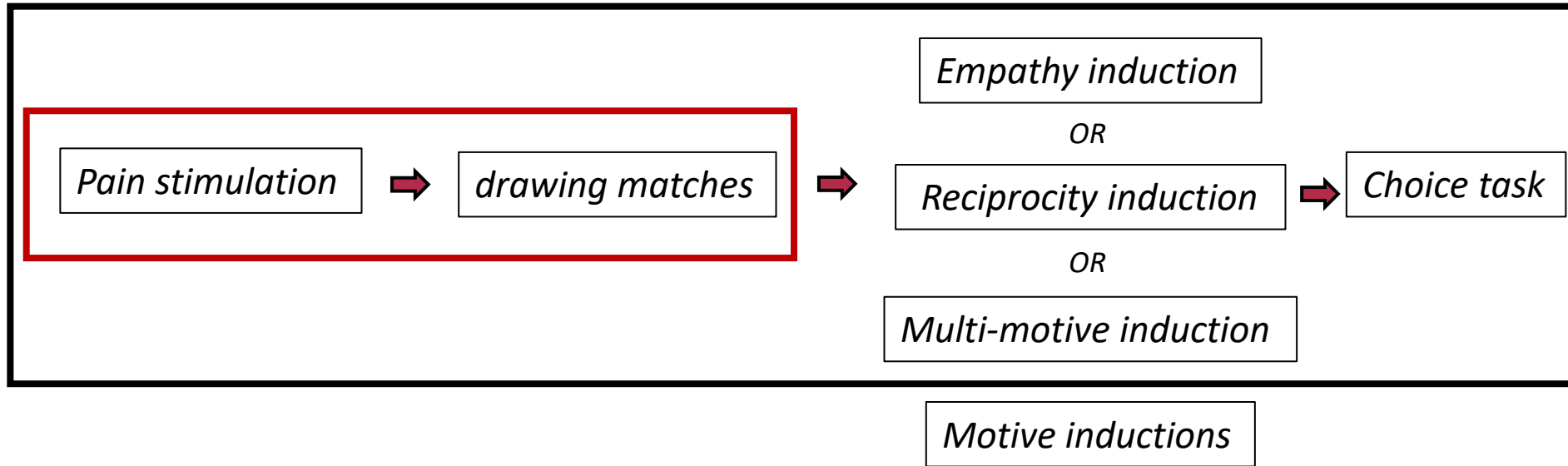
modulation of the  $z$ -parameter



modulation of the  $\alpha$ -parameter



# Design



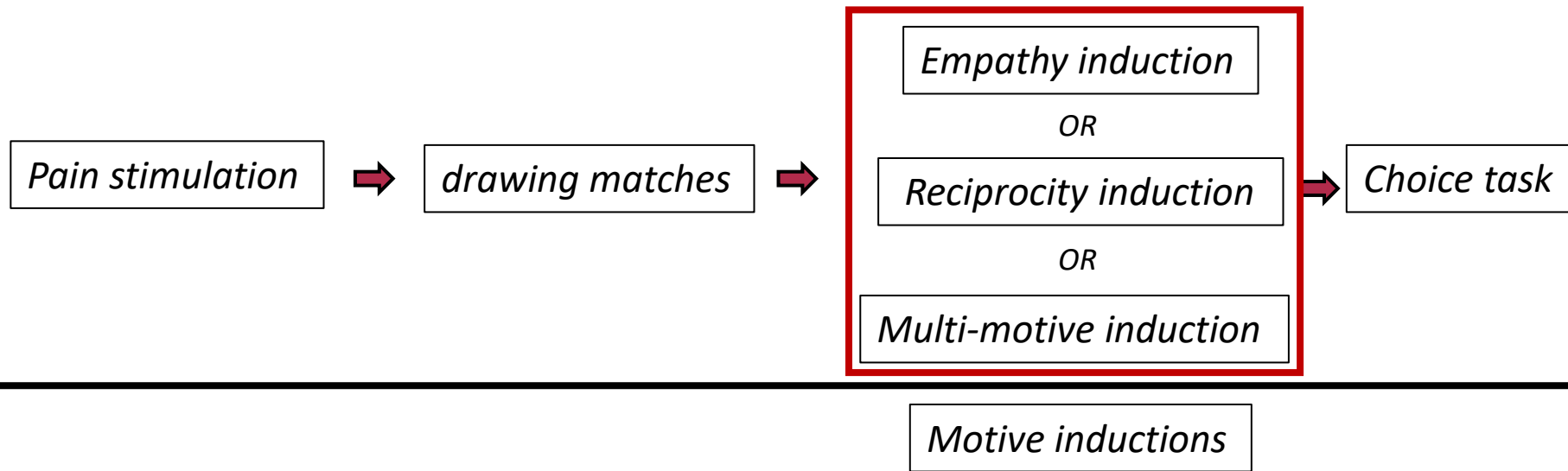
*Empathy induction*

participants saw the hand of the respective partners with the attached pain electrode and repeatedly observed one of the confederates (the empathy partner) receiving painful shocks, a situation known to elicit an empathic response

*Reciprocity induction*

induced the reciprocity motive by instructing one of the confederates (the reciprocity partner) to give up money in several trials to save the participant from painful shocks

# Design



*Empathy induction*

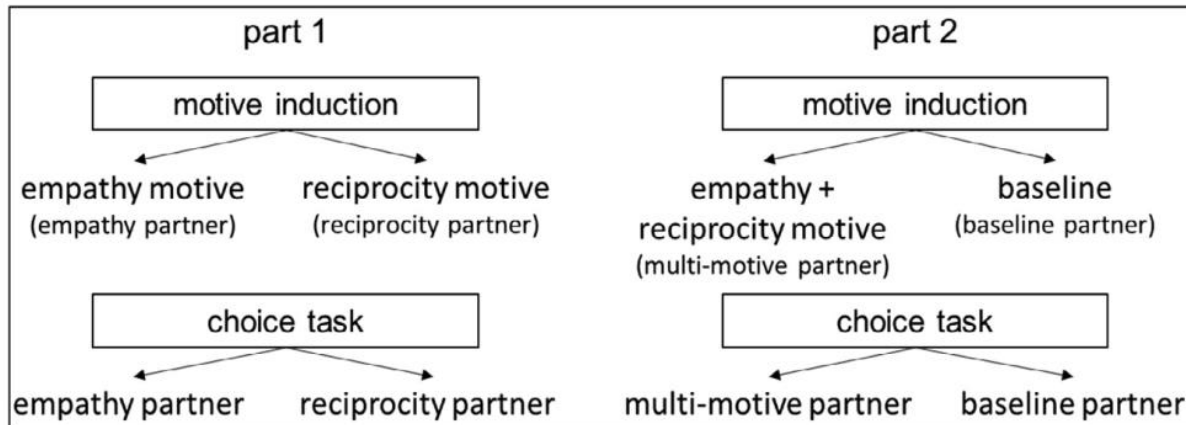
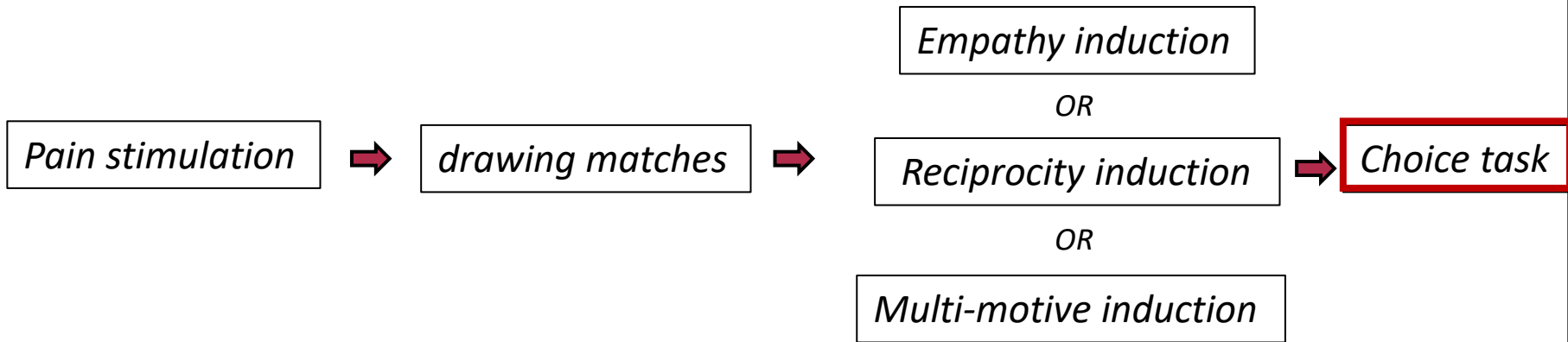
participants saw the hand of the respective partners with the attached pain electrode and repeatedly observed one of the confederates (the empathy partner) receiving painful shocks, **a situation known to elicit an empathic response**

*Reciprocity induction*

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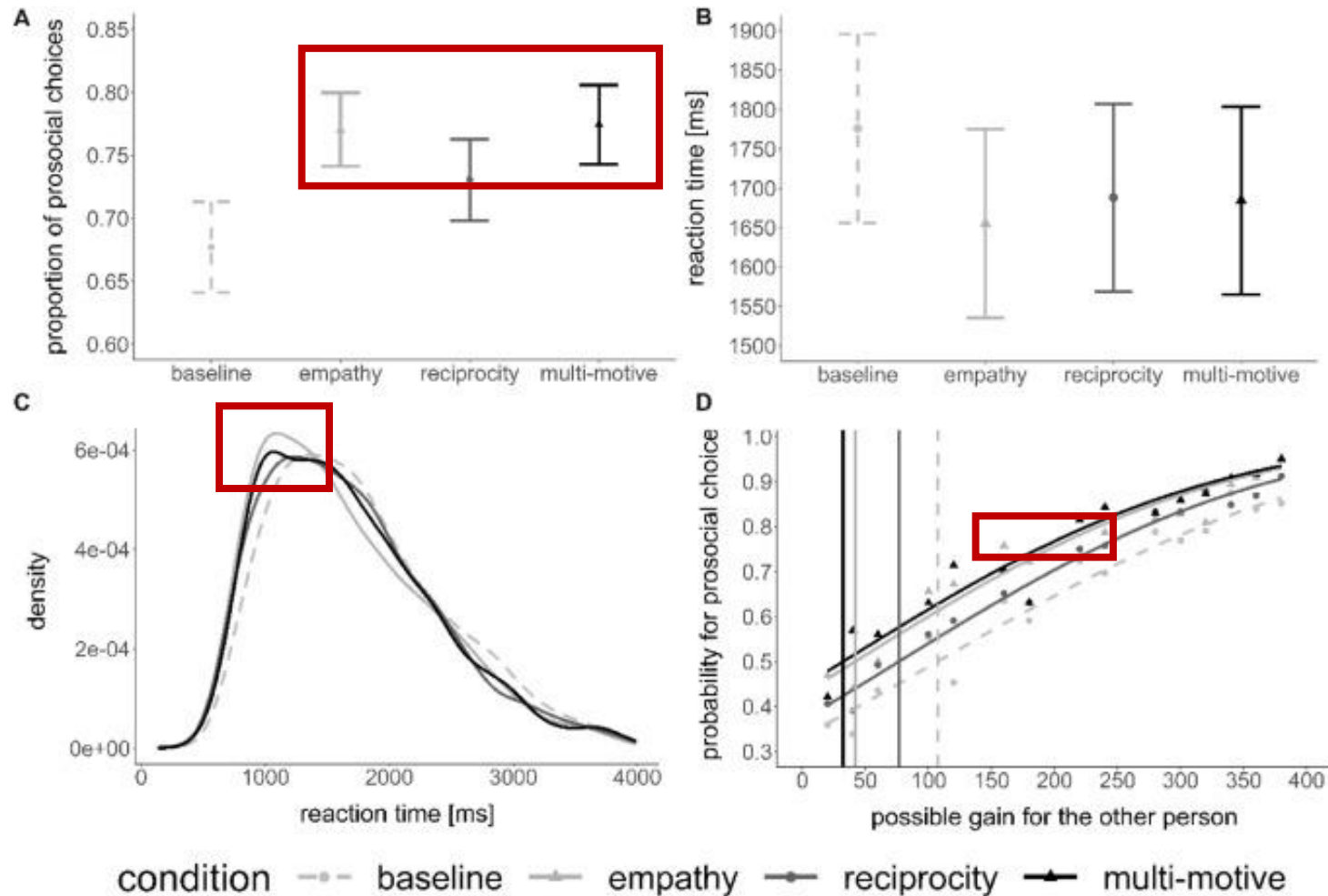


# Design



# Result

Multi-motive = empathy > reciprocity > baseline



demonstrating that prosocial choices were enhanced when reciprocity was **combined with empathy**, relative to reciprocity alone

# Result

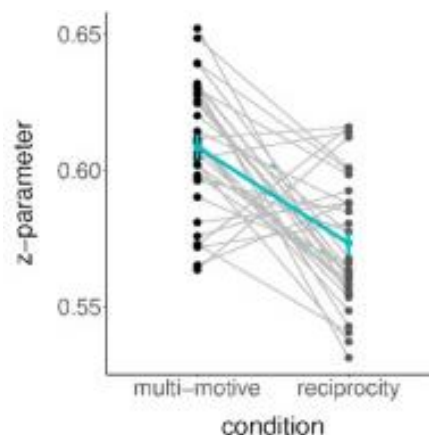
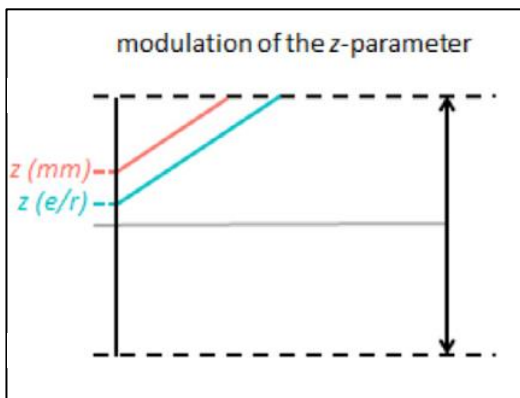
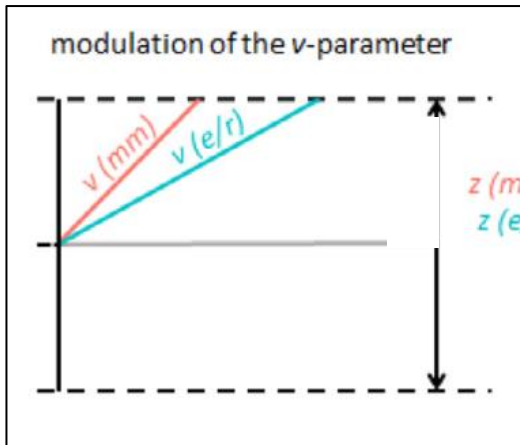
Multi-motive = empathy > reciprocity > baseline

## Hierarchical drift-diffusion modeling

- no significant differences in the  $v$ -parameters

speed of information accumulation **mainly unaffected by the combination of the two motives**

$v$  : Multi-motive = empathy = reciprocity



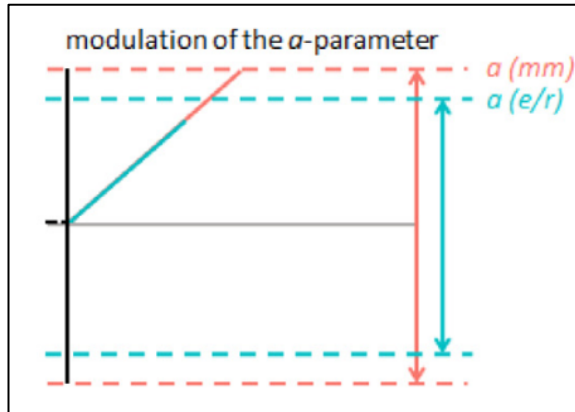
- an increase in initial prosocial bias ( $z$ -parameter) in the multi-motive condition

$z$  : Multi-motive = empathy > reciprocity

# Result

Multi-motive = empathy > reciprocity > baseline

## *Hierarchical drift-diffusion modeling*



- the  $\alpha$ -parameter was **only on a trend level higher in the multi-motive** condition compared to the reciprocity condition, and not significantly higher than the empathy condition

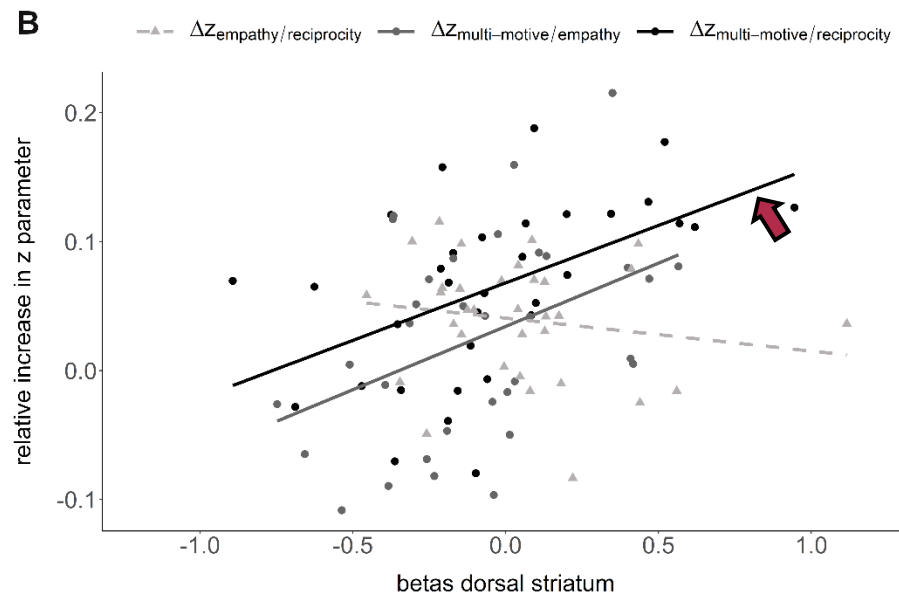
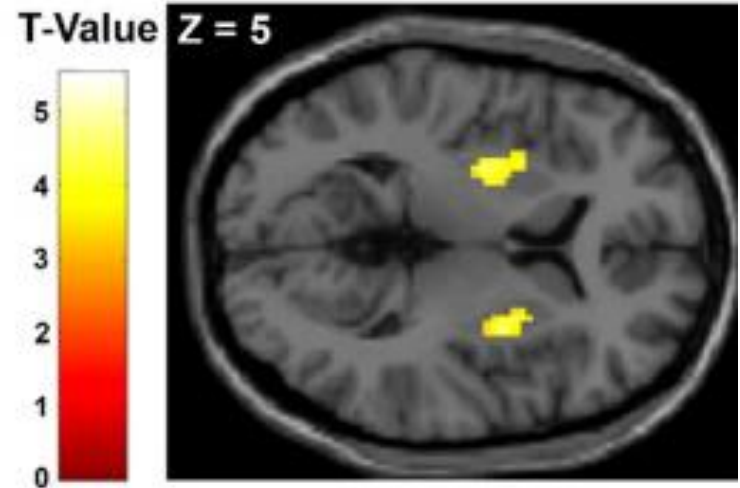
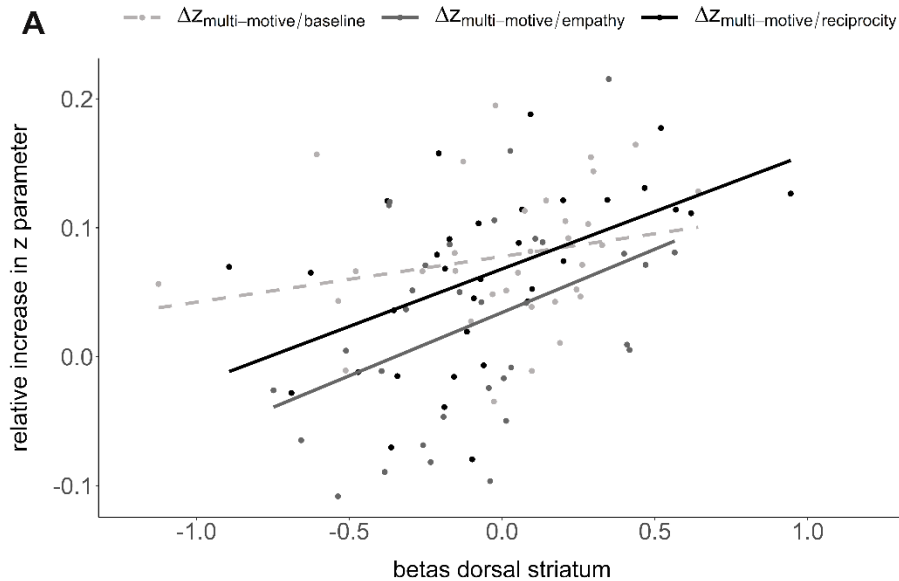
$\alpha$  : Multi-motive = empathy  $\geq$  reciprocity



***The observed changes in the multi-motive condition cannot be explained by the dominance of one motive over the other when the two motives were activated simultaneously?***

# Result

Multi-motive = empathy > reciprocity > baseline



bilateral dorsal striatum that  
were related to the individual  
change in **prosocial bias ( $\alpha$ )**

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