Speeded response times

Joachim Vandekerckhove

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Response times – reaction times – latencies

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- asked to do a simple task like categorizing the stimulus (is this an ‘A’ or a ‘B’?)

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- participants presented with a perceptual stimulus
- asked to do a simple task like categorizing the stimulus (is this an ‘A’ or a ‘B’?)
- instructed to perform the task as quickly and accurately as possible

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Response times – reaction times – latencies

A very common type of data in experimental psychology

- participants presented with a perceptual stimulus
- asked to do a simple task like categorizing the stimulus (is this an ‘A’ or a ‘B’?)
- instructed to perform the task as quickly and accurately as possible
- repeated many times with small variations or under different conditions

A few subtle distinctions: Speeded vs. not

Speeded response times

These result from easy tasks where the participant is instructed to respond as quickly as possible. They happen on short time scales – less than a second on average. You might call them 'split-second' decisions. Real life examples are tasks such as deciding when to apply the brake while driving, or whether to duck or jump if an object flies your way.

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Non-speeded response times

These result from more complex tasks where the participant has to weigh many considerations and may have to deal with the consequences of a decision. They happen on much slower time scales – at least several seconds but possibly much longer. They include decisions such as economic decisions (e.g., buying a car) or social decisions (e.g., how to respond to a marriage proposal).

A few subtle distinctions: Simple vs. choice

Choice response times

These result from tasks in which the participant is specifically instructed to choose between several alternatives. They not only have to press a button but additionally have to choose which button to press. There may be two alternatives (two-choice response times) or more than two (multiple-choice or multialternative response times). Note that choice response times are bivariate.

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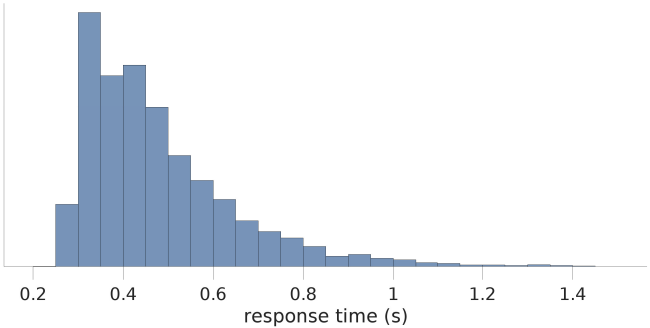
Simple response times

These result from tasks where there is no ambiguity about which button to press – the instruction is simply to press it as quickly as possible. Simple response times are univariate.

The strangeness of choice response times



- Non-normal and skewed

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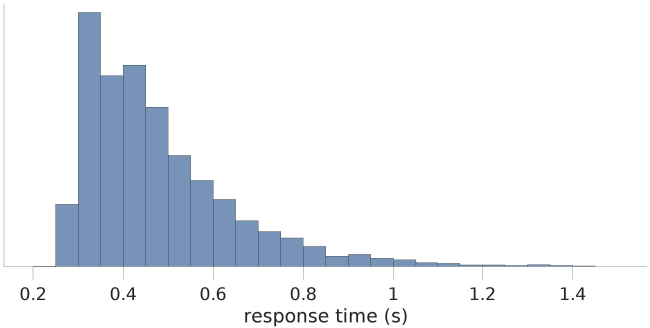
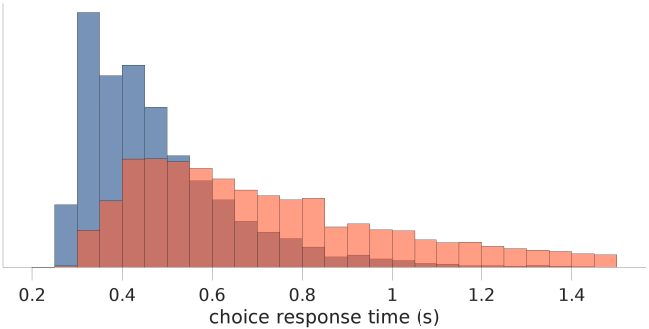


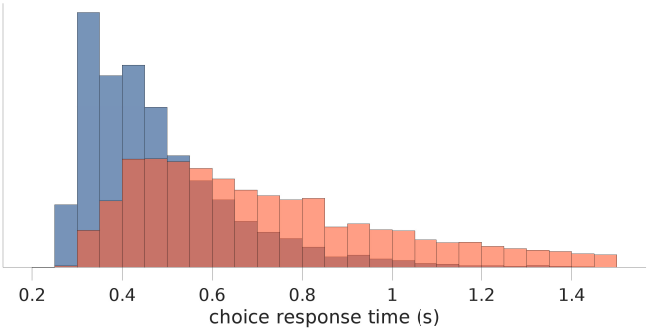
- Non-normal and skewed
- ‘Hard left bound’

The strangeness of choice response times



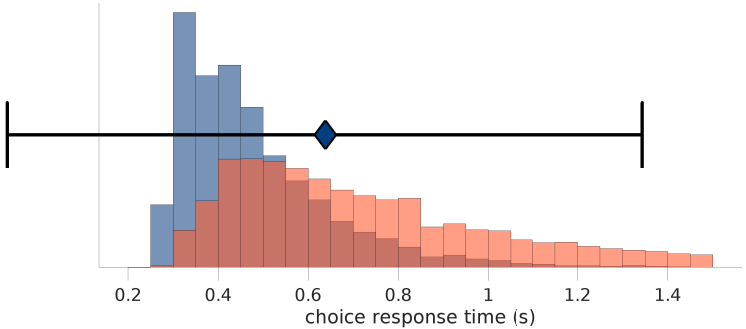
- Bivariate (one continuous, one binary)

The strangeness of choice response times



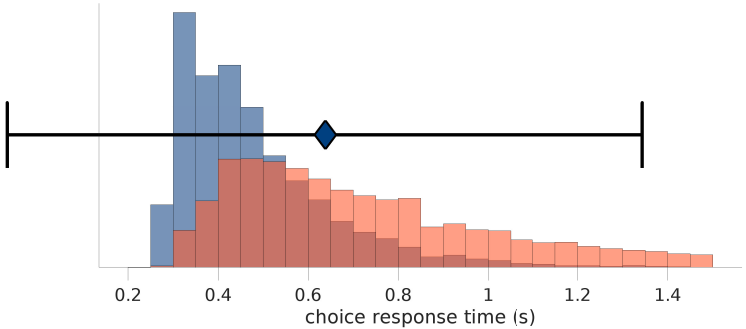
- Bivariate (one continuous, one binary)
- Not independent

Summaries of CRTs



- Are mean and SD really capturing the information in these data?

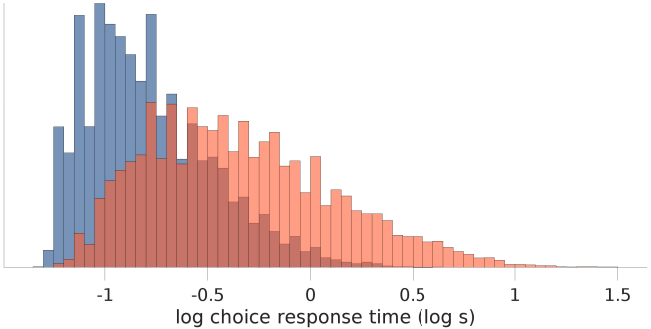
Summaries of CRTs



- Are mean and SD really capturing the information in these data?
- Here the 95% CI goes into the negative

Variance stabilization

It is possible to give a strictly statistical treatment to the skewed data through various variance stabilizing transformations.



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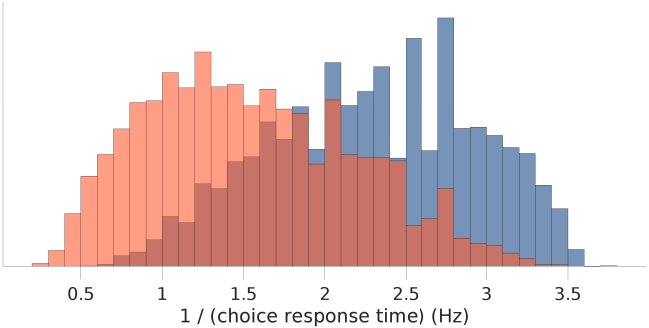
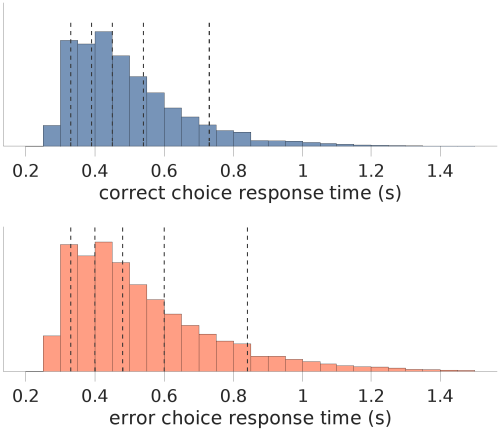


Visualizing CRT data

CRT distributions can have a lot of detail and information in them



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Quantiles can be used to summarize nonstandard distributions

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Here, each distribution is marked with the 10^{th}, 30^{th}, 50^{th}, 70^{th}, and 90^{th}, percentile, so that 20% of the data falls in each of the middle bins

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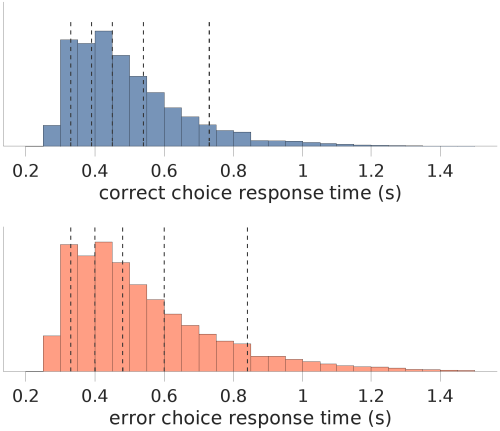
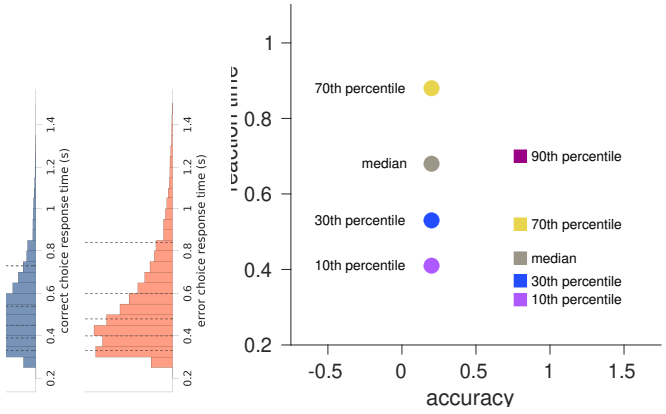


Quantile probability plots (Simen et al., 2009)

Plot the RT quantiles (vertical) over the condition accuracy (horizontal)



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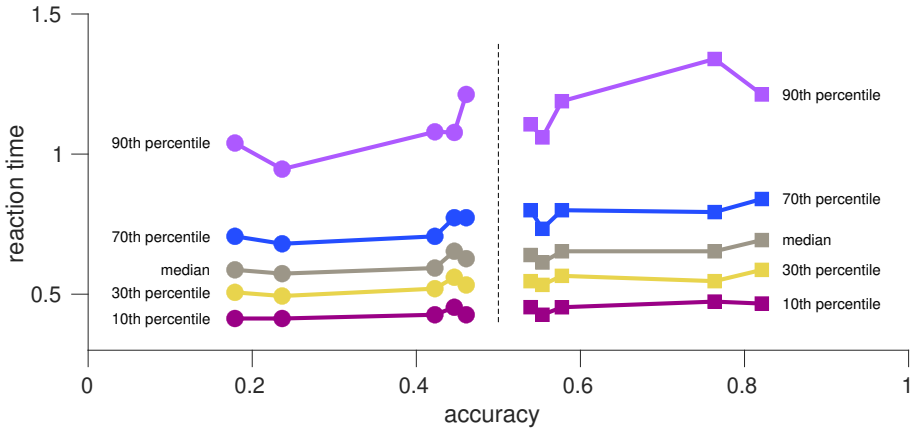
(Data from Vandekerckhove, Panis, & Wagemans, 2007)



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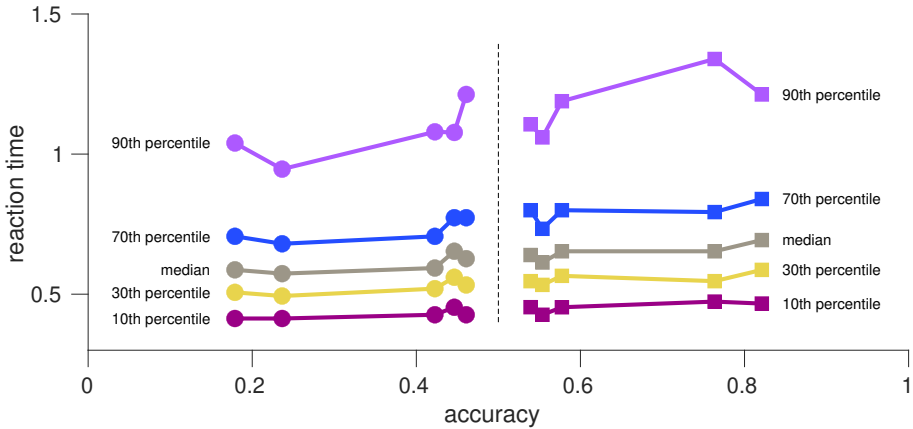

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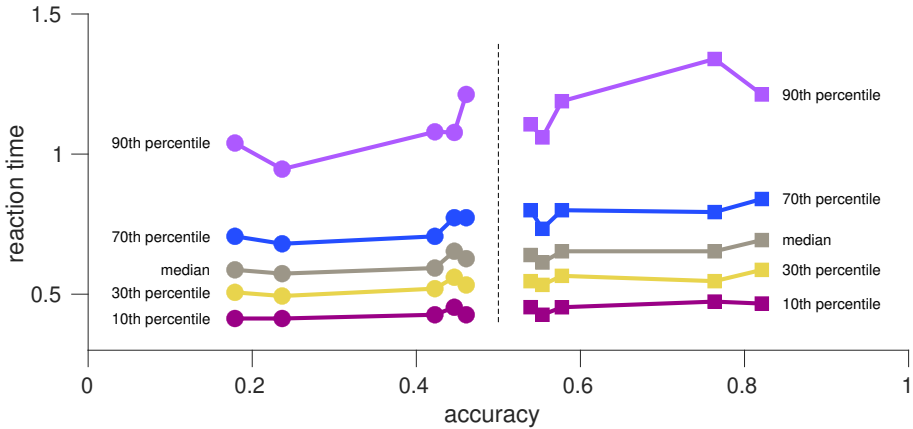

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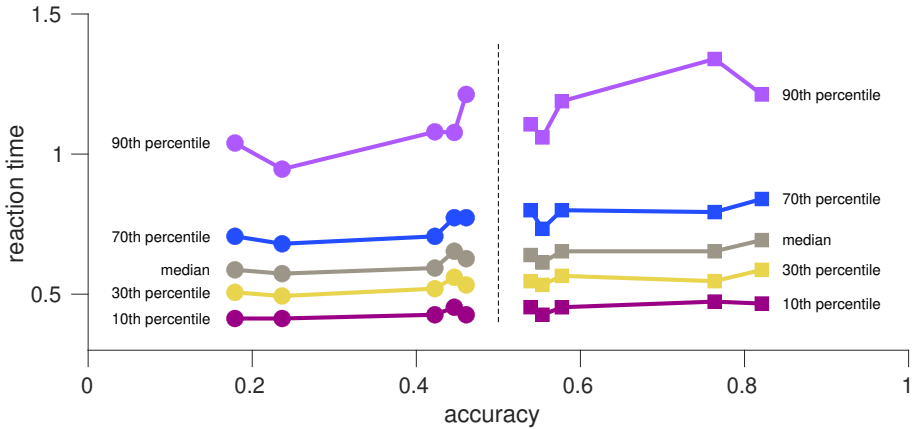

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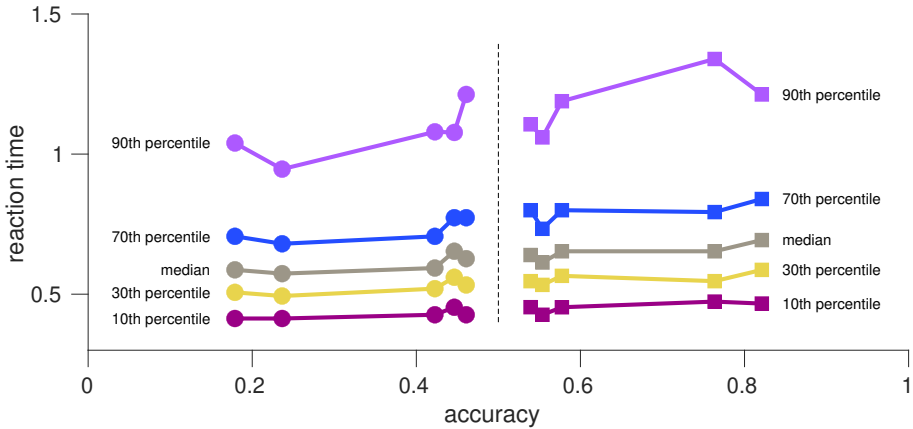

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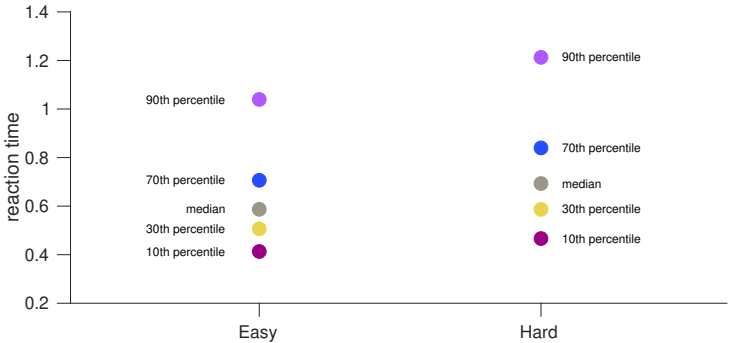

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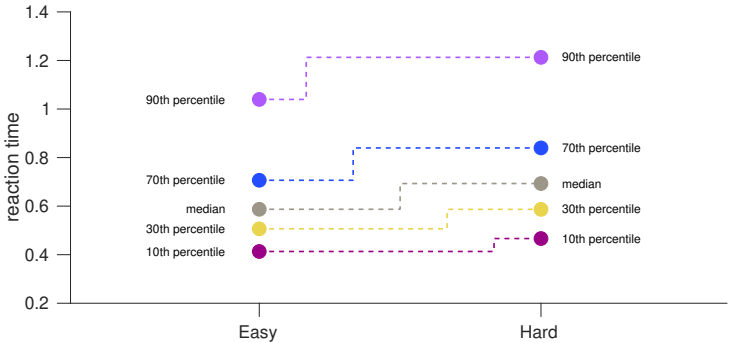

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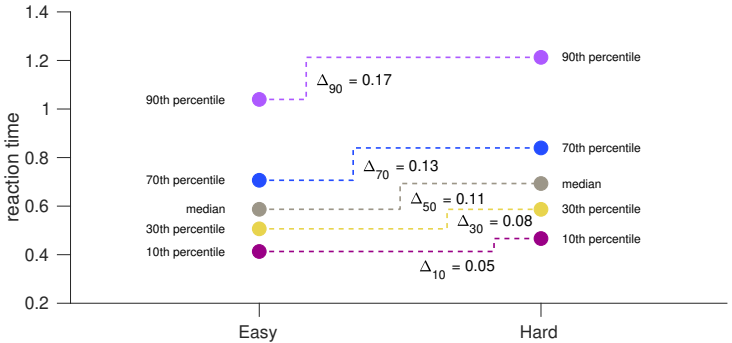
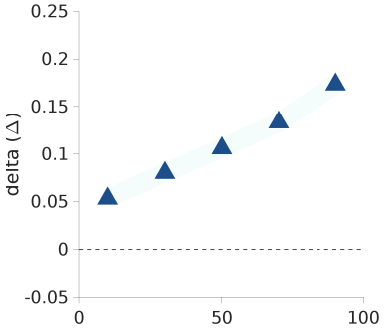


Delta plots (Pratte, Rouder, Morey, & Feng, 2010)

$$\Delta_{10} = 0.05$$
$$\Delta_{30} = 0.08$$
$$\Delta_{50} = 0.11$$
$$\Delta_{70} = 0.13$$
$$\Delta_{90} = 0.17$$



Delta plots can quickly reveal patterns of effects due to experimental manipulations

References

Pratte, M. S., Rouder, J. N., Morey, R. D., & Feng, C. (2010, October). Exploring the differences in distributional properties between stroop and simon effects using delta plots. *Attention, Perception & Psychophysics*, *72*(7), 2013–2025. doi: 10.3758/app.72.7.2013

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