Subjective Reports of Stimulus, Response, and Decision Times in Speeded Tasks

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Background

Researchers studying the relationship of consciousness to the brain often ask, "Which comes first, changes in conscious awareness or changes in the brain?" (e.g., Libet, Gleason, Wright, & Pearl, 1983). To find out, people are asked to indicate *when they decided* to perform a spontaneous action, and neural activity before the indicated decision times is examined. This activity sometimes suggests that the brain starts getting ready to act before the decision is made consciously, implying that the decision is made subconsciously by the brain and that people's subjective impression of free will for these actions is an illusion.

The interpretation of such studies depends crucially on knowing how accurately people report their decision times. But how can this accuracy be assessed? Decision times are not directly observable, so there is no objective measure against which to compare people's reports.

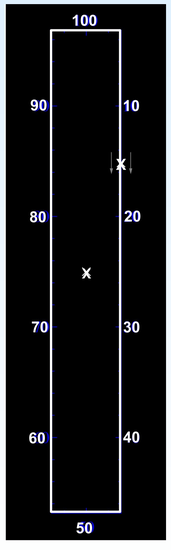
Present Studies

We performed two experiments examining the accuracy of decision time reports within go/no-go RT tasks. Two aspects of the data shed light on the accuracy of decision time reports:

(1) Effects of experimental manipulations on decision time reports. Accurate decision time reports should respond appropriately to experimental manipulations. Like RT, these reports should be delayed in conditions that slow the perceptual discriminations on which decisions depend. Unlike RT, decision time reports should not be delayed in conditions that slow the motor processing taking place after the decisions are made.

(2) Relation of decision time reports to stimulus onset and to key press response. Although we cannot know exactly when the decision was made within the S-R interval of an RT task, we do know it must have been made sometime within this interval. Decision time reports outside this interval are "impossible", so they must not be accurate.

General Method



During each trial of a go/no-go RT task, a participant fixated at the center of the "clock" shown to the left. A time-keeping cross moved continuously around the clock's perimeter (~2.5 s per circuit). A tone was presented randomly after 2-7.5 s of movement, and participants responded (or not) to the tone. The cross stopped 0.5-1.5 s later (randomly), and the participant then used a cursor to indicate where the cross had been when either (a) the tone was presented ("tone time report"), (b) the decision whether to respond was made ("decision time report"), or (c) the response key was pressed ("key press time report"). The indicated cursor location was used to retrieve the "reported time" of that event relative to stimulus onset. We also included blocks in which (d) participants made no time reports. The decision time reports (b) were of main interest, but the other conditions were also included for comparison purposes. These four time report conditions were tested in different blocks, and their order was counterbalanced across participants.

Experiment 1

We varied the discriminability of the tone signaling the go/no-go response. RT should increase when discriminability is low, but will people's decision time reports increase comparably? They should, if people can report their decision times accurately.

Method

The tones were 349, 392, 440, and 494 Hz. Half of the participants were asked to respond (go) to the two higher tones but not the two lower tones, and this mapping was reversed for the other half. Discriminability was high for the outer tones (349 & 494) and low for the middle ones (392 & 440).

Results

Effects of discriminability (Fig 1):

- Mean RT increased by 75 ms when tone discriminability was low.
- Mean decision time report increased by 36 ms when tone discriminability was low (60 ms in go trials, but only 12 ms in no-go trials).
- Tone and key press time reports were unaffected by discriminability.

Finding larger discriminability effects on RT than on decision time reports suggests that these reports are not very accurate.

Impossible decision time reports:

- 29.3% of decision time reports were before stimulus onset.
- 8.8% of decision time reports were after the key press.

Finding many decision time reports outside the S-R interval suggests that these reports are not very accurate.

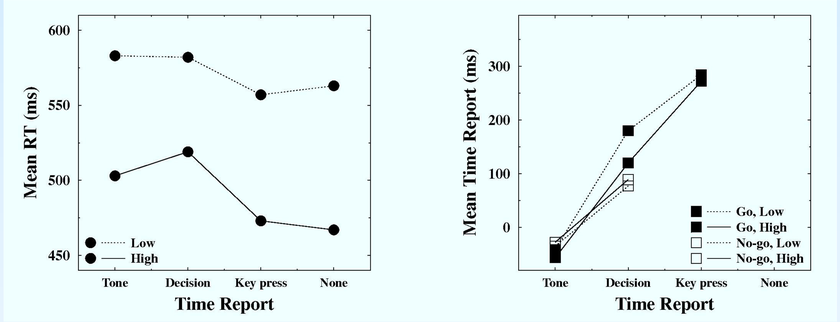


Fig 1. Mean RTs (left) and time reports (right) in Experiment 1 as a function of tone discriminability (outer tones=high, middle tones=low) and time report type. Time reports were measured in ms relative to stimulus onset.

References

Libet, B., Gleason, C. A., Wright, E. W. Jr., & Pearl, D. K. (1983). Time of conscious intention to act in relation to onset of cerebral activity (readiness-potential): The unconscious initiation of a freely voluntary act. *Brain, 106,* 623-642.

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Experiment 2

We varied the complexity of the motor response to manipulate post-decision processing times. RT should increase with more complex responses, but will people's decision time reports increase comparably? They should not, if people can report their decision times accurately.

Method

Only the two high discriminability tones were used. Simple responses were single key presses. Complex responses were three key press sequences with the index, ring, and middle fingers, in that order.

Results

Effects of response complexity (Fig 2):

- RT: Complex responses were slower than simple ones.
- Decision report times were 51 msec *later* with simple responses than complex (effect opposite to RTs).
- Key press report times were much less than actual RTs, and were 106 ms later with simple responses than complex (effect opposite to RTs).

Finding opposite complexity effects on decision time reports, relative to RT, suggests that these reports are not very accurate.

Impossible decision time reports:

- 20.3% of decision time reports were before stimulus onset.
- 15.4% of decision time reports were after the key press. This percentage was higher for simple responses (21.7%) than for complex ones (9.2%).

Finding many decision time reports outside the S-R interval suggests that these reports are not very accurate.

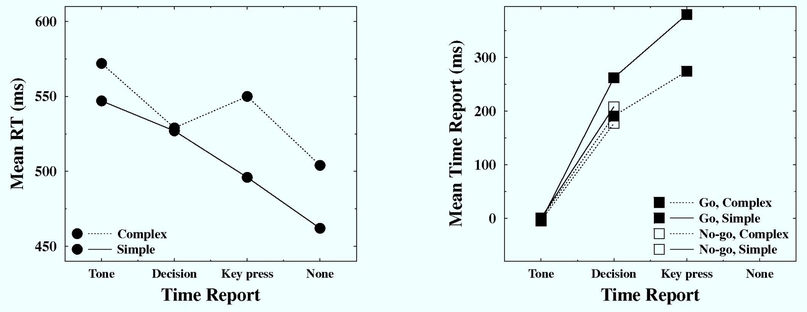

Fig 2. Mean RTs (left) and time reports (right) in Experiment 2 as a function of response complexity and time report type.

Conclusions

3. Decision time reports are inaccurate.

a. The reports are not appropriately sensitive to experimental manipulations.

b. Reported decision times are often impossibly early (before the onset of the stimulus about which the decision was made) or late (after the key press response reflecting the outcome of the decision).

4. Inaccuracy of decision time reports casts doubt on previous claims that changes in the brain come before changes in conscious awareness.

5. We may have free will after all.