Brain functions to recognize and hit a fastball

Abstract

When hitting a 95-mph blazing fastball in baseball, the batter must judge the ball's path and control the bat in about 0.4 seconds. However, it takes longer to achieve accurate judgment and movement. Though many studies have examined judgment and movement processes in the brain separately, they are closely related. We investigated how the brain establishes quick judgment and movement processing under strict time constraints. To this end, we conducted a baseball-like hitting experiment and clarified that the Strike/Ball judgment had less effect on hitting performance as the time constraint became stricter, but changing the movement strategy restrained the decrease. Our goal is to provide novel methods to evaluate and improve the brain functions of athletes to enhance cognitive-motor control in support of conventional approaches to physical fitness testing and training. We believe that this work will elucidate now hidden mental processes and find application in other research fields.

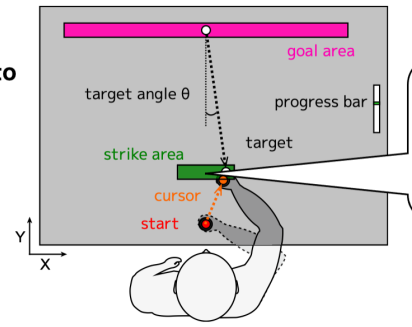
Quick judgment and movement

Though it takes more time for more accurate judgment and movement, how does our brain achieve quick judgment and movement processing under strict time constraints, like a blazing fastball?

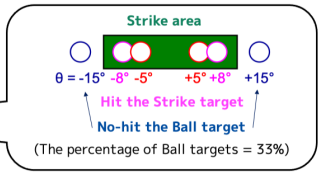
Our designed task is judging Strike/Ball target and hitting Strike targets.

Time from ball release to ball hitting
(time-to-contact: TTC)
- **0.4 s ≒ 95 mph**
- **0.5 s** ≒ 76 mph
- **0.6 s** ≒ 63 mph

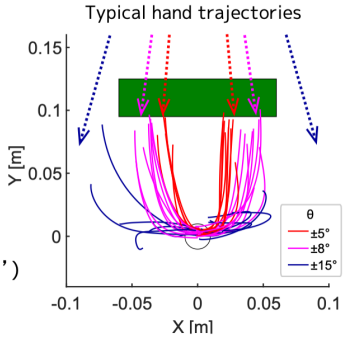
Another task to hit both targets without judgment was also conducted.



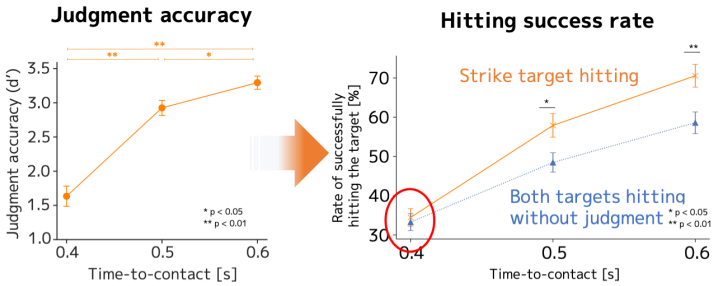
30 healthy adults participated.



Judgment accuracy: sensitivity (d')
(calculated by the signal detection theory)



Judgment and hitting success in a fastball?

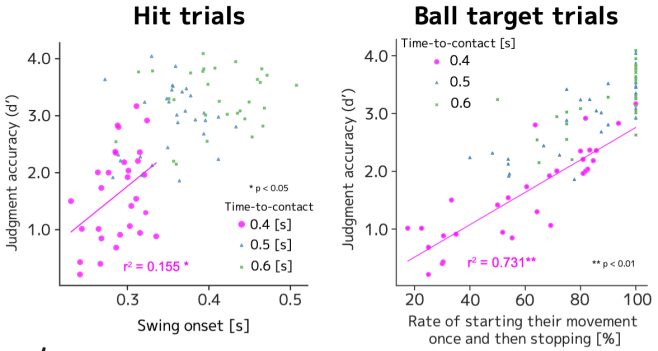


Judgment accuracy greatly impacted hitting success.

Strike/Ball judgement was effective at 0.5s and more TTC, but not at 0.4 TTC.

As the time-to-contact became shorter, the judgment accuracy got worse, resulting in a loss of judgment efficacy.

Swing strategy in a fastball?



'Wait before move as possible'

'Move, then stop when judging Ball'

The ability to change the swing strategy, slowing the swing onset and stopping the swing for Ball targets, is critical for improving judgment success.

References

[1] A. Kobayashi, T. Kimura, "Effects of cognitive strategy on hitting tasks," IEICE Technical Report, Vol. 118, No. 470, pp. 37-42, 2019.
[2] A. Kobayashi, T. Kimura, "Motor redundancy affects decision-making behavior," SICE Division of Life Engineering Symposium 2020, 2020.
[3] A. Kobayashi, T. Kimura, "Go/No-go decision making under severe time constraints interferes with hitting task performance," in *Proc. The Society for Neuroscience 49th Annual Meeting*, 2019.

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