On-Field Swimming Analytics

Olympic Games Tokyo 2020

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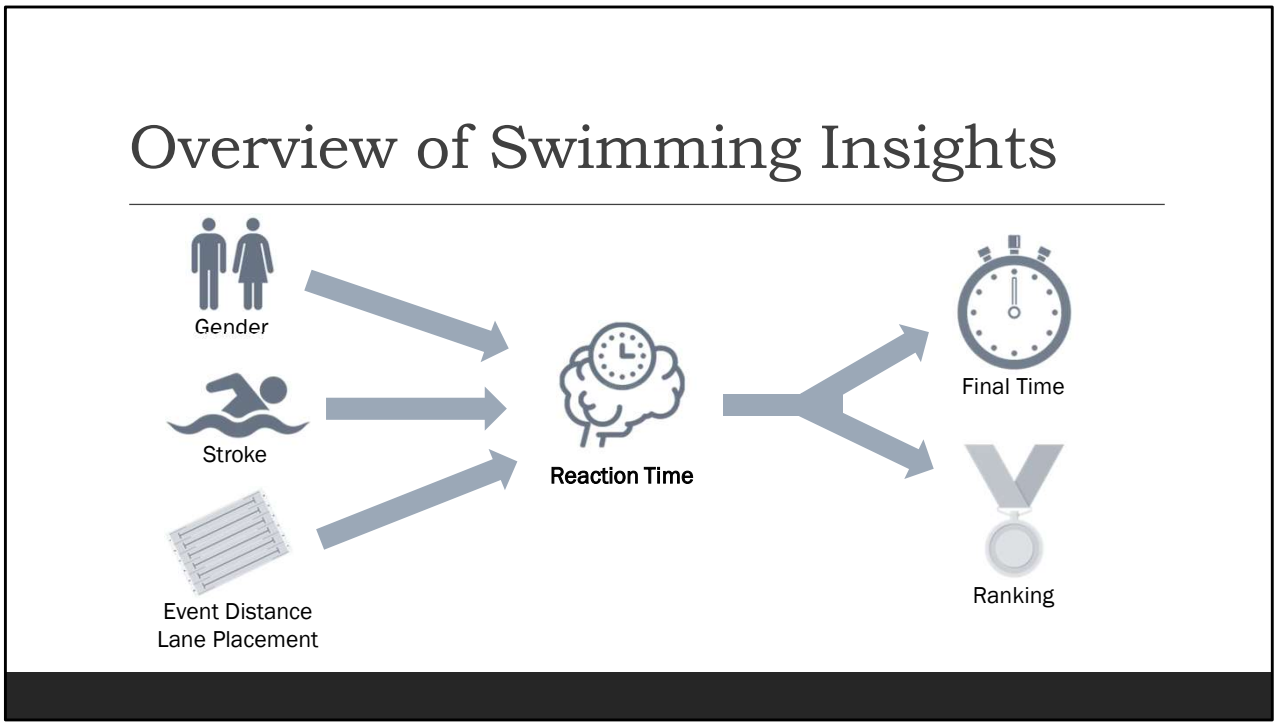


Sports analytics involves using data and statistical analytics to drive decision making. On-field analytics involves studying the performance, strategy or health and fitness of an athlete or team. The examination of these data can potentially enable athletes and coaches to make better decisions, allowing them to stand a competitive edge.

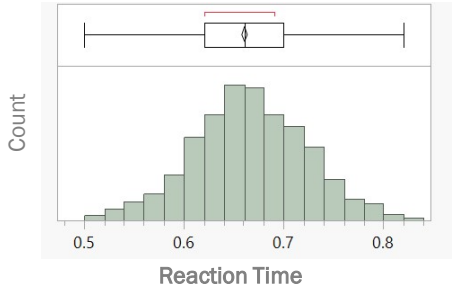
In this study, we plan to review data from the Tokyo 2020 Olympics data for Swimming events, to discover interesting on-field insights and use statistical analysis to proof these theories.

The objective of this study is to understand the factors affecting the reaction time of Olympic swimmers, as well as determine if reaction time affects the performance of the swimmers. The reaction time across all swimming events will be examined, to identify any relationship between the events, physical attributes or performance and reaction time.

After the insights are uncovered, actionable recommendations will be proposed.

Factors affecting Reaction Time | Impact on Performance | Actionable Recommendations

General Insights



a) Majority of olympic swimmers have a reaction time of 0.62 – 0.70s

b) Reaction time ranges from 0.49s to 0.94s

	Mean	Median
Reaction Time	0.661	0.660

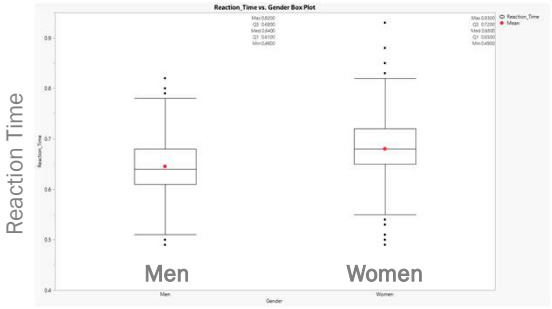
First, we observe that the distribution resembles a bell curve, which is expected.

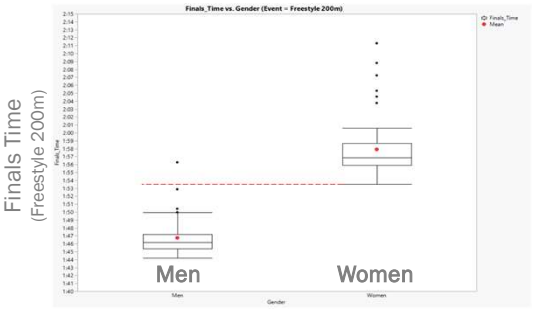
The mean and median reaction times of the Olympic swimmers are similar at about 0.66s. Examining the distribution in detail, we observe that majority of Olympic swimmers (>50%) have a reaction time of 0.62s – 0.70s. The range of reaction time ranges from 0.49s – 0.94s.

As we uncover this general insight from reaction time, we will move on to more factors that may impact the difference in reaction time.

Factors affecting Reaction Time | Impact on Performance | Actionable Recommendations

Gender impact on reaction and final times





Gender	Mean	Median
Men	0.645	0.64
Women	0.680	0.68

Men tend to have faster reaction and final times.

From the boxplot, we observe that across all events, men had lower mean and median reaction times than women. Women swimmers also demonstrated slightly higher variability in their reaction time.

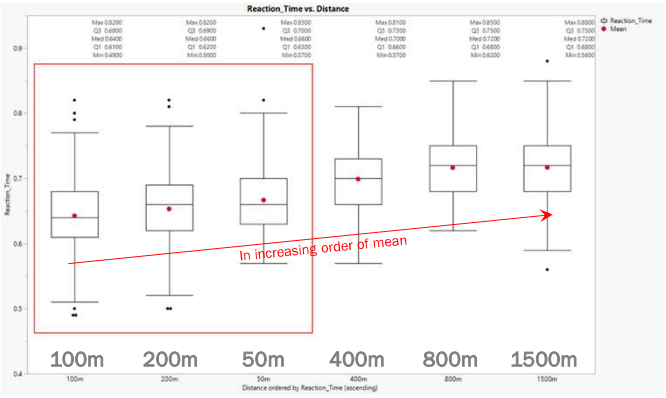
To further examine if Gender has an impact on the performance, we use the Freestyle 200m event to gauge the finals time. The boxplot also shows a similar trend, whereby almost all men outperform women in this event.

Though we have ascertain that gender differences does affect the reaction time and finals time, it would be too hasty to conclude based on this that reaction time is related to final time and performance of an athlete.

With that, we will further continue our analysis.

Factors affecting Reaction Time | Impact on Performance | Actionable Recommendations

Distance of Event impact on reaction time



Distance	Mean	Median
50m	0.667	0.66
100m	0.642	0.64
200m	0.653	0.66
400m	0.699	0.70
800m	0.716	0.72
1500m	0.717	0.72

The longer the event distance, the longer the reaction time.

An interesting observation from the plot above is that swimmers who participate in events with shorter distances (<400m) tend to have lower mean and median reaction of 0.64s – 0.67s, as compared to the longer distance events (≥ 400m) of 0.70s – 0.72s.

This may be because reaction time accounts for a smaller fraction of the final time for longer distance. Hence, the swimmers may focus on other significant factors that may have a greater impact in their performance for these event.

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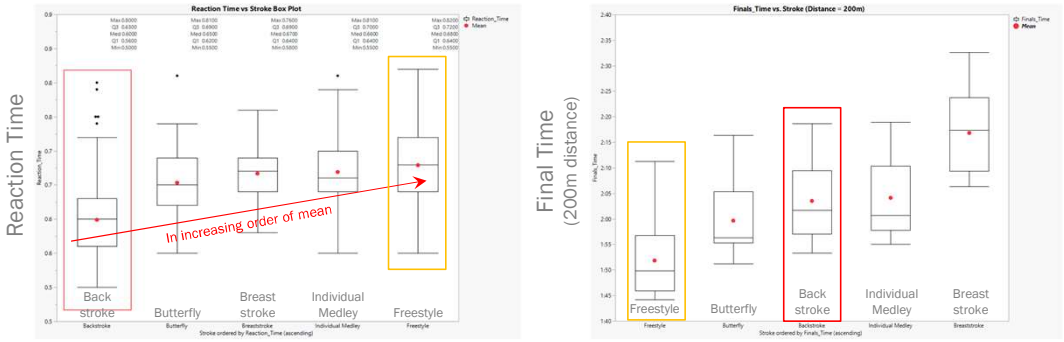
Stroke impact on reaction and final times



Freestyle swimmers have the longest reaction time, but the shortest final time.
Breaststroke swimmers have the shortest reaction time, but mid-range final time.

From the plot above, we can observe that backstroke swimmers have the lowest mean and median reaction times of 0.598s and 0.60s respectively, which indicates they have the fastest reaction time. Breaststroke have a more consistent reaction time, based on narrow distribution range and variability. We also uncover that the stroke with has the longest reaction time is Freestyle.

However, from the final time plot, we uncover that Freestyle swimmers have the shortest final time, indicating they are the fastest, despite time taking the longest to react. Despite backstroke swimmers having the fastest reaction time, amongst all strokes in 200m events, they end up with mid-range final times.

This indicates that there are other stroke-related factors, which are not covered in this study, that has a greater impact on a swimmers' performance.

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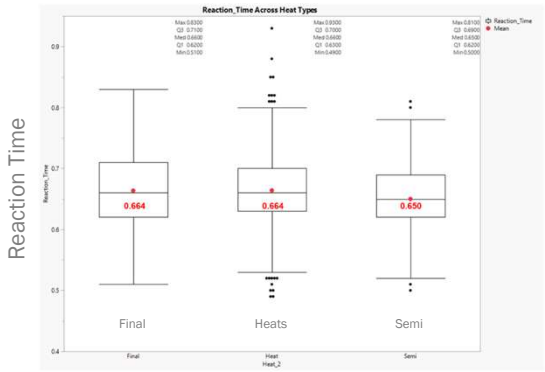
Heat type impact on performance



Swimmers in the semi event demonstrated the fastest reaction times, with the swimmers in the final event having the largest inter-quartile range.

Though one would expect the best performance of swimmer to be demonstrated in the Final round, the semis event swimmers demonstrated the lowest mean and median reaction time of 0.65s, compared to heats and finals.

Another unexpected observation is that the reaction time for finals event has the widest IQR.

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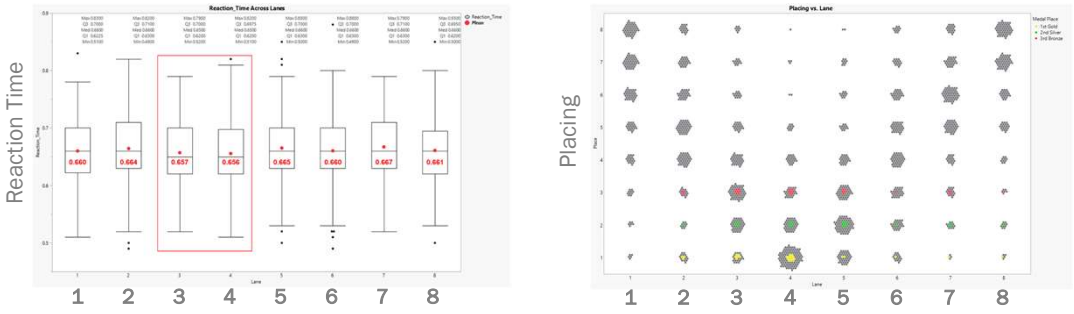
Lane impact on reaction time and placing



Although the centre lanes tend to churn out more medallists and higher placed finishers, the reaction time across all lanes are consistent.

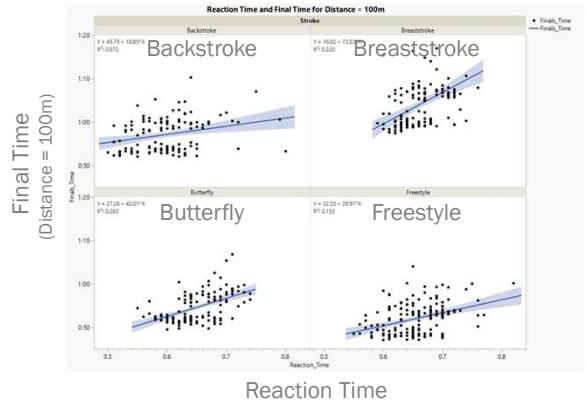
The boxplot on the left shows the reaction time of swimmers in Lanes 3, 4 have a median of 0.65s and their means are < 0.66s, whereas swimmers in the other lanes have medians of 0.66s and means > 0.66s. Even though the swimmers in the centre lane do have a lower reaction time, the difference is very small, and the reaction time is pretty consistent all throughout the lanes.

The dot plot below shows that swimmers with better performance seem to be placed in the centre Lanes 3-4, with lane 4 having the highest concentration of Gold medalists. Most podium finishers (1st, 2nd, 3rd) were also competing in Lanes 3-5. Conducting more in-depth study, of swimmers who compete in Lane 4 finals, 96% end up in the Top 3, and receive medals. There is also a high proportion of Olympic medalists in Lanes 3-5, where >50% of the finalists end up with podium finishes.

Although the centre lanes tend to churn out more medallists and higher placed finishers, the reaction time across all lanes are consistent. Hence, the reason centre lane swimmers perform better is unlikely due to better reaction time.

Factors affecting Reaction Time | Impact on Performance | Actionable Recommendations

Impact of Reaction Time on Final Time



a) Reaction Time and Final Time are positively correlated

b) Line of fit is poor for correlation

The regression between the Final Time and Reaction Time for different events, with distance of 100m, indicates that 2 variables are positively correlated. This means that the Final Time increases as Reaction Time increases. However, we also have to take note that even though there is a correlation, the line of fit for this relationship is poorly fitted with the highest R2 being 0.283 for the Butterfly event.

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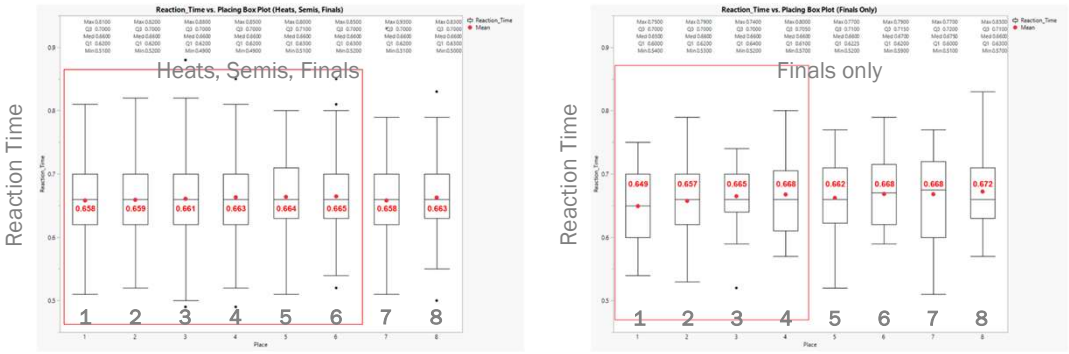
Impact of Reaction Time on Placing

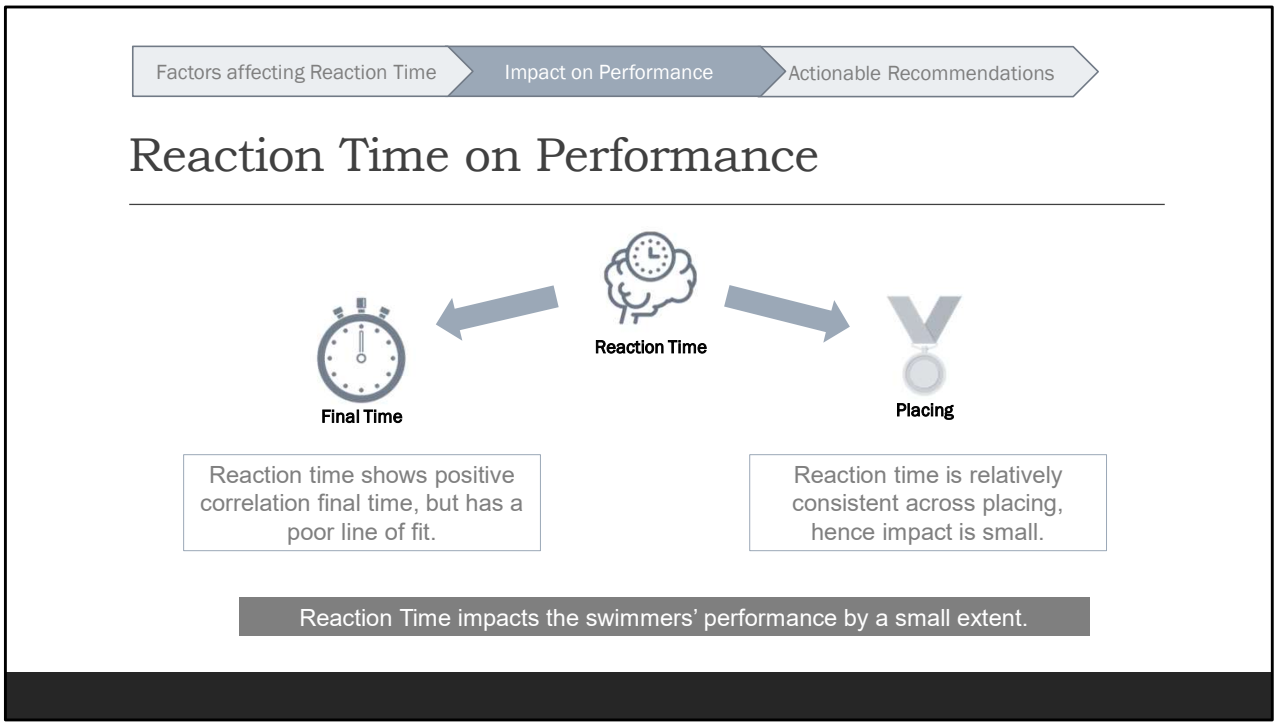


Reaction Time may have a small but not significant impact to a swimmer's placing.

The 2 boxplot differentiates the reaction time for all heats (left), and finals only (right). An interesting observation comparing the 2 boxplots is that the finalists tend to have a tighter range of reaction times than the non-finalists.

Regarding performance, the boxplot on the left (all heats) shows reaction time fluctuates across swimmers for all placings, with 1st-3rd place swimmers having similar reaction times to 7th-8th place. This may mean that the reaction time may not have a large impact on a swimmer' placing.

Though, in the finals event (right boxplot), Gold medalists have the lowest mean (0.649s) and median (0.65s) reaction times. However, from the 2nd placement onwards the reaction time also starts to fluctuate, indicating it does not impact much on the placing.



To sum up the impact of reaction time on an athlete's performance, we review the analysis previously done.

The regression does show a positive correlation between the reaction time and final time, indicating that the Final Time increases as Reaction Time increases. However, we also have to take note that even though there is a correlation, the line of fit for this relationship is poorly fitted with a low Rsquare.

Next, though better placed swimmers do show a slightly mean lower reaction time, the statistical hypothesis testing does indicate reaction time is relatively consistent across placing. Hence, the impact of reaction time on placing is relatively small.

With this, we conclude the study that the reaction time does impact the swimmer's performance but only by a small extent. There are probably other more significant factors that affect their placing of final time, such as starting time, stroke distance, stroke speed, turning time.

However, that does not mean that the impact of the reaction time can be entirely neglected, it is dependent on individual performance and other factors which we will elaborate more in the recommendations.

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Actionable Recommendations

Athletes/Coaches should make use of the study to:

a) Identify personal attributes (Gender, Stroke, Distance)
b) Compare individual performance with data in study
c) Uncover potential weakness in reaction time and focus to target a healthy reaction time

Study can be further extended to:

a) Uncover other attributes such as age, time of event, starting time, stroke distance, stroke speed, turning time, which may have greater impact on the performance of athletes
b) Inclusion of team data for relay analysis

Recommendation for an athlete would be to compare his/her individual performance across the data in this study to determine if reaction time is their weakness.

Another recommendation is to collect and analysis other factors (e.g., stroke distance, stroke speed, turning time) which may higher impact to allow athletes and coaches to identify their areas of focus. A last suggestion is to include team performance, which is not covered, for a separate analysis as well.