Analysis of team-level pace of play in hockey using spatio-temporal data

D. David Yu*, Christopher Boucher, Mehrsan Javan | SPORTLOGiQ, Montreal, QC

*Corresponding Author: david.yu@sportlogiq.com

Background

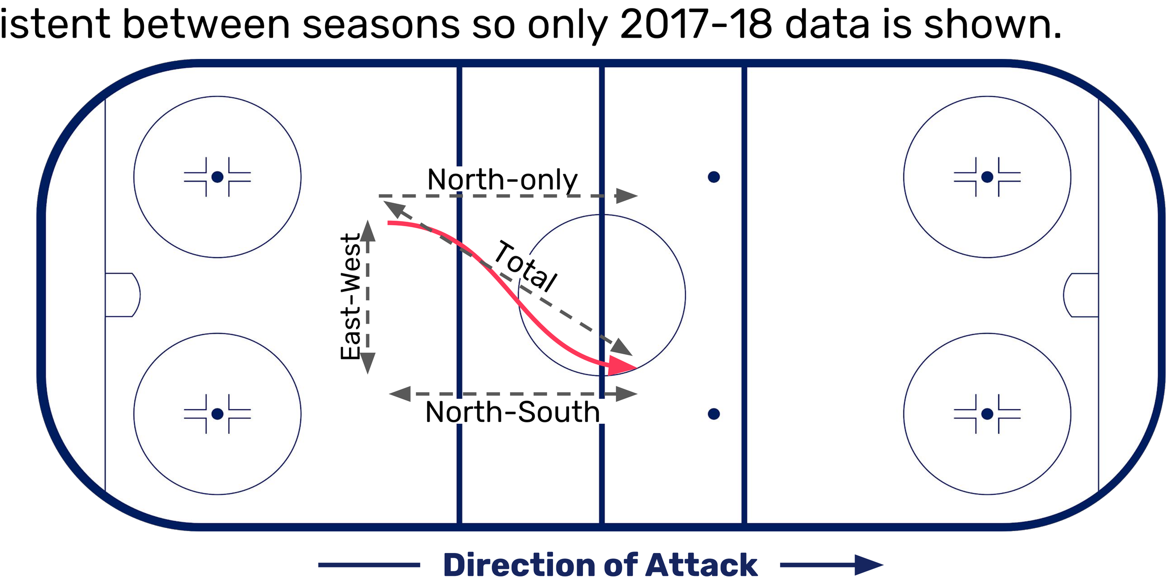
Pace or tempo of play is an important characteristic in hockey as well as other team sports. The past decade has seen tremendous advancements in the capture of spatio-temporal data in team sports[1]. While much attention has been focused on speed and distance covered at the player level, spatio-temporal data also allow for more granular definitions of team-level pace of play such as measures of the speed between successive events or the speed of a possession as a whole.

Objectives

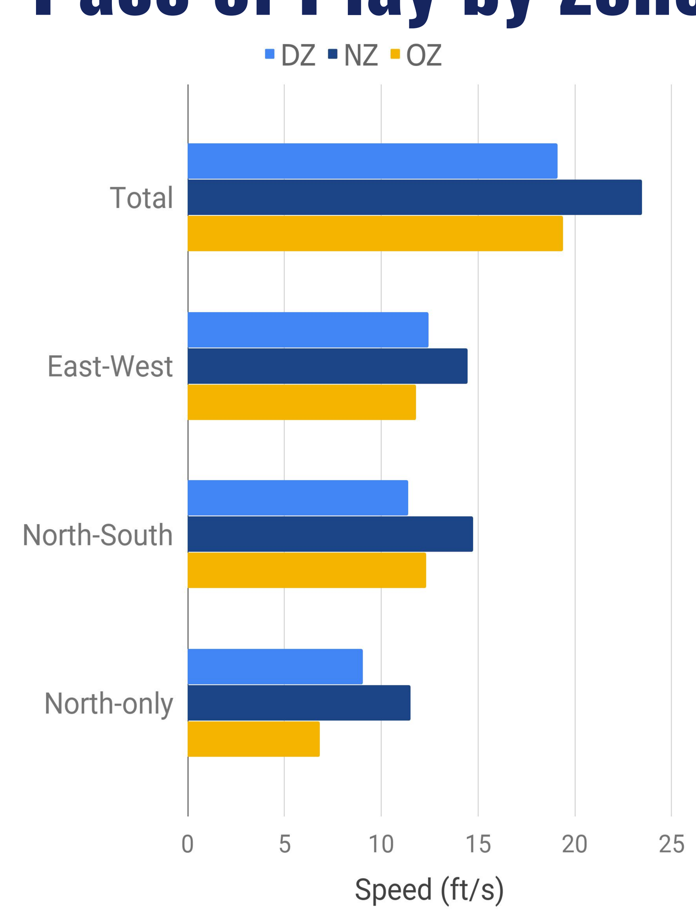
1. Examine how pace of play varies across the surface of the rink
2. Determine if the pace preceding various events (such as shots, zone entries and passes) has an effect their outcomes

Data and Methodology

SPORTLOGiQ's proprietary spatio-temporal dataset contains an average of 3650 events per NHL game with 21 event types and 89 distinct subtypes. Each event contains precise X,Y rink coordinates and timestamps. We have used the distance travelled and time elapsed between successive possession events (i.e. passes, receptions, puck recoveries) to calculate various definitions of pace including **total speed**, as well as the **east-west**, **north-south,** and **north-only** components of speed. Analyses were performed on all regular season games in the 2016-17, and 2017-18 NHL seasons. Results were consistent between seasons so only 2017-18 data is shown.



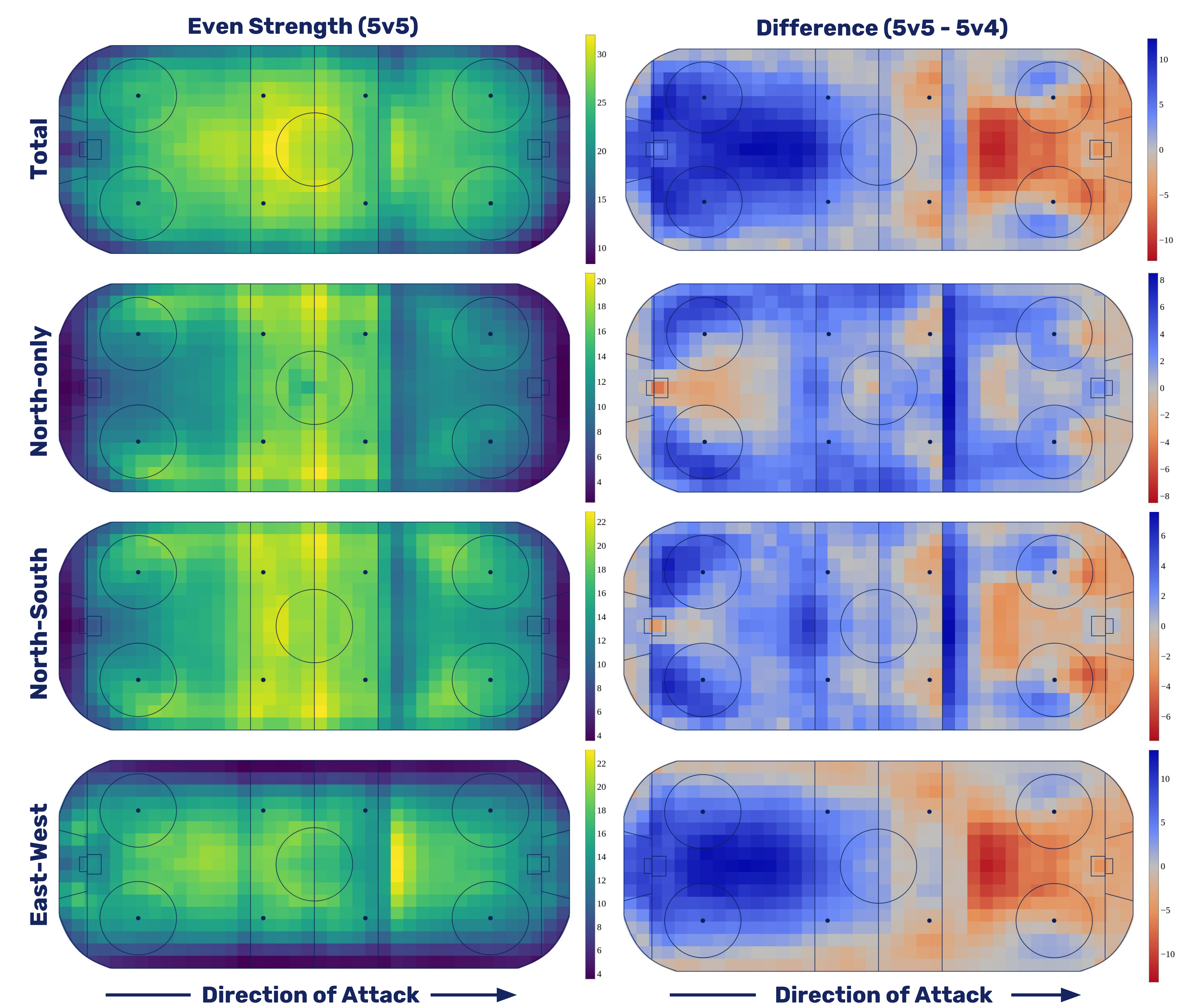
Pace of Play by Zone



We first determined how pace varies by zone. Speed is highest in the NZ and generally ~20% slower in both the OZ and DZ. The only exception is North-only speed in the OZ which is 41% slower than NZ play. Our analysis helps to explain some of the counterintuitive results obtained in prior studies. For instance, the negative correlation between forward attacking (north-only) speed and shots/goals reported in a prior study[2] is likely due to the large decline in north-only speed after a play enters the offensive zone.

Pace of Play Across Rink

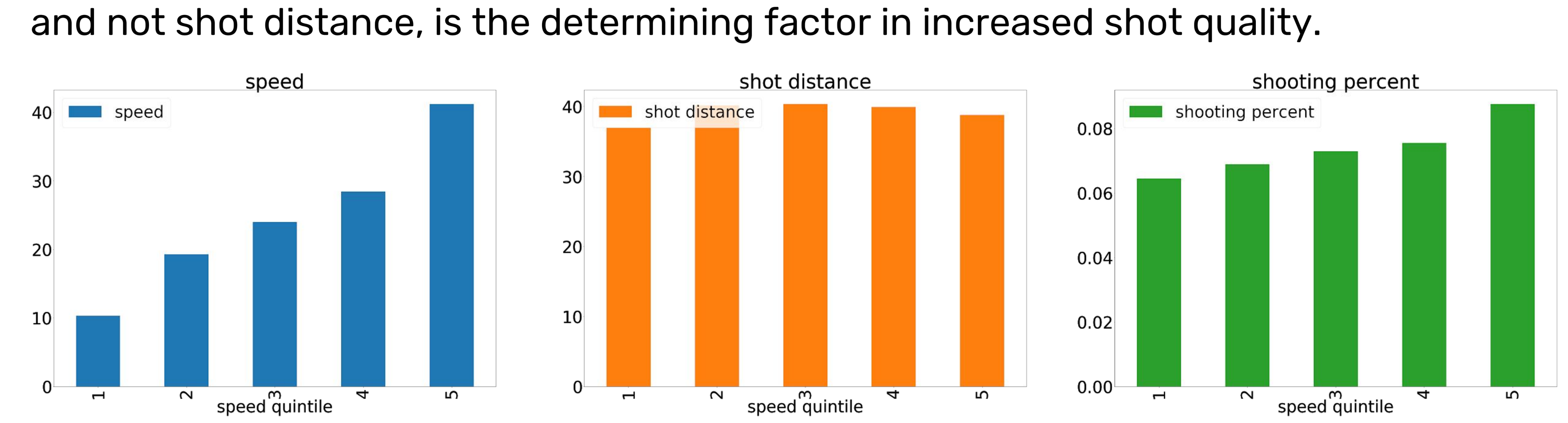
To obtain a more granular view into how pace varies across the rink, we divided the rink into 668 equal sections measuring 5ft x 5ft. We then assigned the distance travelled and time elapsed between successive possession events equally to all grid sections on the path between the successive events.



The results show that speed is non-uniformly distributed across the length and width of the rink. For example, the effect of hockey's offside rule can be clearly seen at the offensive blue line with a marked decline in North-South speed and a peak in East-West speed. We also measured differences in speed between even strength (5v5) and power play (5v4) situations. While pace on the power play increases in large sections of the offensive zone (red), it declines by a similar magnitude (blue) in the defensive half.

Pace Preceding Shots

We examined the total speed in the 5 sec. preceding unblocked, non-deflected shots (ES 5v5 - 59.5k shots). Shots were divided into quintiles by preceding speed (mean: 10-41 ft/s). Shooting percentage increases from 6.4%-8.8%, an increase of 36%. Mean shot distance remains fairly constant (37-40ft) suggesting that speed of preshot movement, and not shot distance, is the determining factor in increased shot quality.



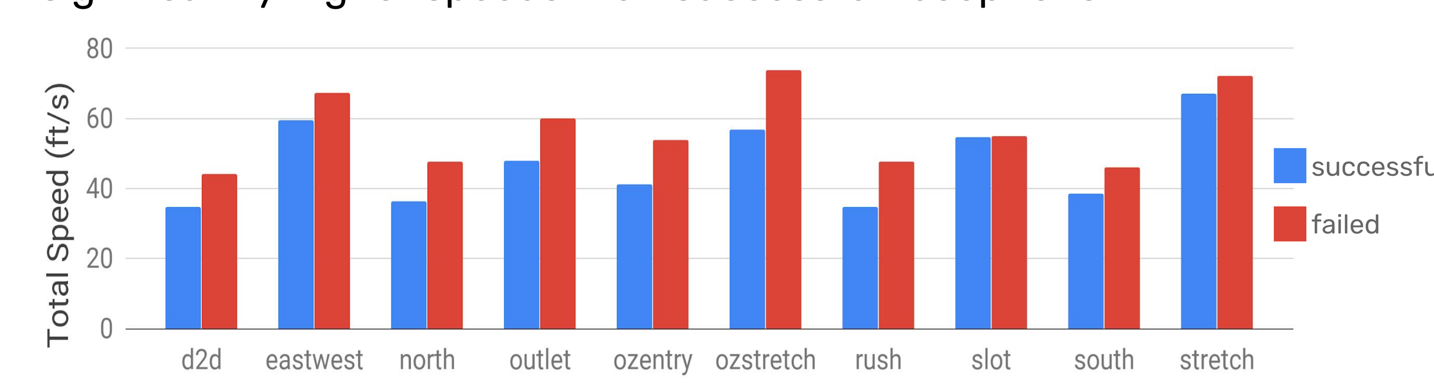
Pace Preceding Zone Entries

Entry	Shooting %	Speed (ft/s)
1on0	26.19%	40.3
3on1	25.52%	
2on1	22.05%	
3on2	10.27%	36.4
1on1	8.74%	
2on2	7.21%	
3on3	5.18%	34.3
1on2	4.77%	
2on3	4.58%	
dumpin	N.D.	33.3

Not all zone entries are of equal value and SPORTLOGiQ event data tracks the manpower situation for controlled entries. We used the shooting percentage of shots taken within 5 sec. following a controlled entry to classify entries into high/mid/low danger (note that not all odd man rushes are high danger). We calculated the total speed of all possession events preceding entries (5v5) and found that higher danger entries occur at a higher pace.

Pace of Passing

SPORTLOGiQ event data contains the coordinates and timestamps for all passes and receptions. Receptions can be classified as failed if the pass is on the receiver's blade but they fail to gain possession. We examined the effect of pass speed on reception outcome for all even strength 5v5 passes (1.00 million). We used SPORTLOGiQ pass types to account for variability in pass length, speed and difficulty. Aside from passes to the slot, failed receptions from all other pass types occur at significantly higher speeds than successful receptions.



Discussion

Our findings suggest that increased team-level pace is beneficial, but perhaps only up to a certain point. Higher pace can create breakdowns in defensive structure and lead to both higher danger zone entries and improved shot quality. On the other hand, our pass reception analysis shows that very high pass speeds can lead to more turnovers. Taken together, our results demonstrate that measures of team-level pace derived from spatio-temporal data are informative metrics in hockey and may prove useful in other team sports. Future work will examine how these measures vary between players/lines/teams (for and against) to provide quantitative metrics for assessing play.

References

1) Gudmundsson & Horton (2017) ACM Computing Surveys 50(2): 22
2) Silva et al. (2018) Journal of Sports Analytics 4(2): 145-151

Acknowledgements

E. Keane provided the data on shooting percentage by zone entry types. Thanks to E. Keane, N. Czuzoj-Shulman, M. Perri and L. Bornn for helpful discussions and comments.