Score and Venue Adjustment on Transition Data in Hockey

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Abstract. Are zone exits and entries influenced by score and venue the same way shots and goals are? Using our proprietary database of over 120,000 transition events, we analyzed how score and venue can impact how much you control your transitions and your success percentage. Playing at home or on the road does not seem to have much impact overall, especially compared to the influence the score of the game has. Trailing teams appear to be able to make more controlled zone exits, with greater success, probably due to a lesser pressure. On the other hand, leading teams tend to dump the puck out of their defensive zone more often. A trailing team would also try more zone entries but the split between controlled and dump attempts surprisingly remains stable, contradicting a common idea that defenses make it harder to enter the offensive zone when protecting a lead. The "play a simple game on the road" mantra, with less controlled transitions, does not seem to hold either, when looking at the data.

1 Introduction

One of the key motivations behind data-driven research in sports has been to confirm or infirm common ideas about the game. In hockey, a sport played on a relatively overcrowded small surface where it is easy to slow down the flow of the game, we know that leading or trailing in the score will push one team to naturally dominate the other in terms of puck possession and shots taken. This also means that the attacking team will face less pressure to exit its defensive zone, as the defending players are more likely to wait in the neutral zone, but will have a tougher time entering the offensive zone in control as they face a tighter wall of defensemen at the blue line.

Earlier in 2022, Micah Blake McCurdy published research [1] on transitions but based on puck movement between the three zones, without any details on the transition events per se. He confirmed some assumptions, namely that trailing teams were exiting their defensive zone faster or that away teams were slower to exit than home teams.

In the last 10 to 15 years [2], multiple studies have analyzed the impact of such a paradigm on shots and goals, pushing data providers, both public and private, to add a "score adjustment" to their data, reflecting the fact that one team is supposed to be attacking and the other is supposed to be defending at some point in the game. That idea was also derived for teams playing at home, or on the road and was called "venue adjustment".

However, such adjustment has never been made on transition data, such as zone exits and entries. Which leads to our main question in this paper: how score and venue (playing at home or away) impact the way a team is transitioning the puck?

To answer it, we investigated how often teams execute zone exits and entries in a given score and venue situation. How they execute such plays (in control or dumping the puck) and with what success rate.

2 Exploring Zone Exits and Entries

2.1 Collecting Transition Events

Hockey games play-by-play data are now largely available around the world and many public initiatives have used them over the last ten years to help us analyze and understand teams and players performances. However, these publicly available datasets are almost entirely shot-related data, and do not include anything regarding how the puck is moving on the ice between two shots.

Transition data, whether zone exits, zone entries or passes, also called "Microstats", are available through private data providers or public initiatives, such as the All Three Zones project funded by Corey Sznajder [3] for the NHL. Data is collected by individuals, outside any league or private providers, to make it available to the public. NL Ice Data [4] is a project that has been manually collecting data on the Swiss National League since 2019-20, including transition data that will be used in this paper. We acknowledge the dataset includes more games from certain teams based on the work done at the time by NL Ice Data, but every team in the league had enough representation by season so we were not worried about the sample being driven by one or two teams.

2.2 Definitions of Transition Events

The database used for this paper includes events collected in 440 games between 2019-20 and the end of January 2022. It includes 73,778 zone exits and 55,689 zone entries, all made at 5v5.

We defined three types of zone exits. Carry exits happen when a player skates in possession of the puck across his defensive blue line. Pass exits happen when a pass leads the puck to cross the defensive blue line or puts the receiver in an immediate and safe situation to do so. Carry or Pass Exits are successful or failed if the team keeps possession of the puck in the neutral zone. Dump exits happen when a player chips the puck in the air or against the board to send it in the neutral zone or farther away. A successful Dump Exit is retrieved by a teammate in the neutral zone or if the puck reaches the offensive zone. It fails if it becomes an icing though, if an opponent recovers the puck in the neutral zone or if the puck does not even leave the defensive zone.

We defined two types of zone entries. Controlled Entries happen when a player skates in possession of the puck across the offensive blue line or passes it to a teammate in immediate position to do so. It is a success if the attacking player keeps control of the puck for at least two seconds in the offensive zone. Dump Entries happen when the puck is sent in the offensive zone with no passing intent. It is successful if the first or second player to take full possession of the puck is attacking, otherwise it is failed. Figure 1 shows how many events are included in this research.

Fig. 1.

Number of transition events included in the database for this research

	Home	Away
Entries		
Successful Dump Entries	2,539	2,573
Failed Dump Entries	7,620	7,568
Successful Controlled Entries	13,569	13,116
Failed Controlled Entries	4,286	4,418
Exits		
Successful Dump Exits	4,299	4,387
Failed Dump Exits	3,817	4,065
Successful Carry Exits	8,176	8,271
Failed Carry Exits	1,113	1,186
Successful Pass Exits	13,389	13,182
Failed Pass Exits	5,989	5,904
Total	64,797	64,670

Data: NL Ice Data database, manually collected since 2019-20

3   Calculating Score and Venue Effects on Transitions

We can split the 129,467 transition events from our database between the different score states and venues (Figure 2).

3.1   Method

In this paper, we are building on the earlier work by Micah Blake McCurdy back in 2014 [5] on Score-Adjusted Fenwick and with the same rationale behind it. Here, we take controlled entries tried (success or failed) as an example for an event. The adjustment coefficient is the ratio between the rate at which the event happens over all Score & Venue possibilities and the event at a given Score difference (tied for example) and for one of the venues (home team for example).

More formally:

$$Rate\ (per\ 60)\ of\ any\ event = \frac{\sum_{i=trailing}^{leading}\ \sum_{j=home}^{away}\ event_{i,j}}{\sum_{i=trailing}^{leading}\ \sum_{j=home}^{away}\ TOI_{i,j}}$$

Which leads to the following adjustment coefficient for any event for a home team in a tied game:

$$Adjustment\ coeff. = \frac{Rate\ (per\ 60)\ of\ any\ event}{Rate\ (per\ 60)\ of\ any\ event\ (home\ team, tied\ game)}$$

3.2   Score & Venue Effect

To go back to our example, on average, 51.102 controlled entries are tried per 60 minutes, whatever the score difference and venue context. For a home team in a tied game, on average, 51.811 controlled entries are tried. Using the above formula, the adjustment coefficient for controlled entries tried with a home team in a tied game is then 0.986 (or 51.102/51.811). As home teams in a tied game try more controlled entries on average than in any given context, they should weigh less than 1. Figure 3 shows all our adjustment coefficients, per score difference and venue context.

Fig. 3.

Adjustment coefficient for transtion events

Score state	TOI[7]	Carry Exits		Pass Exits		Dump Exits		Contr. Entries		Dump Entries	
		Home	Away	Home	Away	Home	Away	Home	Away	Home	Away
Leading	13,283	1.084	1.073	1.061	1.096	0.844	0.782	1.043	1.118	1.072	1.014
Tied	14,985	0.996	1.005	0.963	0.984	1.067	0.988	0.986	1.019	0.981	1.004
Trailing	13,283	0.936	0.928	0.947	0.974	1.327	1.189	0.933	0.935	0.934	0.989

[7] **TOI**: TOI at 5v5 in minutes

Data: NL Ice Data database, manually collected since 2019-20

These adjustment coefficients are further discussed in Section 4.4.

4   Findings

4.1   Rate of Transition Events per Score and Venue

We began our analysis by looking at the rate of transition events during a game. And it immediately appeared that the score was heavily driving how often each team would transition the puck.

Fig. 4: Rate of Event by Score & Venue per 60 minutes
Rate per Scoring state: Trailing, Tied, Leading.

Data source: NL Ice Data database, manually collected since 2019-20
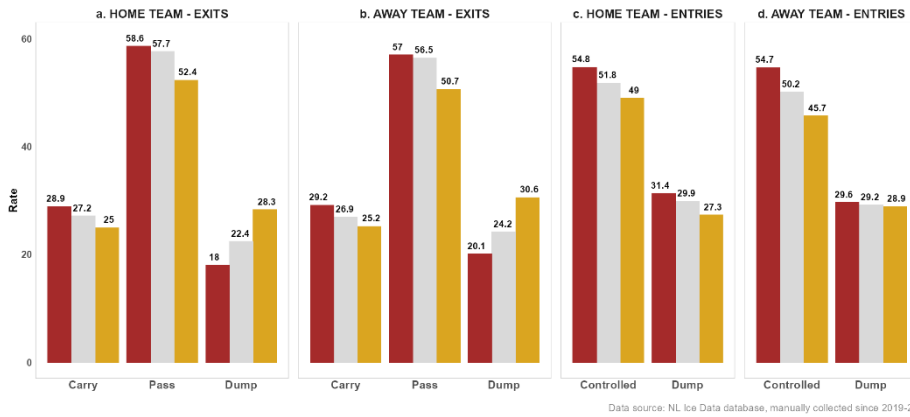
It appears that a trailing team would add about 10 controlled exits (carry or pass) per 60 minutes compared to a leading team (Figure 4, a). And a leading team would perform about 10 more dump exits compared to a trailing team (Figure 4, a), which represents a 57% difference.

A trailing home team would also perform around 5 more controlled entries compared to when leading the game (Figure 4, c). Interestingly, a trailing team on the road would add almost 10 controlled entries compared to a leading away team (Figure 4, d), a 20% difference. We also see that, unlike what we could have thought, the rate of dump entries does not increase much when a team is trailing (Figure 4, c, d). When chasing the score, teams are more likely to add more controlled attempts than dumps-in.

4.2   Zone Exits

Intuitively, the collective knowledge, or also called "eye test", would state that exiting your defensive zone at 5v5 can often become an easy thing if you are trailing, as the leading team is entering shell mode in the neutral zone.

Fig. 5: Types of Zone Exits by Score and Venue
Types of Zone Exits per Scoring state: Trailing, Tied, Leading.

Data source: NL Ice Data database, manually collected since 2019-20
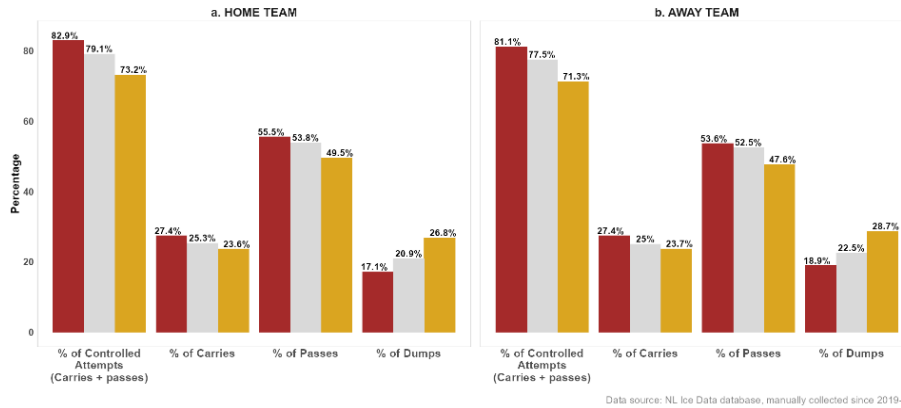
And this historical intuition is supported by numbers. On average, there is a 10 points of percentage drop in the share of exits attempted in control between a team leading or trailing (Figure 5, a, b). A leading home team would attempt 73% of its exits in control, 79% if the score is tied, and 83% if they are trailing (Figure 5, a). A leading away team would attempt 71% of its exits in control, 77% if the score is tied, and 81% if they are trailing (Figure 5, b). The dynamics at play are the same here: the score driving the change of style more than playing at home or on the road. A leading team will use less carry or pass exits and increase the number of pucks dumped out of their zone. On the contrary, a trailing team would use less dumps and equally more carry or pass exits.

We still see a tiny difference created by home ice advantage, especially with a tied score, but it is maybe less than expected. It is to be noted that the difference comes from more pass exits tried by the home team, when carry exits are not impacted. One theory here would be that carry exits are driven by individual talents, players that would execute their play no matter the home ice advantage.

In terms of success rates, they seem to be less impacted by the score or venue than the style chosen to exit. A trailing team would see its success rate on carry and pass exits increase, especially in the third period, as per our data, probably from the lack of pressure. But there is not much difference otherwise before the third period, or overall if you are leading or in a tied game.

4.3   Zone Entries

Do we see a similar dynamic for zone entries? But if zone exits see a change from a sole reduced forecheck, entries might have a double dynamic, with the defending team tightening its play on their defensive blue line, and with the offensive team having a choice between still trying to enter in control, or simply dump the puck in.

Fig. 6: Types of Zone Entries by Score and Venue

Types of Zone Entries per Scoring state: Trailing, Tied, Leading.

| a. HOME TEAM - SHARE | b. AWAY TEAM - SHARE | c. HOME TEAM - SUCCESS | d. AWAY TEAM - SUCCESS |
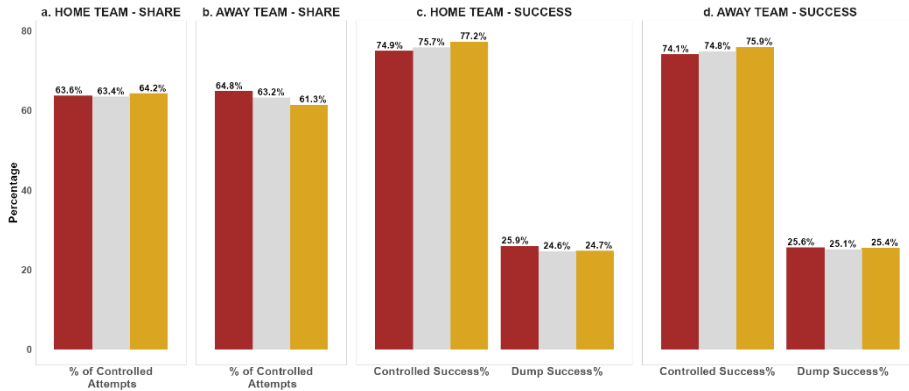
Data source: NL Ice Data database, manually collected since 2019-20

And here, the historical preconception might be a bit off. First, a trailing home team would barely change its style between controlled and dump attempts (Figure 6, a). A trailing away team, however, would increase their share of controlled attempts (Figure 6, b), which goes probably against the "play a simple game on the road" mantra. One common thing is the slightly reduced success rate on controlled attempts when trailing the score (Figure 6, c, d), showcasing that it gets harder to get through the defensemen at the blue line. Dumps success rates barely move, or even from a few decimal points in favor of the trailing team. Does an increased pressure from the trailing forwards compensate the fact defensemen are playing tighter? Defensemen might also let forwards recover the dump in order to pin them along the boards.

And what could drive how zone entries are performed might be how easily the defense can set up and send fresh legs on the ice: namingly the location of the benches.

Fig. 7: Types of Zone Entries by Period

Types of Zone Entries by Period: 1st period, 2nd period, 3rd period.

Data source: NL Ice Data database, manually collected since 2019-20
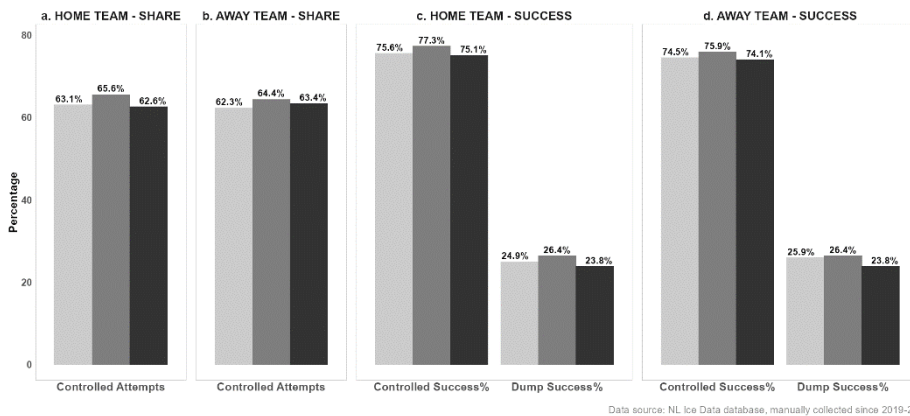
We clearly see a small but steady increase in the second period, both in the share of controlled attempts and the success rate of those (Figure 7, a, b, c, d). And if a team uses fewer dumps in the second period, their success rate also improves. On the other hand, the first and third periods are almost copycats on all metrics. Based on this, teams willing to build on controlled entries could intentionally push harder for them during the second period of games.

4.4   Score and Venue Adjusted Transition Values

If indeed score and venue impact the way teams are transitioning the puck in a hockey game, it seems possible to now use score and venue adjusted values for exits and entries data when collecting them. More importantly, using adjusted numbers would benefit talented players and teams able to keep on executing controlled plays despite a less favorable context and increased pressure. And, of course, penalize players and teams unwilling to face tougher adversity.

That means, instead of each event having a value of 1, the adjusted value would depend on the score and venue situation, following the formula detailed in Section 3.1.

$$Adjustment\ coeff. = \frac{Rate\ (per\ 60)\ of\ any\ event}{Rate\ (per\ 60)\ of\ any\ event\ (home\ team, tied\ game)}$$

The adjustment for a play made harder by score and venue, for example a controlled zone exit when leading the score, would give that event a value higher than 1, rewarding the play. However, an easy or expected play, for example a controlled exit when trailing the score, would have an adjusted value lower than 1, highlighting the easier context surrounding the event.

Fig. 8: Score and Venue Adjustment Coefficients for Transition Events
Adjustment Coefficients per Scoring state: Trailing, Tied, Leading.

Data source: NL Ice Data database, manually collected since 2019-20
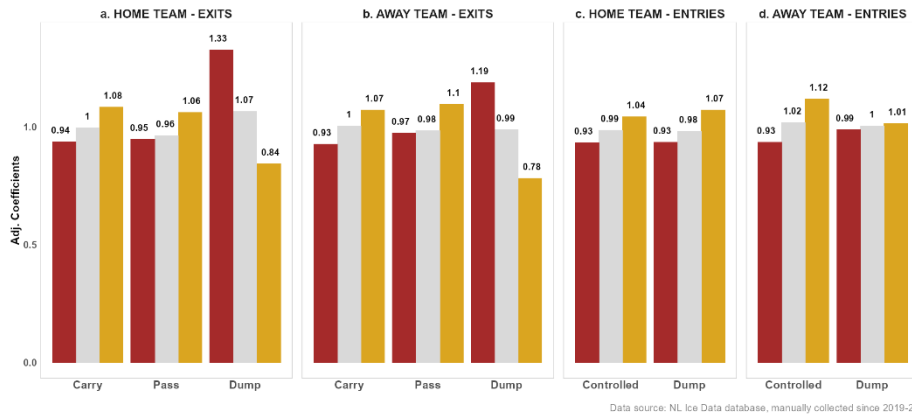
Here we chose to group successful and failed events, as we position ourselves ahead of the transition, when the player must choose how he will execute the play. Findings are very similar for home and away teams. A leading home team, facing increased pressure from the trailing forwards would see carry exits (1.08) and pass exits (1.06) (Figure 8, a) bonified to reward the will to keep control of the puck instead of getting rid of it to escape forecheck. On the other hand, dumping the puck as the leading home team is expected and one dump exit would now be worth 0.84 (Figure 8, a), not penalizing the player responsible.

The opposite dynamic is witnessed for the trailing home team. As zone exits get easier, your carry or pass attempts are now worth 0.94 or 0.95 each (Figure 8, a). Dumping out the puck as the trailing home team is not something you are supposed to do and a dump would now be worth 1.34 (Figure 8, a), penalizing the player responsible in his stats, as most agree that dump exits are to be avoided in general because they generate less offense [6].

On zone entries, we discovered that trailing did not mean less controlled entries. Therefore, you would not be rewarded for trying to enter the offensive zone in control when chasing the score. A controlled entry for a trailing team, home or away, would now be worth 0.93 (Figure 8, c, d). Even if controlled entries become harder to complete when trailing, the fact that you are trying many more is driving the adjustment down.

One thing here is also to remember that the side of the ice mattered more than the score on entries, and the third period, where the score would most impact the game, has benches on the easy side for defensemen.

5 Conclusions, Limitations and Future Work

In the end, historical assumptions seem to mostly hold. A leading team would control transitions less and dump the puck more, when a trailing team would face easier zone exits. However, the fact that trailing teams increase their number of zone entry attempts quite a lot, leading to more controlled entries, was a bit surprising.

It also appeared clearly that score dynamics are a much stronger driver than venue dynamics. And that the net difference in style or success between home and away teams is very close, making us wonder if the old saying "play a simple game on the road" is a thing of the past, or even ever existed.

One unexpected finding concerned the impact of playing far from your bench during the second period. It leads to more controlled transitions and better success rates, probably as defenders are more tired and lines get stretched over the ice. Knowing this, teams should really push harder during that second period if they can, also knowing the risk they face defensively.

The next step in our studies would be to look at how trailing teams specifically decided to approach zone entries. Do the way trailing teams approach transitions help them tying the game? What are your probabilities to score based on how much controlled and successful your transitions are at that time? That way, we could possibly highlight the most effective strategies to score goals under the pressure of losing a game.

It would be interesting to see how our work hold for other professional leagues (KHL, NHL, Liiga, SHL, …), envisioning a difference between European hockey, played in big rink, and North-American hockey.

We tracked games during the 2022 Olympics, played in a small rink, and controlled entries percentage tended to be 5 to 10 points of percentage lower than our average numbers in Switzerland. Defending zone entries in a small rink is indeed much easier and running the same analysis with NHL data could bring different conclusions.

Furthermore, if score and venue dynamics probably explain a non-neglectable part of the results, what other variables or aspects of the game could help us understand the observed differences? Does this Score & Venue adjustment offer an improvement in the repeatability of the different transition measures? Would any adjustment of time be justified? In another research [7], Micah Blake McCurdy stated that "*time-adjustment for possession calculations is not justified*".

References

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