When Should a Team Use the Power Play?

Introduction to Timing of the Power Play

The power play (PP) is a unique addition to mixed doubles curling where the team with the hammer may elect once per game to move the prepositioned stones to the right or left side, opening up the center of the ice. Many players revere this as a secret weapon to use near the end of the game and score big. To understand best how and when to use this power play, we must first look at how it is currently being used and what successes and shortcomings come from those plays.
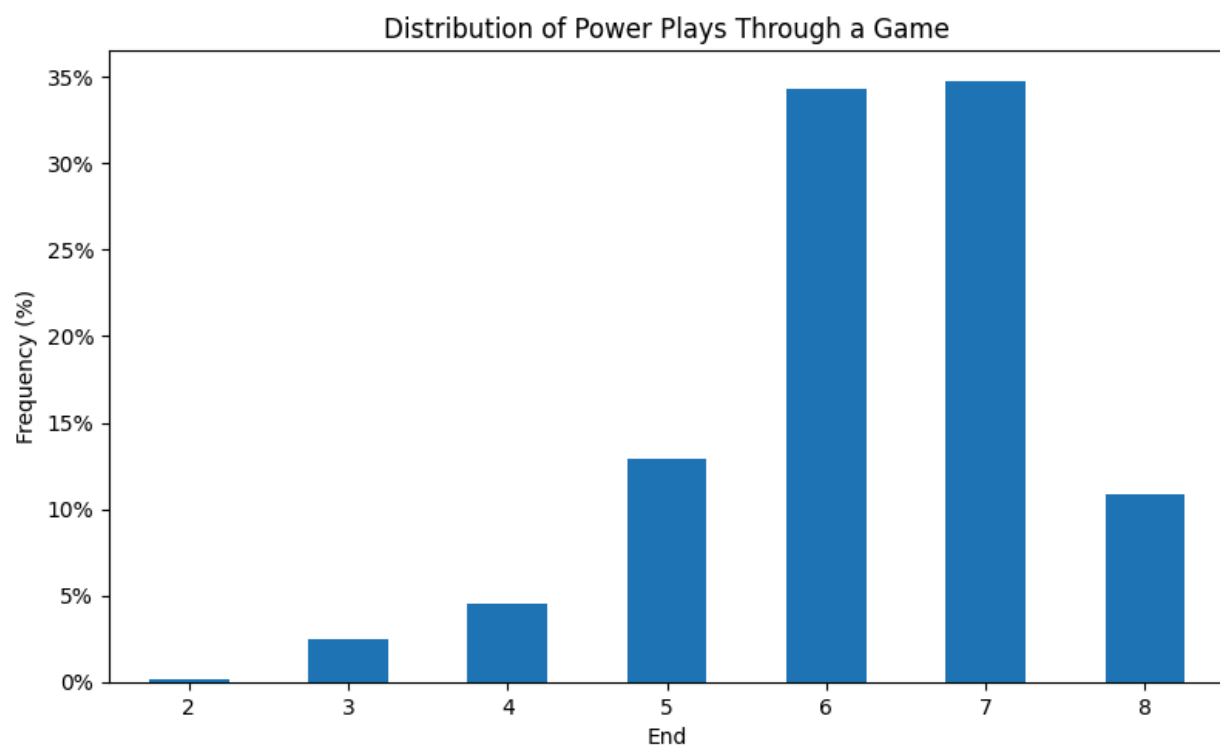

Figure 1: *Power play frequency in 2022 Winter Olympics and 2023-2025 Mixed Doubles World Championships.*

Power Plays are typically saved for later ends, with 67% of all PPs done in the 6th or 7th end. They are seldom used in the opening ends unless the team finds themselves with a very low margin of victory (MOV), defined as the difference in a team's score relative to their opponent at the beginning of an end (ex. If Team A has 4 points and Team B has 2 at the start of the 4th end, Team A's MOV will be 2 and Team B's MOV will be -2 for End = 4). This goes in line with conventional wisdom of wanting to save the PP for the end.
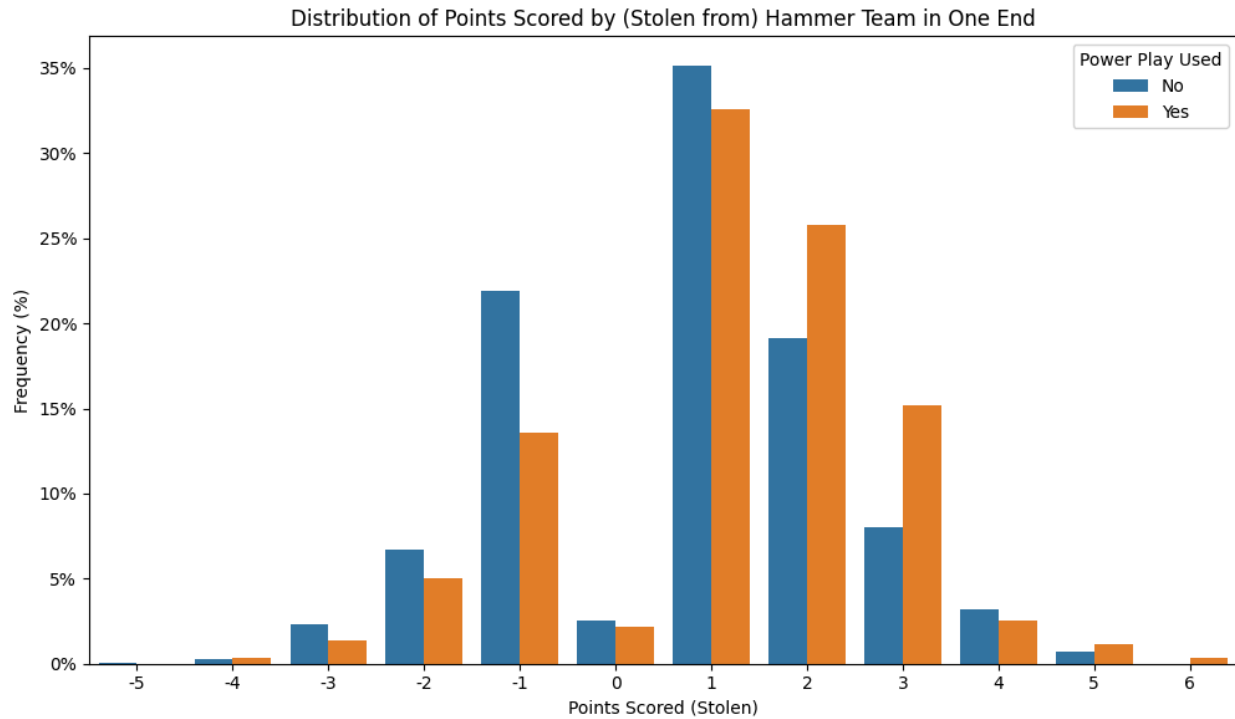
Figure 2*: Distribution of points scored by the hammer team or stolen from the hammer team while a power play was used or not during the end.*

The benefits of the PP are modest, but noticeable. Teams with the hammer score 2+ point ends much more frequently with an added benefit of reducing both the risk of a steal and the total points lost from a steal.
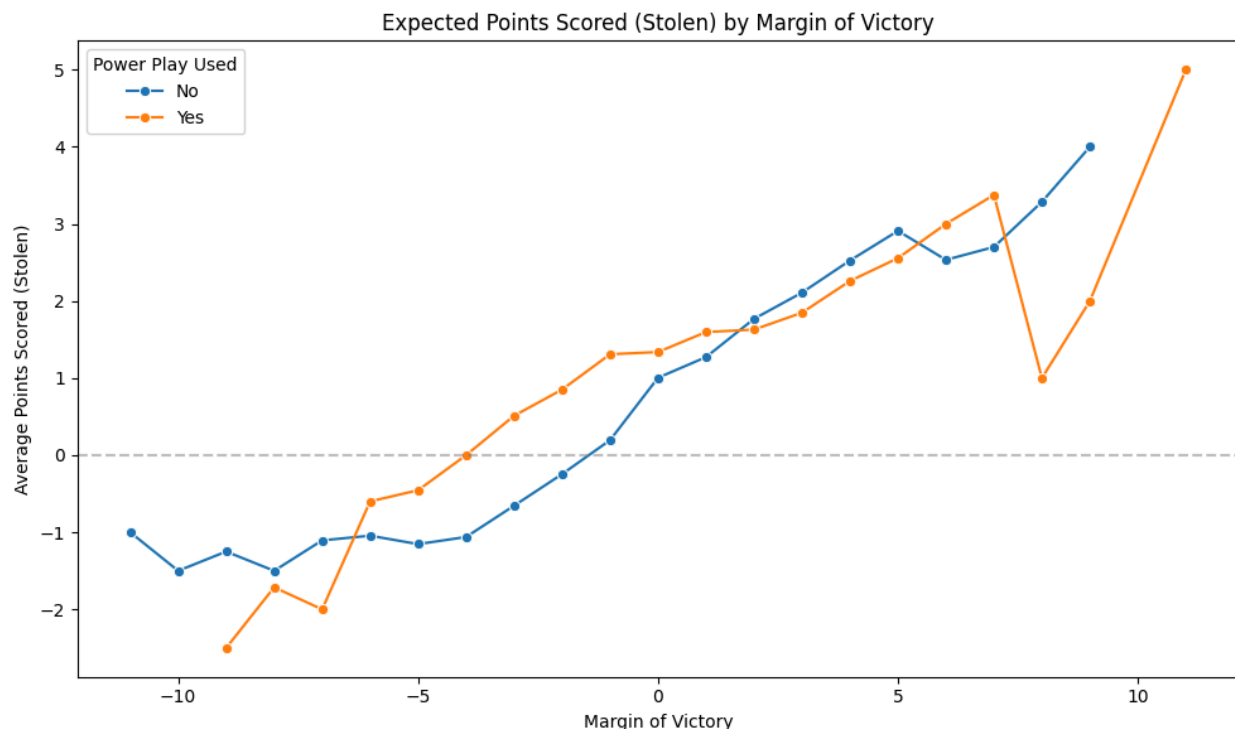
Figure 3: *Average points scored by the hammer team or stolen from the hammer team based on the play's given margin of victory.*

The benefits of using a PP are not always distributed equally. Points earned by the hammer team are correlated with MOV, whether that be from momentum, skill, or a combination. Something interesting has happened for teams in close or negative MOVs though. Unlike teams with positive MOVs who can expect to score the same on a PP or not, teams with losing positions have tended to score an additional point, on average, when using a PP.

With these initial findings in mind, we have found strategies simplified to rules of thumb that can optimize the PP use of a team depending on the situation the team is in.

Rule of Thumb One: Don't Intentionally Retain the Hammer

Unlike traditional curling, blanking an end doesn't allow you to retain the hammer. To retain the hammer, you must actually lose one or several points. When would a team ever be willing to do this?

Imagine it is the 7th end and the hammer team has a PP remaining. It is very common to use a PP here, but if all goes well, the opponent will have the hammer in the last end of the game. Allowing your opponent this ending control isn't ideal, especially if they have a PP remaining which has the potential for a big, last-second score. If any situation warrants a sacrifice to retain the PP, this is likely it. When observing teams who elected to use this strategy, the results were

great (see Appendix C). Every team had a slight lead before sacrificing a point and proceeded to win the game.

Is this a viable strategy? Or did these teams get lucky?

Sacrificing a point limits upside potential, obviously, but the tradeoff could mean reducing the risk of your opponent scoring 2+ points (see Figure 2). We hypothesized that this probably wouldn't be desirable in a losing situation where you want to maximize your upside, but teams would benefit from capping their losses in a close game when they have a slight MOV advantage.

We created an experiment using ten-thousand bootstrapped samples which calculated the odds of winning a game. To make this simulation easier to understand, imagine Team A playing against Team B. For the situation where Team A elects to use a PP in the 7th end, two cases were tested: one where Team B had a PP remaining for the 8th end (Case A1), and another where they did not (Case A2). These cases' results were compared to the situation where Team A sacrifices 1-2 points in the 7th end to maintain control of the hammer in the 8th end (Case B). Each case was separately tested when Team A was losing by >2 points, losing by 1-2 points, tied, winning by 1-2 points, and winning by >2 points.
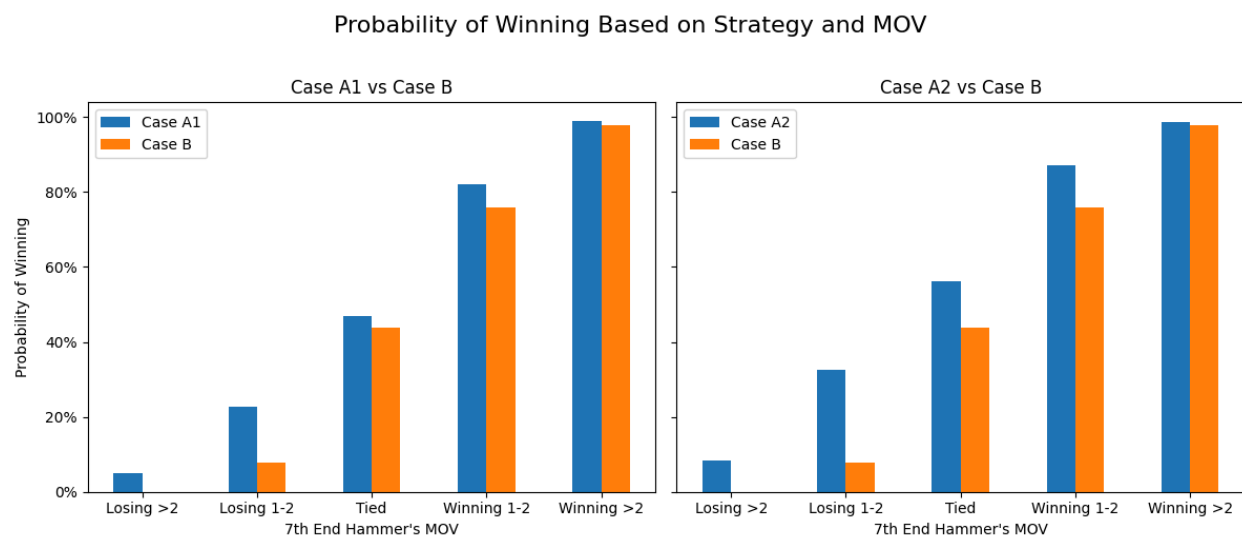

Figure 4: *Shows the likelihood of the Power Play Retention Strategy winning the game (Case B) versus electing to use the power play earlier, based on whether the opposing team has a power play remaining (Case A1) or not (Case A2). Case B consistently underperforms Case A.*

Surprisingly, the results were very unfavorable to support sacrificing an end - even when the opposing team had a PP remaining. Due to limitations in comparable data, we don't want to make a strong assertion that one strategy is certainly better or worse than another. If more comparable data became available, it's very possible that one strategy may clearly prevail over another. However, it appears today that intentionally sacrificing a point in the 7th end to use the PP in the 8th carries a lot of risk with minimal, if any, upside.

Don't sacrifice an end to intentionally retain the hammer.

Rule of Thumb 2: Use the Power Play Earlier

Are teams using the power play too late? We saw from Rule of Thumb 1 that sacrificing for the PP probably isn't worth the risk, but what about when the risks of holding on aren't as obvious? Our data says teams are absolutely waiting too long, at least for a specific subset of game states.
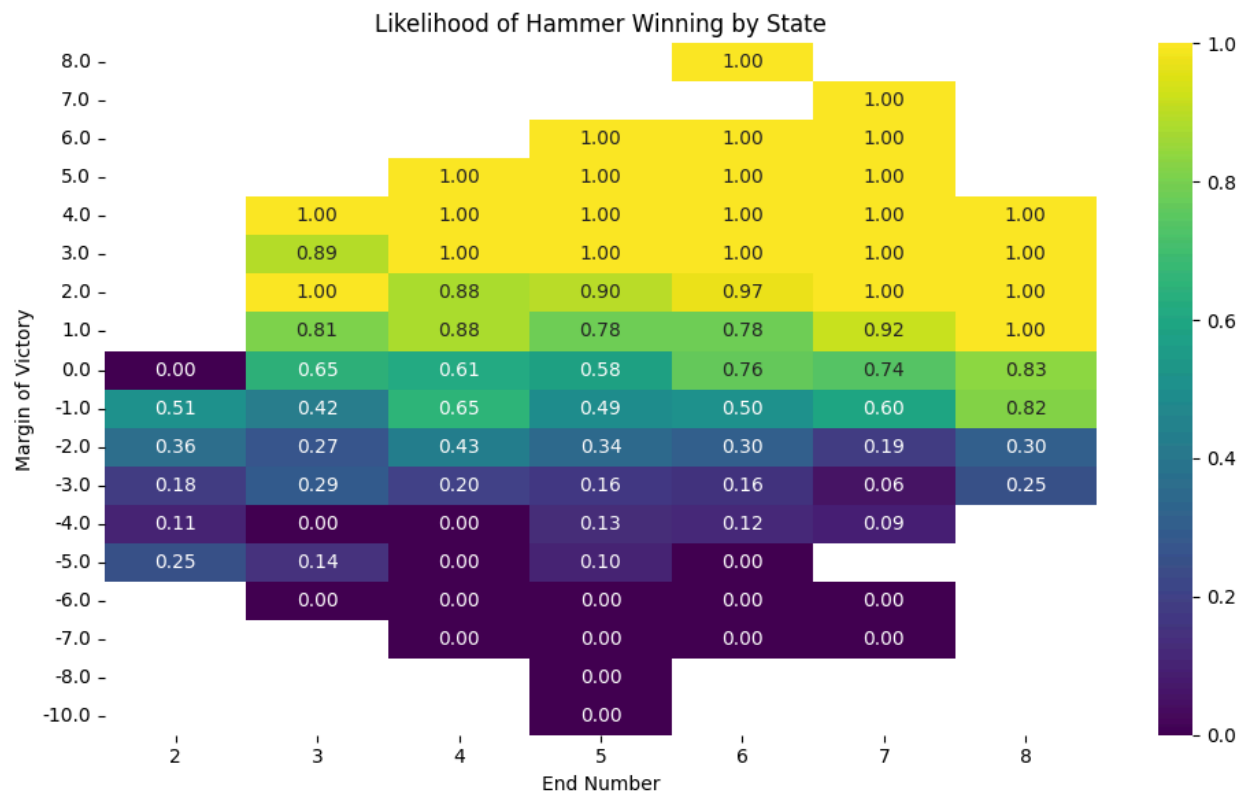

Figure 5: *Likelihood of hammer team winning based on MOV by End. MOVs of two or more almost result in a win, and MOVs below -3 almost always lose.*
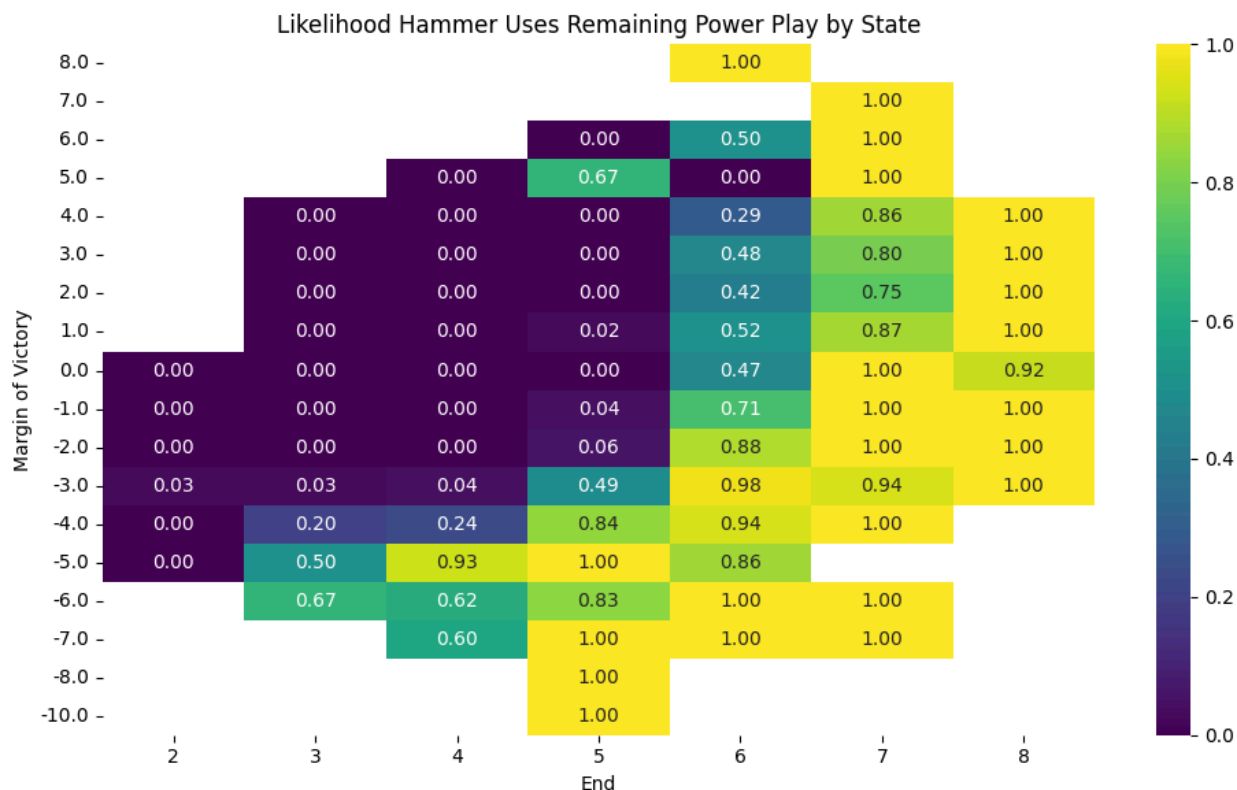
Figure 6: *Likelihood the PP is used by the hammer team based on MOV and End. Most teams use the PP at the end of the game unless they have fallen significantly behind.*

These two figures show values for a given state of a game based on the Margin of Victory entering a specific End. These can be read together as showing the odds of winning and the odds of using a PP at any given state where historical data exists.

Figure 6 shows conventional wisdom holds where teams will often wait until the very end to strike, unless they are down significantly and need a miracle. But this miracle may be used too late for some, as looking at Figure 5, teams with low MOVs don't use the PP early until their odds of winning are practically zero! Many of the cases on the borders are outliers with small samples (see Appendix A), such as a MOV of -10 at the 5th end, so being caught off guard with a huge win or loss may be unexpected. It still makes you stop and ask though why this team hadn't used a power play when they were down by 4-7 the round or so prior? Why did they wait until they were even more certain to lose?

Teams may not be able to wait as long as they'd hope before defeat is inescapable. Teams with the hammer and an MOV of -4 at *any time in the game* are almost guaranteed to lose, yet many still postpone the use of the power play, even with MOVs of -6. Why are they waiting to use their best tool to catch up? Going from a MOV of -2 to -3 alone after the 3rd end with the hammer halves your chances of being victorious. If a team's MOV is -2 after the first few ends, a subsequent steal can doom their attempt for redemption. We know from Figure 2 that a PP

raises the chances of scoring big and reduces the chances of a steal, and that seems entirely appropriate for a team who needs to get back in the fight and can't afford to fall further behind.

Alternatively, when a team is ahead or the score is very close, holding on to the PP as late as possible is reasonable. This can be evidenced by Figure 3 as well, which shows minimal upside from teams using the PP when ahead. Despite few having the idea to use the PP early to create an insurmountable lead, there is a massive selection bias in PP usage. This makes determining whether early PP usage is beneficial nearly impossible as all the teams who do so are outliers.

There are some ways we can try, although the results are far from ideal. We can calculate the marginal benefit of using the PP on a state-by-state basis. This works by using a scoring distribution (we used the one from Figure 2) to find the expected odds of a team winning after using a PP less the expected odds of winning after using a regular play. So, if a team scores 2 points using the PP versus 1 point without, this calculates how much more likely the team to win is now that they have this extra point. Due to limitations in data, we'll have to make concessions such as "double dipping" of the PP as we can't calculate the odds of winning without a power play remaining in most cases. This means that although in our hypothetical example the team who elected an early PP shouldn't have one remaining, some of the data to calculate the odds of winning include teams with PPs remaining. These errors are applied consistently throughout the data, so the relative results, especially in earlier ends, may be more valuable than the final results.
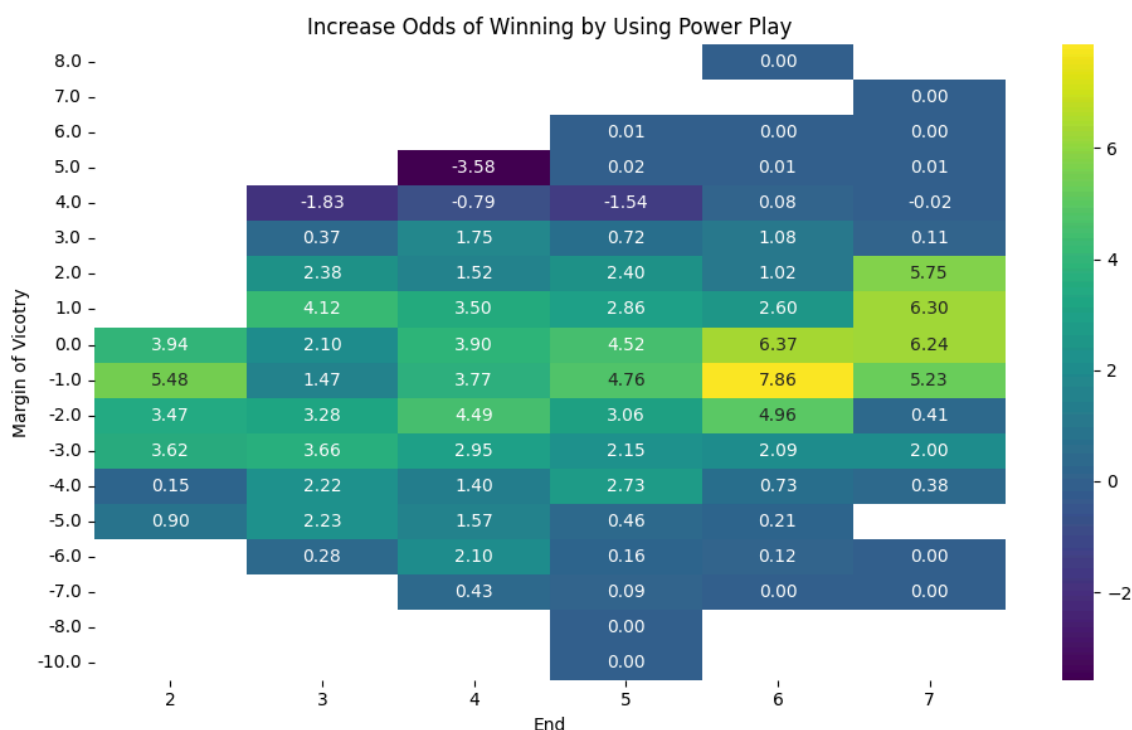

Figure 7: Increase in odds of winning by using the power play in a given state. Late-game PP usage increases odds of winning for tight or high MOV states, but decreases in negative MOV states.

When looking at MOVs < -2, we see that using the PP earlier generally resulted in larger increases in odds of winning, suggesting that getting yourself back in the fight early can better your odds of redemption. For closer games though, there may be more appeal to reserve the PP for later ends.

More data needs to be collected on attempts to use the power play earlier in the game, possibly from practices or lower-level competitions where the stakes of trying new things are lower. This will give additional insight to how likely a team is to win given they don't have a PP remaining and allow for clearer recommendations on when the optimal time to use the PP is. What we can say with high confidence now is that teams are waiting too long to use the PP when they fall behind. We also strongly recommend for teams to consider using the PP as early as the 3rd end when they find themselves with a MOV of -3 or lower.

Losing teams need to use the power play sooner than they think, before they fall too far behind to catch up.

Rule of Thumb 3: Draw More to Score More

The powerplay represents a key opportunity for the team with the hammer to score more than a normal end. When a powerplay is used, the hammer team scores 3 or more points 19.2% of the time, significantly higher than the 12% chance in a normal end.
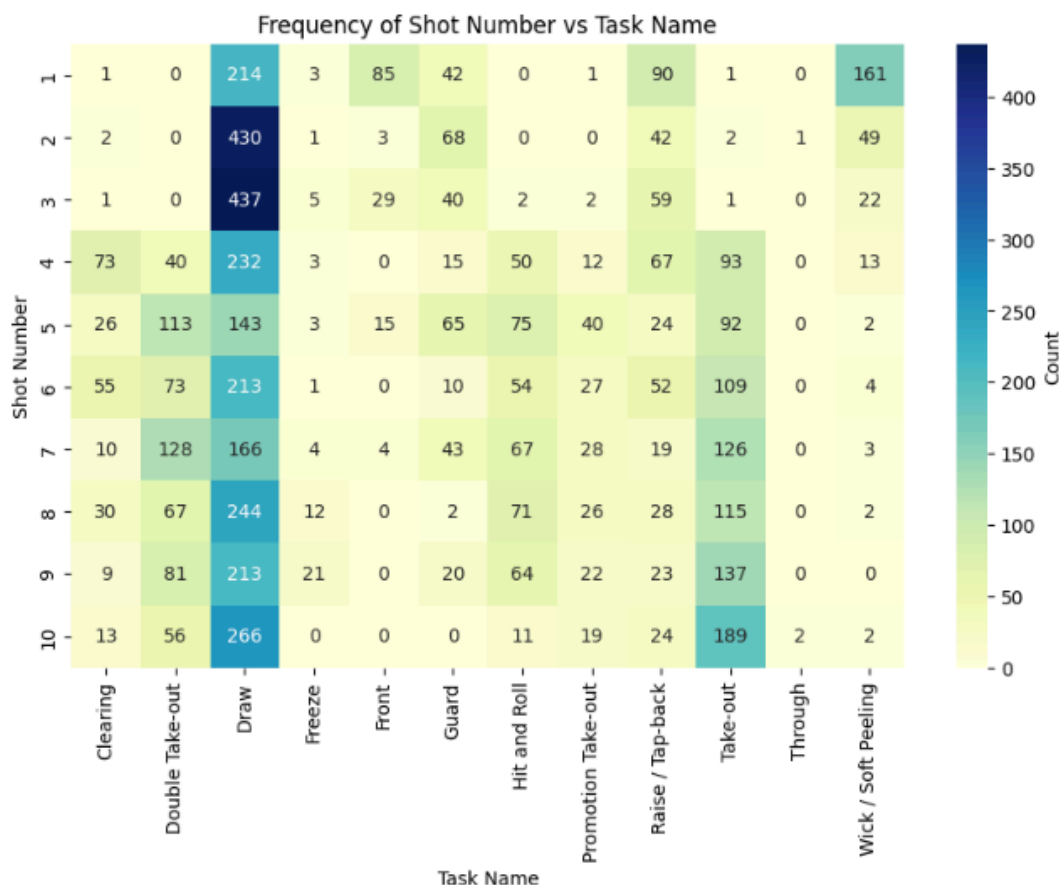
Frequency of Shot Number vs Task Name

Shot Number	Clearing	Double Take-out	Draw	Freeze	Front	Guard	Hit and Roll	Promotion Take-out	Raise / Tap-back	Take-out	Through	Wick / Soft Peeling
1	1	0	214	3	85	42	0	1	90	1	0	161
2	2	0	430	1	3	68	0	0	42	2	1	49
3	1	0	437	5	29	40	2	2	59	1	0	22
4	73	40	232	3	0	15	50	12	67	93	0	13
5	26	113	143	3	15	65	75	40	24	92	0	2
6	55	73	213	1	0	10	54	27	52	109	0	4
7	10	128	166	4	4	43	67	28	19	126	0	3
8	30	67	244	12	0	2	71	26	28	115	0	2
9	9	81	213	21	0	20	64	22	23	137	0	0
10	13	56	266	0	0	0	11	19	24	189	2	2

Figure 8. *Frequency of Shot Tasks by Shot Number*

Figure 8 shows how a powerplay progresses shot by shot, with the non-hammer team taking the odd numbered shots, and the hammer team responding with the even numbered shots. The non-hammer team's first shot significantly varies in frequency; however, the following two shots are generally draws. Then, on the fourth shot, the hammer team may elect to perform a take-out to reduce the number of stones in play. The variance in task selection is much higher for non-hammer teams, indicating that the non-hammer team determines the pace of play, with how willing they are to leave stones in play.
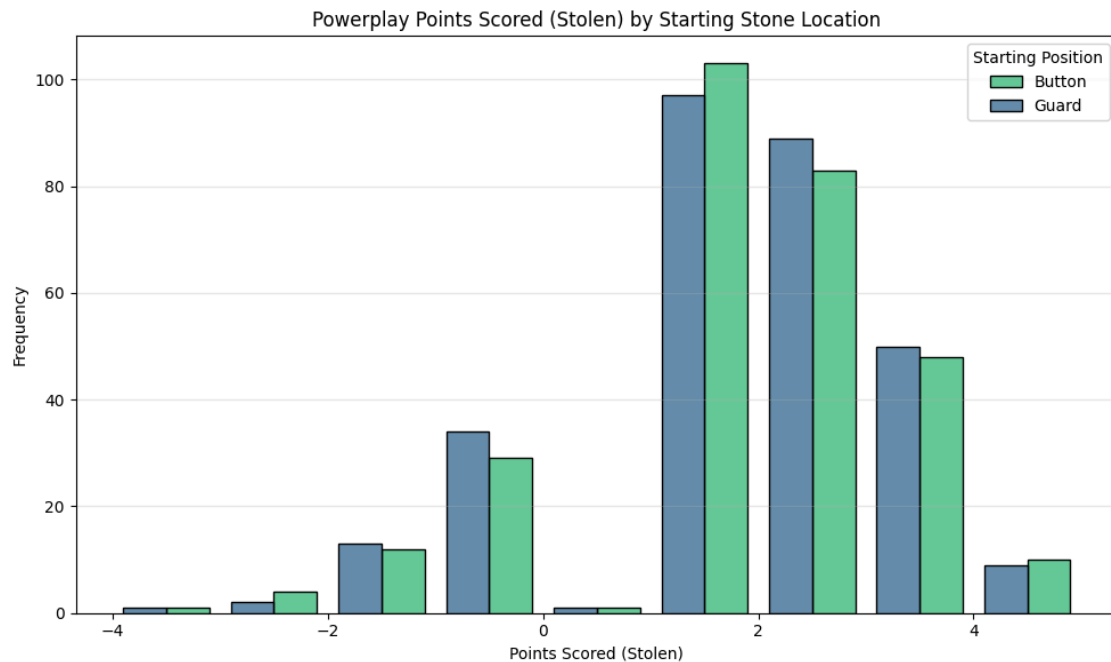

Figure 9. Powerplay Hammer Score by Starting Stone Position

At the beginning of a powerplay, the hammer team gets to choose where they place each stone: on the button or as a guard. When examining the distribution of scores for the hammer team, this decision does not make a significant difference in the hammer team's results as depicted in Figure 9.
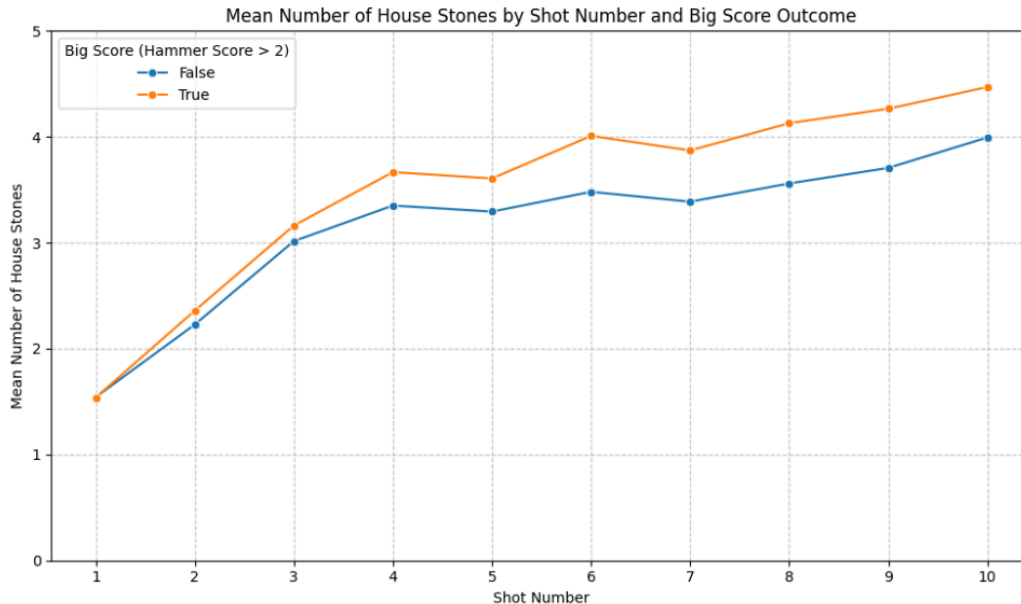
Figure 10. *Mean Number of Stones in the House by Shot Number*

Scoring three or more points during a power play correlates with having more stones in the house. While the first three shots show similar patterns in stone accumulation between high-scoring and low-scoring ends, high-scoring ends show steeper increases from stones 4 and 6 compared to low-scoring ends. This indicates that the hammer team should use the fourth and sixth shots to draw or find another way of adding stones into the house to increase the likelihood that they score big on the powerplay.

Likewise, the non-hamer team's best course of action to prevent this assault is to make it difficult or risky for the hammer team to get a stone on the house during the 4th and 6th shot. One method for accomplishing this is by throwing a guard at the front of the house. When a non-hammer's first throw is to the front, they give up three or more points just 7% of the time, compared to the 24% when the non-hammer team begins with a draw. Both high and low point scoring ends involve an increase in take outs during the 5th and 7th shots, slightly reducing the number of house stones on average, but hammer teams who score >2 points are much more likely to respond better the next play.

To identify promising early-end strategic decisions for the hammer team, we ran a logistic regression to measure what moves increase or decrease the odds at getting a big scoring powerplay. We used existing early game strategies supplemented by bootstrapping the examples to 1000 samples.
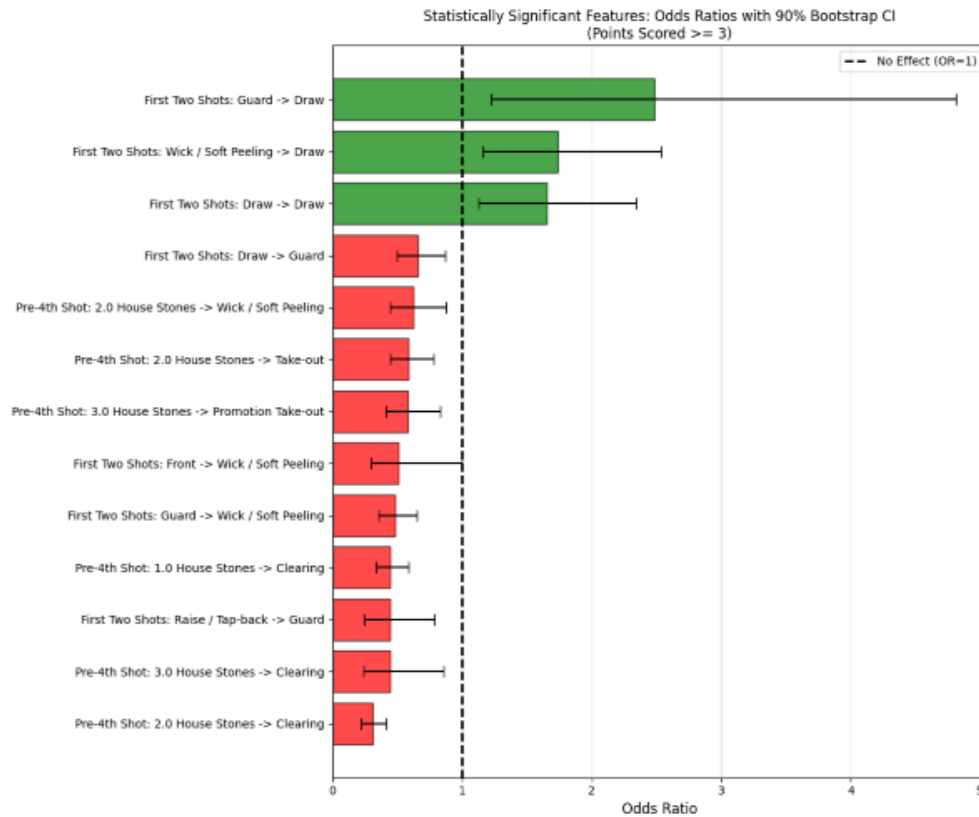
Figure 11. *Odds Ratios of Statistically Significant Features. Green are combinations that increase the odds of scoring 3+, red decreases the odds of scoring 3+.*

Statistically significant features from this logistic regression model are displayed in Figure 11. A feature was deemed statistically significant if the 90% confidence interval did not contain an odds ratio of 1, which represents the feature having no effect on the likelihood of a big scoring power play.

Looking at Figure 11, while the non-hammer team may choose to draw, soft peel, or throw a guard with their first throw, it is generally best for the hammer team to draw in response. Following a guard, the hammer team is 2.5 times more likely on average to score 3 or more points if they draw on their second stone. Additionally, for the 4th shot, the hammer team should avoid clearing or performing a take-out when attempting a big powerplay score. These shots remove stones in play, which is inadvisable for scoring big.

As the hammer team on a powerplay, to score more, draw more.

Appendix

Supplemental information to aid in understanding the analysis and recommendations made in the report.

Appendix A

Frequency of Specific Hammer State Occurences
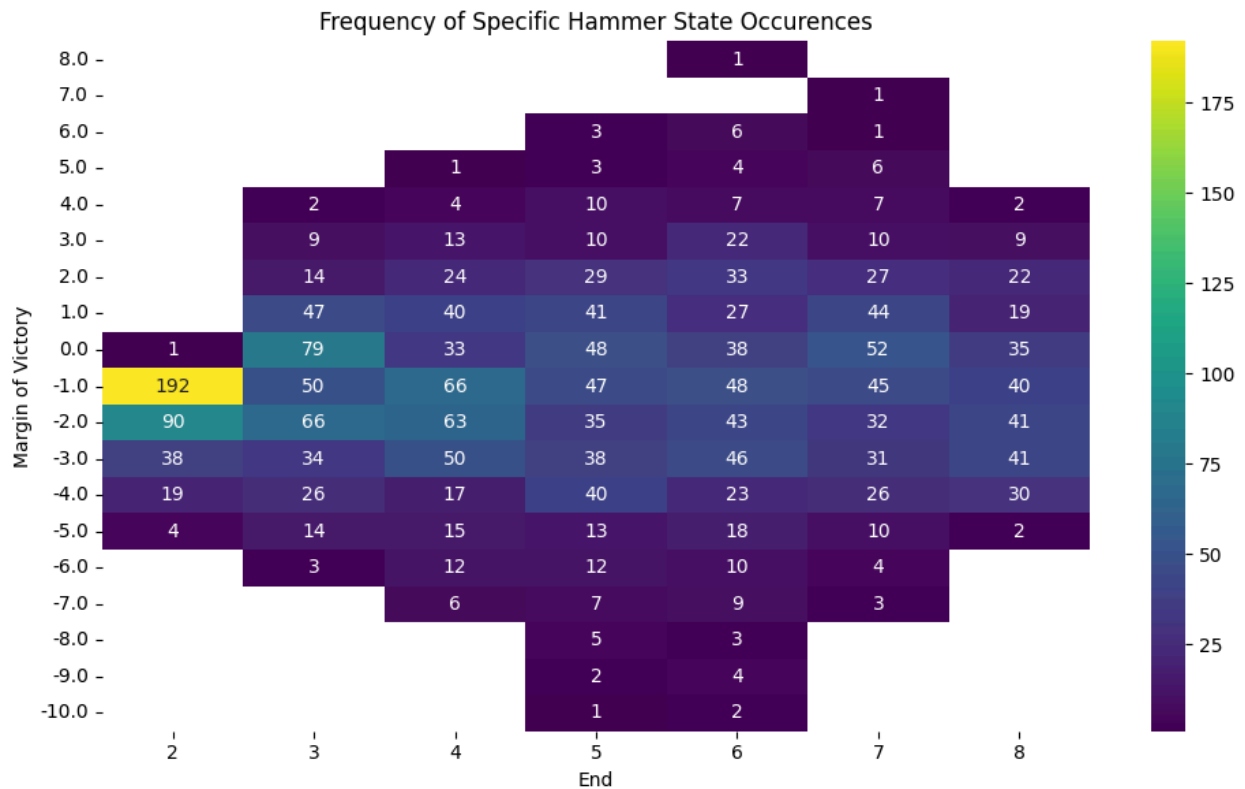
This figure shows the frequency each state happens from the dataset available. We can see a bit of bouncing around from end-to-end, showing that teams often trade off scoring points on one another. Importantly, we see that large and cumulative losses or gains are unusual. Figures 5 and 6 are filled with states with limited samples to draw from, and this can result in unusual like State(End = 5, MOV = 5) on figure 6 standing out among its peers. We can see this was a 67% increase in likelihood, but this case only had a sample size of 3 - an outlier perhaps caused by chance, not necessarily a unique insight waiting to be discovered.

Appendix B

Probability of Winning or Tying Based on Strategy and MOV
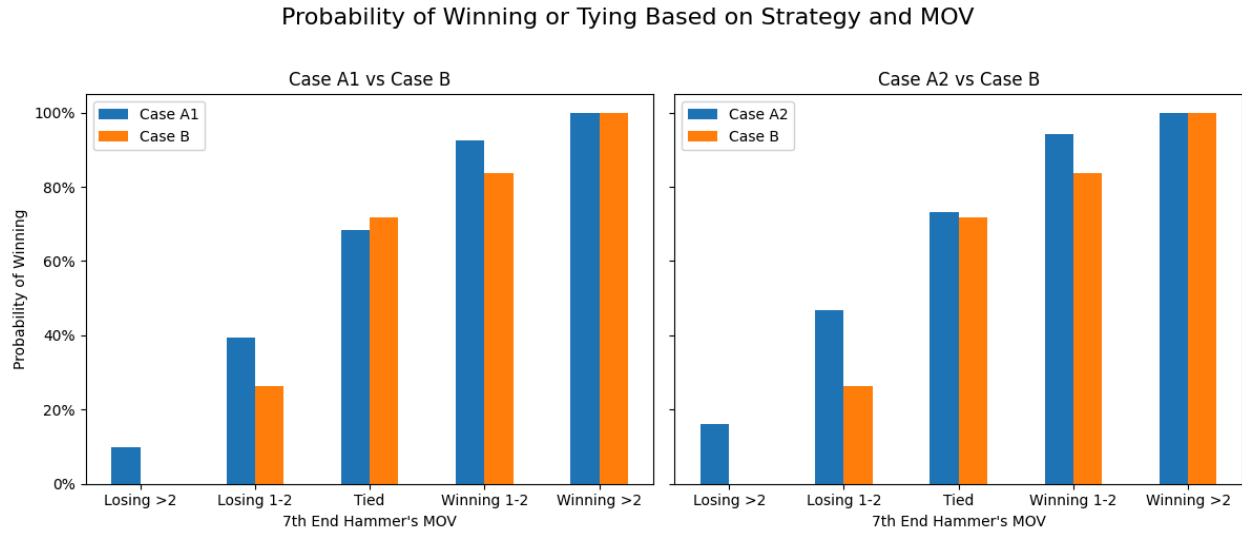
An alternative figure for Figure 4. Instead of just winning, this shows the odds of winning *or tying*. Tying may be desirable for some teams in certain situations, especially if they have the hammer in the 9th end. The only noticeable difference between this and the former graph, despite some broad elevation in likelihood, is the slight increase in odds when tied (Case A1 vs Case B). This was likely an anomaly as we expected the odds to get better as MOV increases, not peak then fall back down, and the difference is too small to be significant. We presume this was a chance occurrence rather than an insight. This ultimately supplements the overall theme that there isn't enough data to suggest that this sacrificial strategy has a worthwhile payoff.

Appendix C

Competition Name	Name	Opponent	Score	End	End Type	Opponent PP Remaining?	Hammer	Pre-End Score Margin	End Result	Post-End Score Margin
World Mixed Doubles Curling Championship 2023	DEN	EST	7-6	7	Normal End	No	With Hammer	1	-1	0
				8	Power Play	No	With Hammer	0	1	1
	ITA	KOR	6-3	7	Normal End	No	With Hammer	3	-1	2
				8	Power Play	No	With Hammer	2	1	3
World Mixed Doubles Curling Championship 2024	CZE	NZL	8-6	7	Normal End	No	With Hammer	1	-2	-1
				8	Power Play	No	With Hammer	-1	3	2
	CZE	USA	7-4	7	Normal End	No	With Hammer	2	-1	1
				8	Power Play	No	With Hammer	1	2	3

Appendix C shows every instance where the hammer team elected to not use their remaining power play in the 7th end and then lost the end. Whether intentional or not, the hammer team then retained the hammer for the final end, where they used their power play and won the game.

In all four instances, the hammer team was leading before the 7th end. After giving up one or two points in the seventh end, the hammer team used their power play in the 8th end, scoring the same or more points than they gave up in the 7th end. Interestingly, Czechia (CZE) employed this strategy every instance they were leading into the 7th end during the 2024 World Mixed Doubles Curling Championship, winning both games.