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**Master of
Management
Analytics**

SELECTION OF BEST POWER PLAY AND PENALTY KILL SPECIALISTS

Performance Analytics on Canadian Olympic Women Hockey Team

June 17, 2020 Prepared by Team L (Bangxin Nie, Humza Butt, Haoyu Sun, Kellan Zhang)



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The Path to Championship

Specialists Selection Analytics for legendary Canadian Olympic Women Hockey Team

Context

- While the legendary Canadian Olympic Women Hockey Team is preparing for 2020 World Championships, the team manager is arranging line up and formulating tactics.
- Commissioned by the head coach, the data scientist team has identified the best players under power play and penalty kill scenarios.

Objectives

- Specifically, the analytics aims to select 5 best power play specialists and 4 penalty kill specialists with superior skills to be subbed in under the corresponding scenario.






Data Source

- Our modeling is based on players' game performance statistics over Feb 2018 - Feb 2019.





Specialist Line-up

Selection Results & Rationale

Power Play Lineup Recommendation

					
Top Skills	Marie-Philip Poulin	Haley Irwin	Melodie Daoust	Rebecca Johnston	Brianne Jenner
Shooting Precision	9%	17%	10%	4%	5%
Shot Made/Game	0.5	0.4	0.4	0.3	0.3
Passing Precision	80%	74%	77%	74%	68%
Offensive Passing Precision	85%	75%	75%	73%	70%

Penalty Kill Lineup Recommendation

				
Top Skills	Jocelyne Larocque	Erin Ambrose	Marie-Philip Poulin	Laura Fortino
Takeaway/Game	2.2	1.8	4.0	2.6
PK Takeaway/Game	0.7	1.0	0.4	0.2
Passing Precision	73%	81%	80%	79%
Defensive Passing Precision	74%	78%	72%	78%
PK Passing Precision	67%	67%	67%	60%

Selection Methodology

Preliminary Assessment

- Determine top skills for player evaluation
- Assess relative importance of skills selected
- Constructed a scoring system
- Rank player based on scores

Refine Selection

- Key attribute analysis
- Player chemistry & synergy
- Performance under pressure
- Offensive & defensive coverage

Validation

- Lineup performance

Power Play Specialists

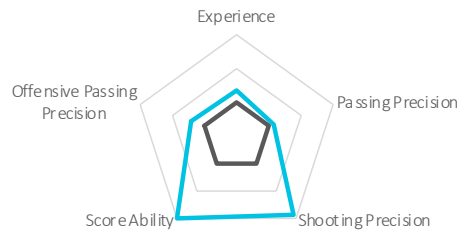
Attributes Analysis: Where They Excel

Overview

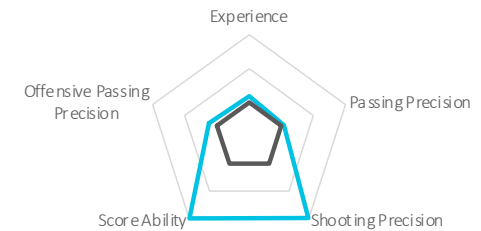
- With an all-around offensive skill-set, **Power-Play** specialists must be a **talented scorer**, with adequate **aggressiveness** and **precision** on **shooting** and **passing**.
- Attribute radar maps give us a profile of a player's ability.
- In these maps, we can clearly see the strength and weakness of our 5 **Power-Play** Specialists compared with team average.

Attribute Radar Map of Power Play Specialist (vs. Team Average)

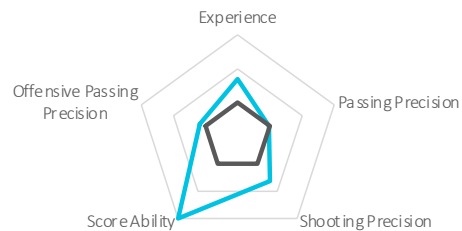
Marie-Philip Poulin
Team Superstar



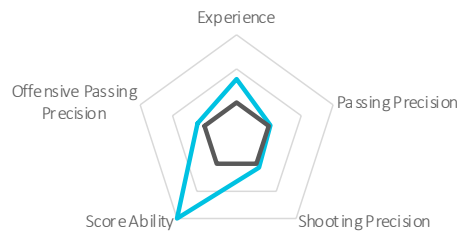
Melodie Daoust
Talent Scorer



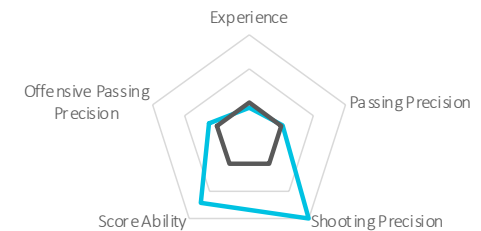
Brianne Jenner
Veteran Attacker



Rebecca Johnston
Veteran Attacker



Haley Irwin
Rising Marksmen



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Penalty Kill Specialists

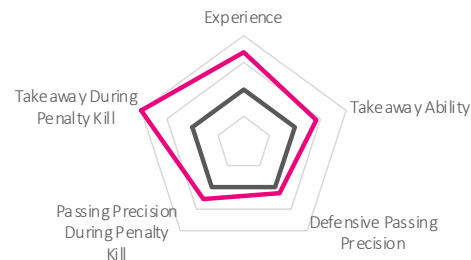
Attributes Analysis: Where They Excel

Overview

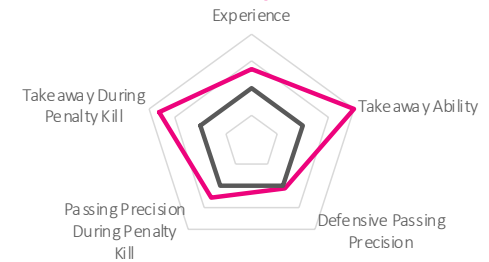
- With an all-around defensive skill-set, **Penalty-Kill** specialists must be a **solid defender**, with brave blocking and **takeover** capacity as well as **precise passing** to turn the able around.
- Attribute radar maps give us a profile of a player's ability. The five attributes are **takeaway** performance in general and in penalty-kill scenario, **defensive passing precision** in **passing precision** in **penalty-kill** scenario
- In those maps, we can clearly see the strength and weakness of each 4 **Penalty-Kill** Specialists compared with team average.

Attribute Radar Map of Power Play Specialist (vs. Team Average)

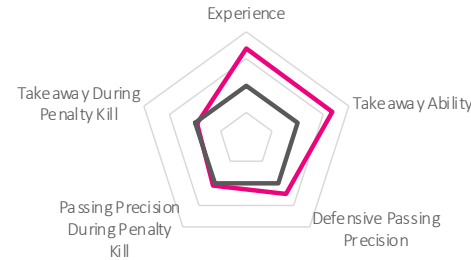
Jocelyne Larocque
Top Defender



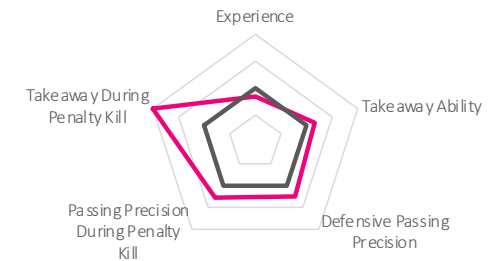
Marie-Philip Poulin
Team Captain



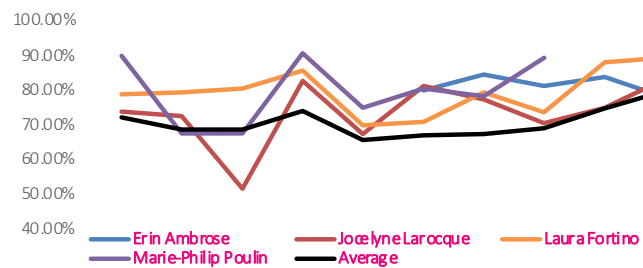
Laura Fortino
Veteran Stopper



Erin Ambrose
Fresh-face Killer



Passing Precision of two Types of Specialists over the last 10 games



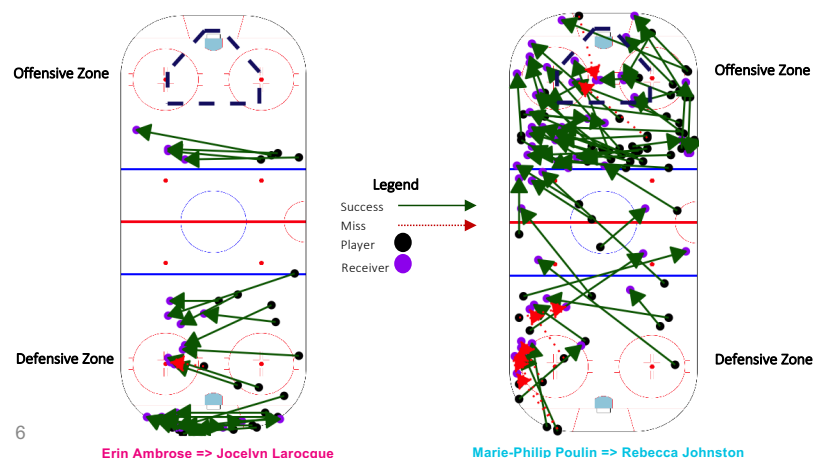
Chemistry & Synergy

Mentality Analysis

Overview

- Player chemistry is deemed crucial on the playfield and can be measured by examining **pass accuracy of two players across multiple games**.
- Best **Penalty-Kill** Dynamic Duo:
Erin Ambrose & Jocelyne Larocque or **Erin Ambrose & Laura Fortino**
- Best **Power-Play** Dynamic Duo:
Marie-Philip Poulin & Rebecca Johnston or **Marie-Philip Poulin & Melodie Daoust**
- Both types of specialists are seen to perform better with each other **above their averages** and placed in the **top 30** in terms of **pass precision**. **Power-play** players tended to pass more at the offensive end than **Penalty-Kill** specialists.

Player to Player Pass Location Visualization



Accuracy Between Players (Total Pass > 20)

Player Name	Receiver Name	Accuracy	Player Average
Rebecca Johnston	Brigette Lacquette	100.00%	73.9%
Jocelyne Larocque	Erin Ambrose	100.00%	73.4%
Lauriane Rougeau	Meaghan Mikkelson	96.55%	83.2%
Erin Ambrose	Jocelyne Larocque	96.43%	81.4%
Erin Ambrose	Laura Fortino	96.00%	81.4%
Laura Fortino	Erin Ambrose	96.00%	79.5%
Brigette Lacquette	Halli Krzyzaniak	95.45%	78.2%
Meghan Agosta	Brigette Lacquette	95.45%	68.3%
Laura Fortino	Renata Fast	95.35%	79.5%
Meaghan Mikkelson	Lauriane Rougeau	92.86%	82.8%
Renata Fast	Laura Fortino	92.73%	69.0%
Brianne Jenner	Brigette Lacquette	92.31%	68.5%
Brigette Lacquette	Rebecca Johnston	92.31%	78.2%
Laura Fortino	Marie-Philip Poulin	91.67%	79.5%
Brigette Lacquette	Brianne Jenner	90.00%	78.2%
Marie-Philip Poulin	Rebecca Johnston	87.69%	80.5%
Laura Fortino	Melodie Daoust	85.71%	79.5%
Marie-Philip Poulin	Laura Fortino	85.42%	80.5%
Melodie Daoust	Marie-Philip Poulin	83.67%	76.8%
Marie-Philip Poulin	Melodie Daoust	82.50%	80.5%
Rebecca Johnston	Laura Fortino	81.25%	73.9%
Rebecca Johnston	Marie-Philip Poulin	79.49%	73.9%

● Penalty-Kill
 ● Power-Play

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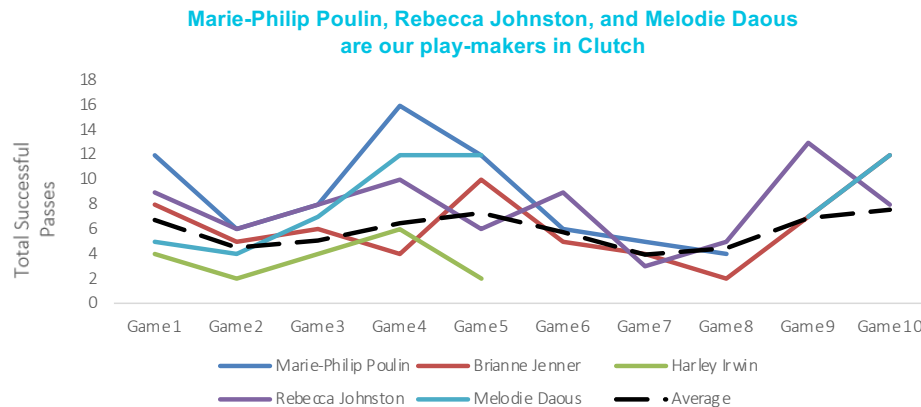
Performance Under Pressure

Mentality Analysis

Overview

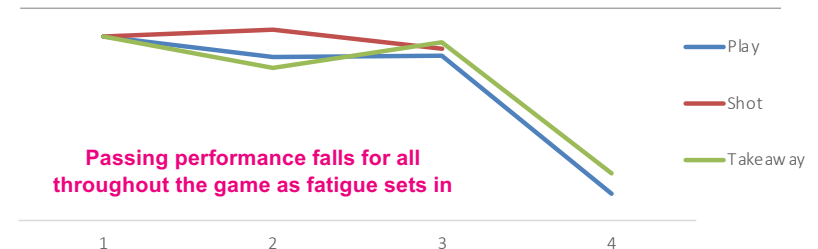
- On average, passing performance falls throughout the game as **fatigue** sets in.
- Power Play Specialists:** Marie-Philip Poulin, Rebecca Johnston, and Melodie Daous exhibit **play-maker** quality during critical clutch (the most stressful period).
- Penalty Kill Specialists:** Players' passing precision declines during penalty kill, however all 4 specialists exhibit outstanding performance, with **Erin Ambrose** and **Marie-Philip Poulin** being our **most reliable passers**.
- Overall, the **mental toughness** of the lineups are a cut above the rest.

Power-Play Lineup Performance in the Clutch (Period 3 & 4)



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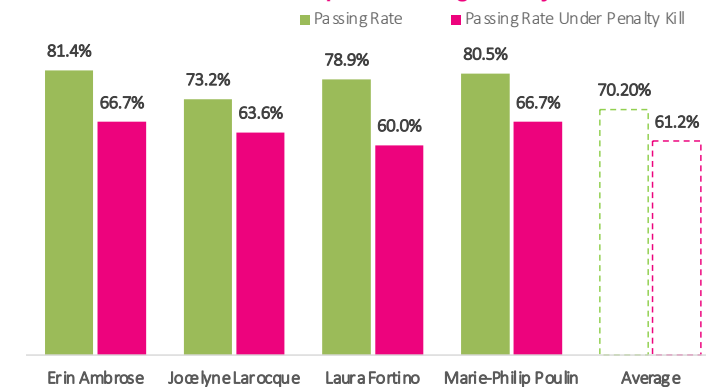
Percentage Change in Passing Performance Throughout Periods



Passing performance falls for all throughout the game as fatigue sets in

Performance During Penalty-Kills:

Erin Ambrose and Marie-Philip Poulin are the most reliable passer during Penalty Kill



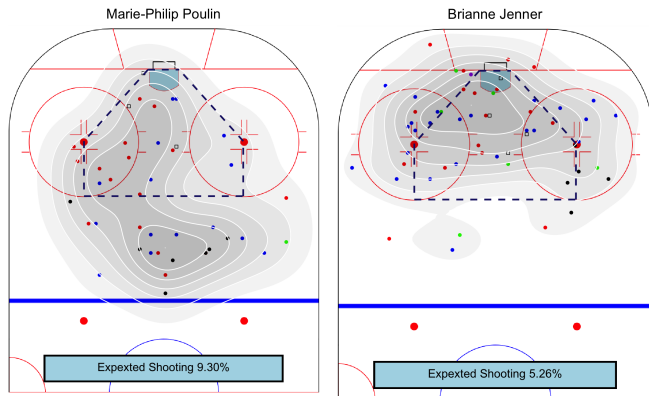
Offensive Coverage

Play Style Analysis

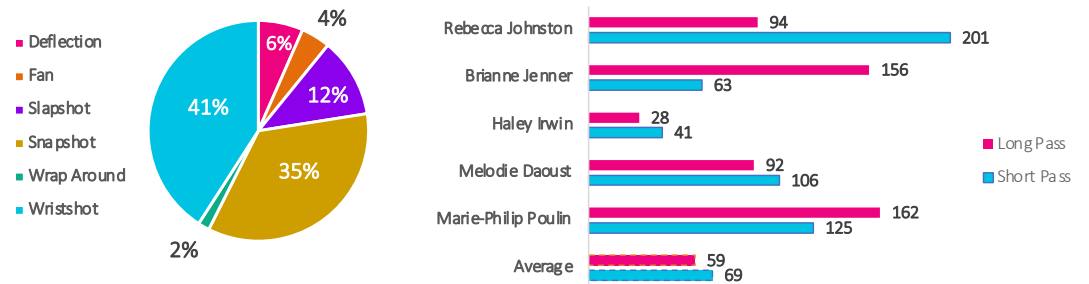
Overview

- On average, our specialists use a mixture of long and short passes.
- Play Style:** Marie-Philip Poulin and Brienne Jenner have tremendous long pass ability; while Rebecca Johnston has a strong style for short pass; Melodie Daust acts as a good all-around player
- Shot Style:** Our attackers overwhelmingly prefer wristshot and snapshots; moreover, deflections and failed accumulate to only 10% of total shots.
- Offensive Coverage:** Marie-Philip Poulin provides strategic depth in attacking with more long passes; while Brienne Jenner covers near-net area from side to side with short passes.

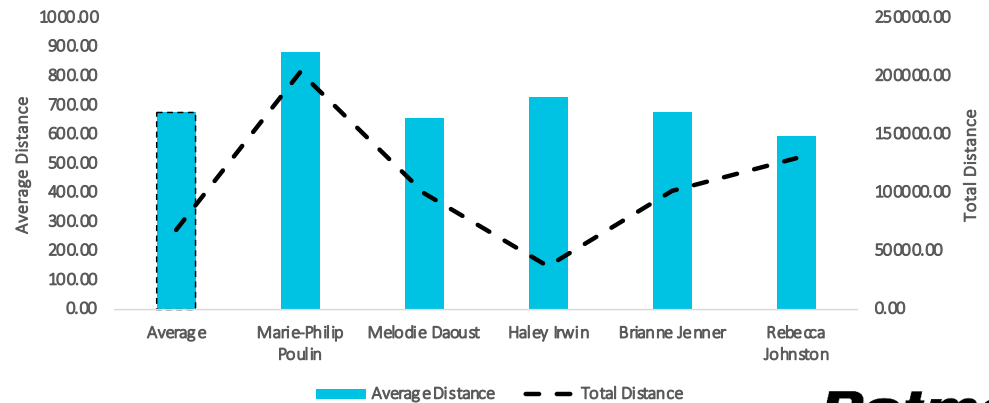
Offensive Coverage Heatmap



Shot & Play Type



Total Distance of Passes



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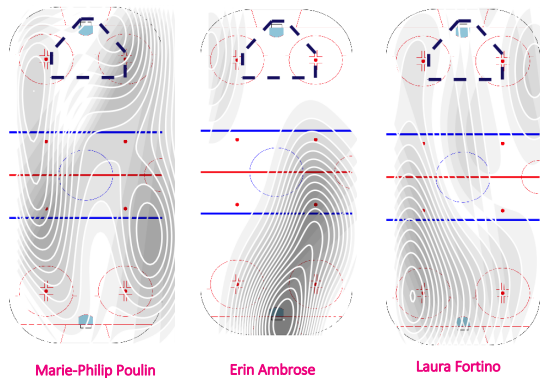
Defensive Coverage

Versatility

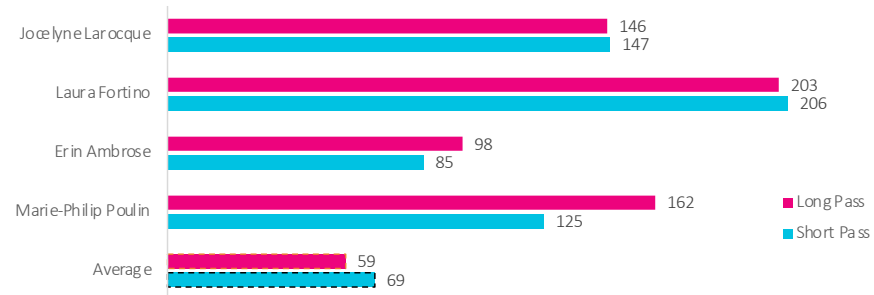
Overview

- On average, we pass **longer distances than average**. However, we still **frequently short pass**.
- Our entire lineup is balanced in terms of frequency of length of passes, but it leads to rigidity that's good for defense.
- Unlike power-play, our lineup is highly experienced and tested as all pass type attempts are way above average.
- Our players have takeaways from every area of the rink leading to no blind-spots.
- Our lineup is not specialized, but solid allowing for versatility in defending different teams.

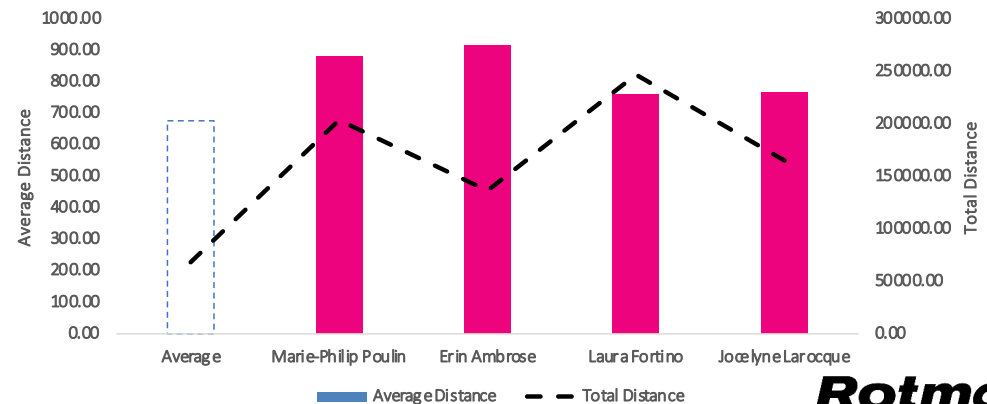
Defensive Coverage Takeaways Visualization



Play Type



Total Distance of Passes



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Lineup Performance

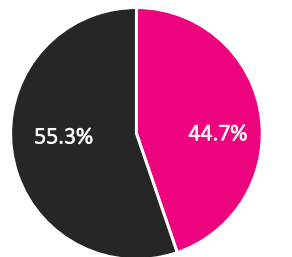
Overall Performance

Overview

- Both the **Power-Play** and **Penalty-Kill** scenarios could be **game changer**, and call for specialists with stronger ability
- Our specialist are better than the average of all other players on average **passes**, **takeaways**, and **scores**.
- Our **Penalty-Kill** lineup is **18.7% more** effective at **passing** than average, while our **Power-Play** specialists are **2.6% more** effective
- Our 5 **Power-Play** specialists **scored 53.6% of all** the goals scored, **7.6% more** goals than that of 29 other players combined. Similarly, the 4 **Penalty-Kill** specialists contributed **44.7% takeaways** among all.
- This can be attributed to the **general talent** of our selected players and the **synergy** that comes from their **chemistry**.

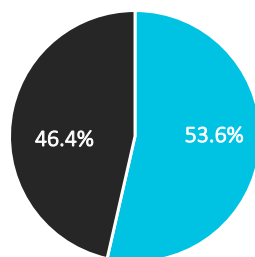
Takeaway & Goal Contributions in the Last Ten Games

Takeaways



■ Penalty Kill Line-up ■ Other Players

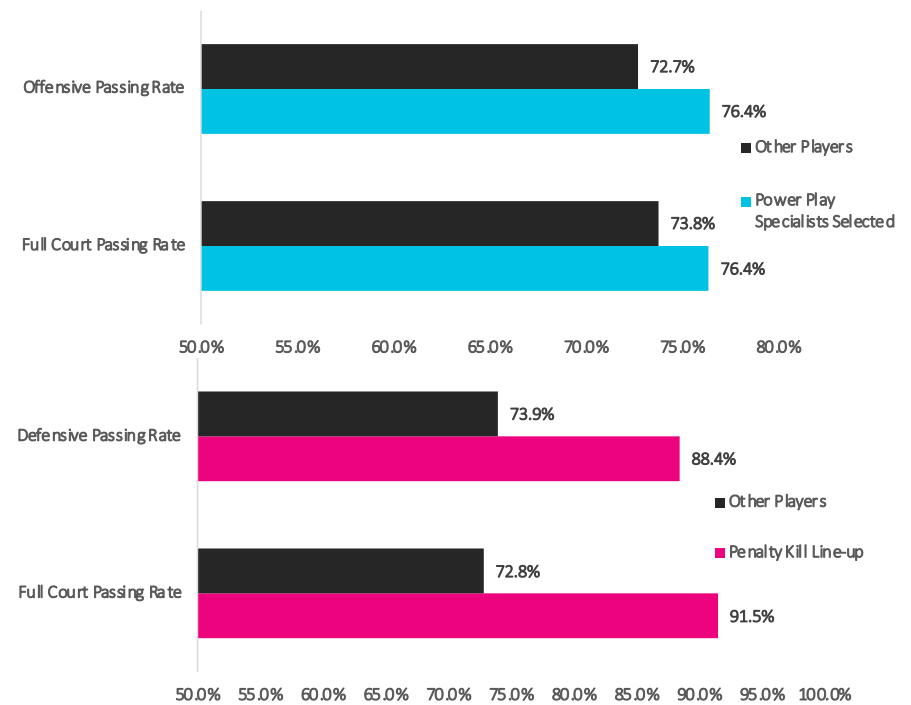
Goals



■ Power Play Specialists Selected ■ Other Players

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Passing Performance



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Conclusion

Next Step / Lessons Learned

Summary of Findings

- Based on specialist selection criteria, we have identified 5 **power-play** specialists, Marie-Philip Poulin, Haley Irwin, Melodie Daoust, Rebecca Johnston, Brianna Jenner and 4 **penalty-kill** specialists, Jocelyne Larocque, Erin Ambrose, Marie-Philip Poulin, Laura Fortino.
- We first used a balanced score card to rank players based on key attributes of specialist types. Then we attempt to fine-tune the line-up incorporating other metrics such as mentality attributes, player chemistry, pressure-resistance, and field coverage.

Next Steps

- Conduct a friendly match with the players selected before the Championship
- Collect more data of players performance (e.g. minutes per game) or use regular season data
- Conduct comparative analysis on potential opponents

Limitations

- Selection is based on a small data collection
- Selection criteria should also be tailored to head coach's strategy
- The selection assumes no position specialization, while there might be a role difference among specialists

Appendix

Selection Process – Power Play

Preliminary Assessment

1. Determine top skills for player evaluation.
2. Assess relative importance of skills selected.

Top Skills	Weight (Wt)
Shooting Precision (PP1)	25%
Shot Made/Game (PP2)	15%
Passing Precision (PP3)	15%
Offensive Passing Precision (PP4)	25%
Number of Game Played (PP5)	20%
Total	100%

3. Constructed a scoring system. Data points are normalized using Min-Max scalar before feeding into the formula.

$$\text{Player Score} = \text{PP1} \times \text{Wt}_{\text{pp1}} + \text{PP2} \times \text{Wt}_{\text{pp2}} + \text{PP3} \times \text{Wt}_{\text{pp3}} + \text{PP4} \times \text{Wt}_{\text{pp4}} + \text{PP5} \times \text{Wt}_{\text{pp5}}$$

4. Rank player based on Player Score.

Top 8 Players	Score
Marie-Philip Poulin	0.79
Jamie Lee Rattray	0.73
Haley Irwin	0.73
Melodie Daoust	0.71
Rebecca Johnston	0.65
Brianne Jenner	0.65
Jillian Saulnier	0.62
Laura Fortino	0.62

Refine Selection

5. Select final lineup from the shortlist based on additional analysis. This includes attribute analysis, chemistry and synergy with each other, as well as offensive and defensive coverage. Jamie Lee Rattray, despite having the highest shooting precision (22% or 2 out of 9), has few passes per game and below average passing precision therefore is dropped from the final lineup.

Specialist Lineup	Score
Marie-Philip Poulin	0.79
Haley Irwin	0.73
Melodie Daoust	0.71
Rebecca Johnston	0.65
Brianne Jenner	0.65

Appendix

Selection Process – Penalty Kill

Preliminary Assessment

1. Determine top skills for player evaluation.
2. Assess relative importance of skills selected.

Top Skills	Weight (Wt)
Takeaway/Game (PK1)	20%
PK Takeaway/Game (PK2)	25%
Passing Precision (PK3)	10%
Defensive Passing Precision (PK4)	10%
PK Passing Precision (PK5)	20%
Number of Game Played (PK6)	15%
Total	100%

3. Constructed a scoring system. Data points are normalized using Min-Max scalar before feeding into the formula.

$$\text{Player Score} = \text{PK1} \times W_{tpp1} + \text{PK} \times W_{tpp2} + \text{PK3} \times W_{tpp3} + \text{PK4} \times W_{tpp4} + \text{PK5} \times W_{tpp5} + \text{PK6} \times W_{tpp6}$$

4. Rank player based on Player Score.

Top 8 Players	Score
Jocelyne Larocque	0.73
Erin Ambrose	0.72
Marie-Philip Poulin	0.71
Halli Krzyzaniak	0.62
Laura Fortino	0.62
Jillian Saulnier	0.62
Laura Stacey	0.62
Rebecca Johnston	0.62

Refine Selection

5. Select final lineup from the shortlist based on additional analysis. This includes attribute analysis, chemistry and synergy with each other, as well as offensive and defensive coverage. Halli Krzyzaniak, despite having high average takeaway per game (2.6 vs 1.5, all player average), has few successful passes with the rest of the top shortlist players therefore is dropped from the final lineup.

Specialist Lineup	Score
Jocelyne Larocque	0.73
Erin Ambrose	0.72
Marie-Philip Poulin	0.71
Laura Fortino	0.62

Appendix

Passing Precision

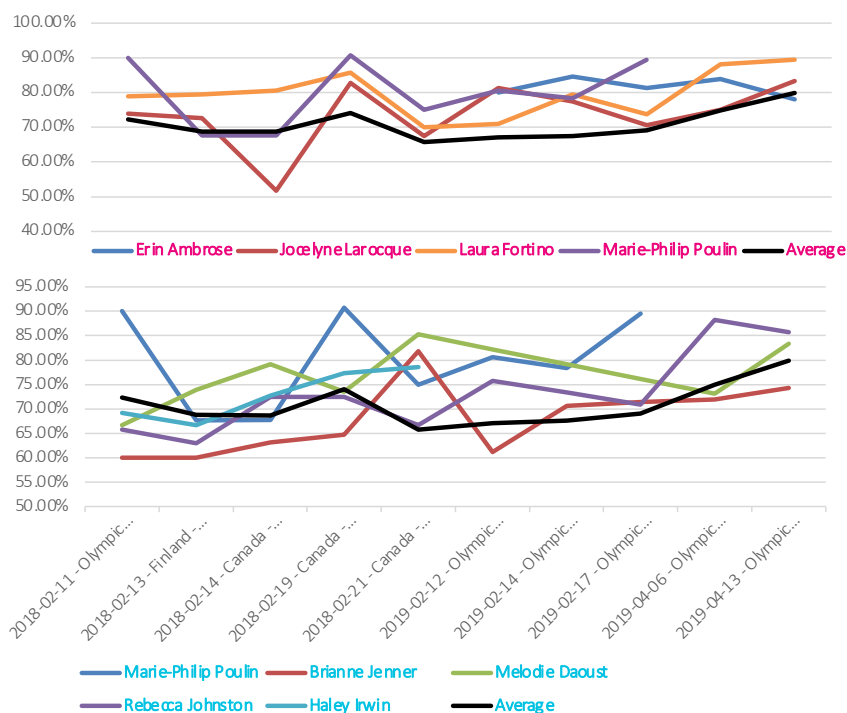
Overview

- Almost all of our specialists possession better-than-average passing ability (70%), with the exception of **Power-Play** Specialist **Brianne Jenner**, who slightly underperformed than average in passing.
- On Average, **Penalty-Kill** Specialists exhibit more consistent precision (70%-90%) than **Power-Play** Specialists (60%-90%)

Name	2018-02-11	2018-02-13	2018-02-14	2018-02-19	2018-02-21	2019-02-12	2019-02-14	2019-02-17	2019-04-06	2019-04-13
Marie-Philip Poulin	90.00%	67.65%	67.74%	90.74%	75.00%	80.56%	78.38%	89.47%		
Brianne Jenner	60.00%	60.00%	63.16%	64.71%	81.82%	61.11%	70.59%	71.43%	71.88%	74.29%
Melodie Daoust	66.67%	73.91%	79.17%	73.53%	85.29%				73.08%	83.33%
Rebecca Johnston	65.71%	62.96%	72.41%	72.41%	66.67%	75.68%	73.33%	70.83%	88.24%	85.71%
Haley Irwin	69.23%	66.67%	72.73%	77.27%	78.57%					
Average	72.27%	68.79%	68.71%	74.08%	65.75%	67.05%	67.53%	69.05%	74.94%	79.89%

Name	2018-02-11	2018-02-13	2018-02-14	2018-02-19	2018-02-21	2019-02-12	2019-02-14	2019-02-17	2019-04-06	2019-04-13
Erin Ambrose						80.00%	84.62%	81.25%	83.87%	78.05%
Jocelyne Larocque	73.91%	72.73%	51.72%	82.76%	67.44%	81.25%	77.42%	70.59%	75.00%	83.33%
Laura Fortino	78.95%	79.41%	80.56%	85.71%	70.00%	71.05%	79.41%	73.68%	88.10%	89.47%
Marie-Philip Poulin	90.00%	67.65%	67.74%	90.74%	75.00%	80.56%	78.38%	89.47%		
Average	72.27%	68.79%	68.71%	74.08%	65.75%	67.05%	67.53%	69.05%	74.94%	79.89%

Passing Precision of two Types of Specialists over the last 10 games



Appendix

Attributes Analysis

Name	Experience	Passing Precision	Shooting Precision	Score Ability	Offensive Passing Precision
Marie-Philip Poulin	8	80.5%	9.3%	4	84.9%
Brianne Jenner	10	68.5%	5.3%	3	69.9%
Melodie Daoust	7	76.8%	9.7%	3	74.8%
Rebecca Johnston	10	73.9%	3.7%	3	72.9%
Haley Irwin	5	73.9%	16.7%	2	75.0%
Average	5.91	70.3%	3.2%	0.82	59.7%

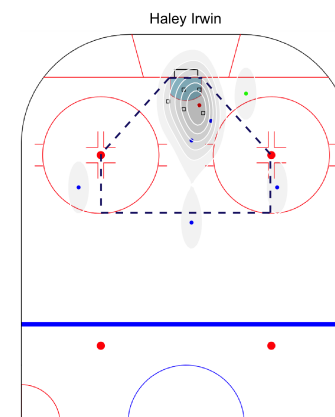
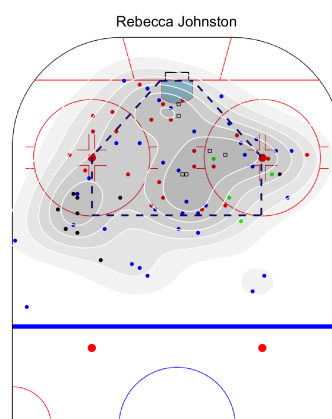
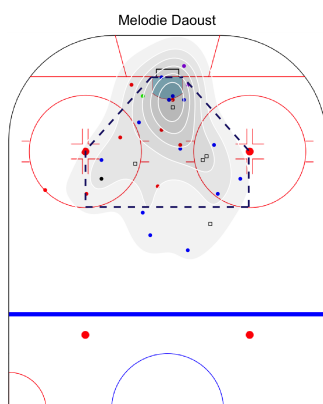
Name	Experience	Takeaway Ability	Defensive Passing Precision	Passing Precision During Penalty Kill	Takeaway During Penalty Kill
Erin Ambrose	5	9	78.3%	0.67	1.00
Jocelyne Larocque	10	22	74.4%	0.67	0.70
Laura Fortino	10	26	78.0%	0.60	0.20
Marie-Philip Poulin	8	32	71.6%	0.67	0.38
Average	5.91	10.79411765	69.5%	0.59	0.21

The charts are based on the ratios of attributes between selected players and all players. A maximum is set for better visualization. The definition of terms are listed.

Power Play Specialists Terms	Definition	Penalty Kill Specialists Terms	Definition
Experience	Games attended	Experience	Games attended
Passing Precision	Overall passing percentages	Takeaway Ability	The number of takeaways per game attended
Shooting Precision	Overall shooting percentages	Defensive Passing Precision	Back court passing percentages
Score Ability	Overall scores	Passing Precision During Penalty Kill	Passing percentages during penalty kill situations
Offensive Passing Precision	Front court passing percentages	Takeaway During Penalty Kill	The number of takeaways during penalty kill situations

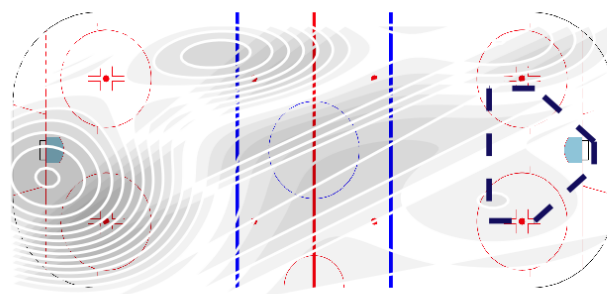
Appendix

Shot Chart Heat Map for Other Power-Play Players & Takeaway Heat Map for Penalty Kill



Legend

Deflection	■	Wrist Shot	●
Fan	●	Snapshot	●
Slapshot	●		
Wrap Around	●		



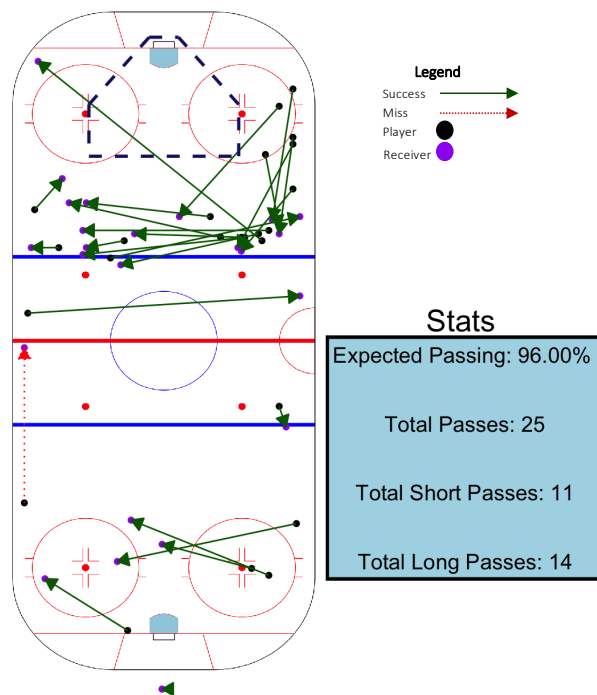
Jocelyne Larocque

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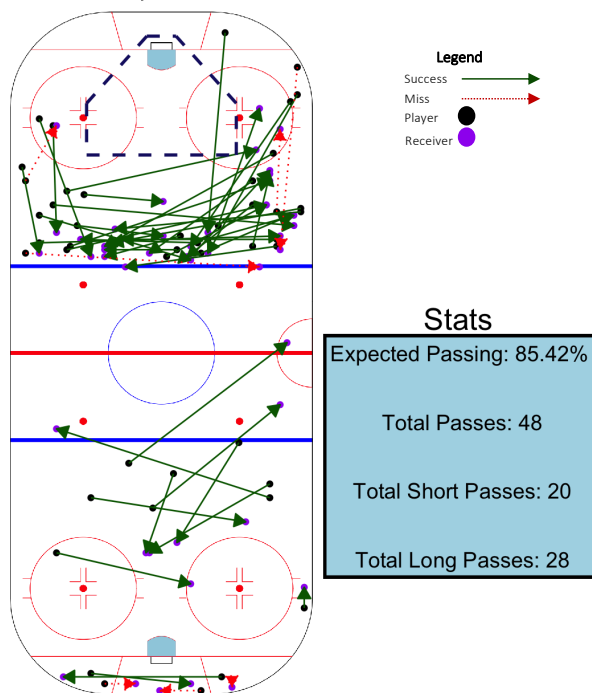
Appendix

Additional Synergy Maps

Erin Ambrose to Laura Fortino



Marie-Philip Poulin to Laura Fortino



Jocelyne Larocque to Erin Ambrose

