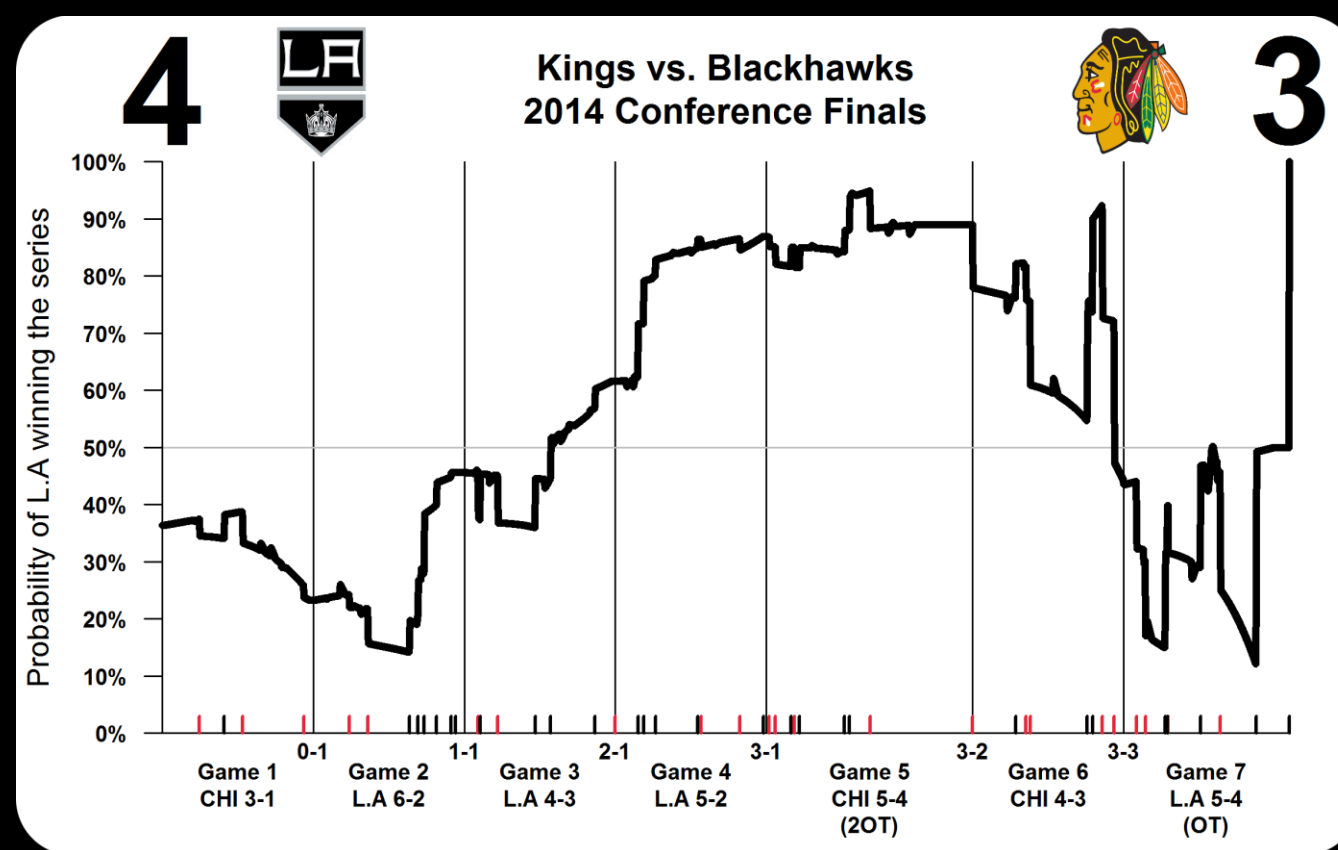
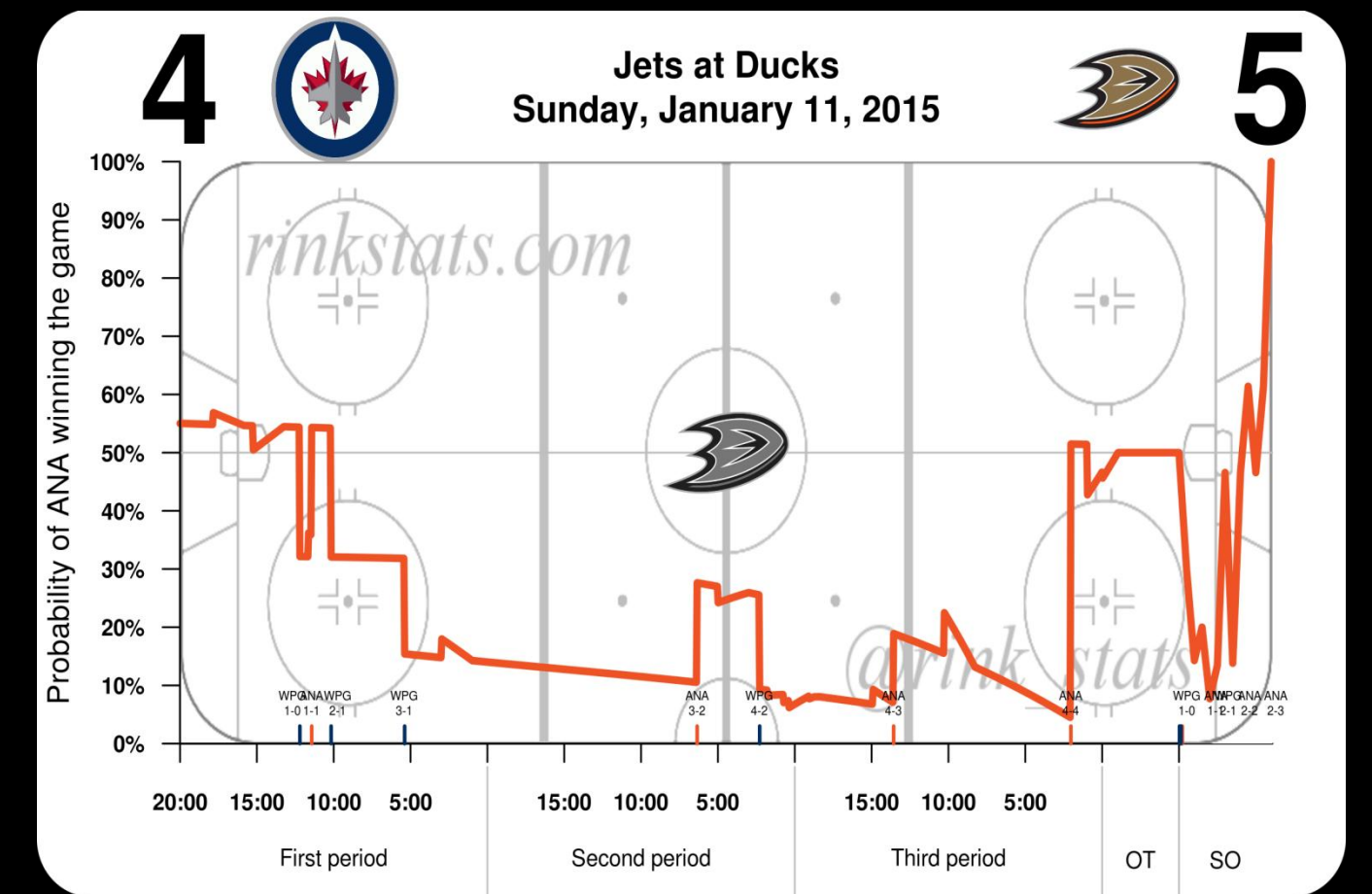
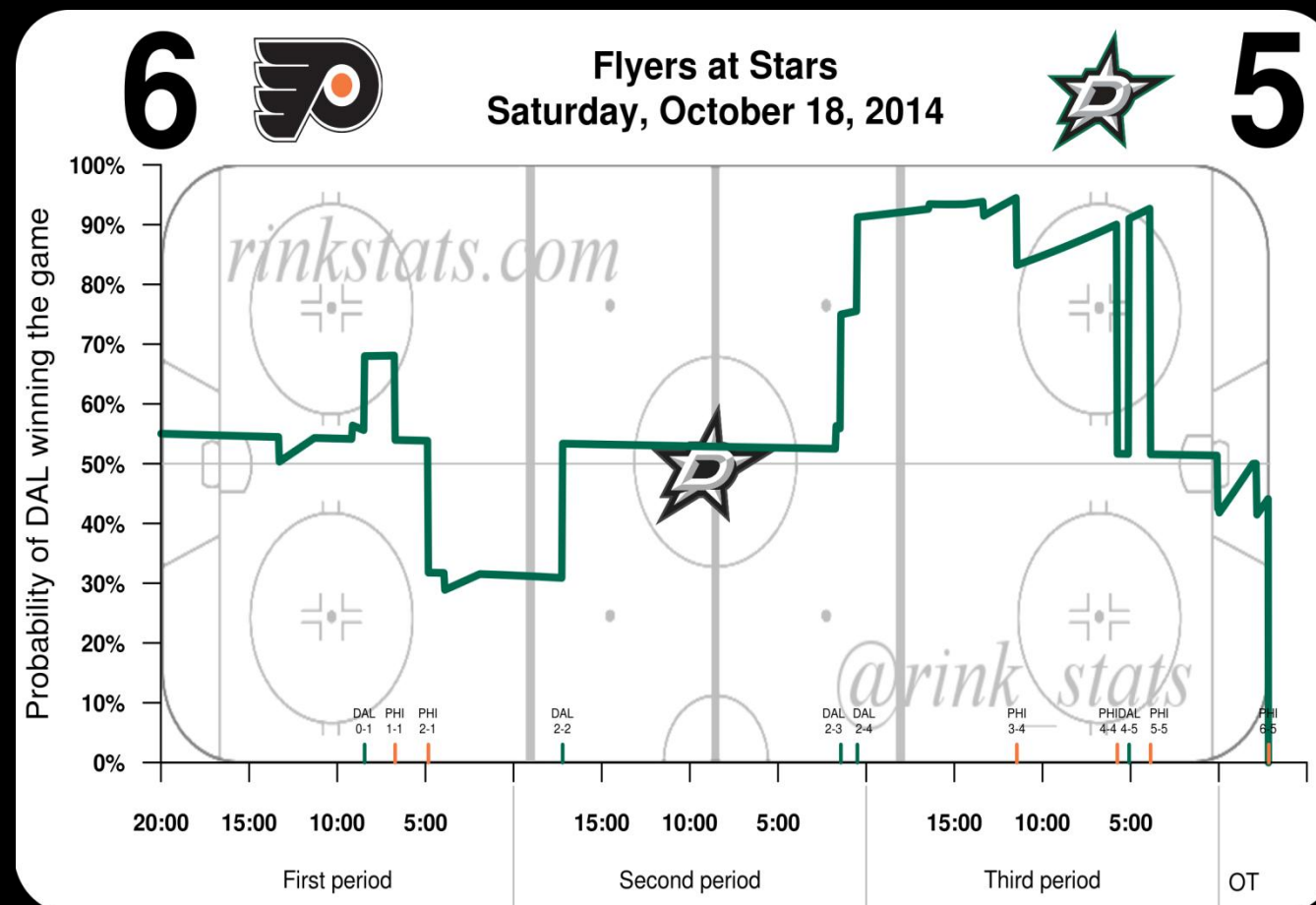


Assessing the Offensive Productivity of NHL Players Using In-Game Win Probabilities

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A new NHL win probability metric

- Only currently available statistic for calculating second-by-second win probabilities for the NHL
- Based on empirical data from over 9000 games
- Uses a new algorithm for calculating the time remaining on the powerplay which is not available in the play-by-play data
- Flexible framework allows future incorporation of other factors that influence goal scoring (zone starts, Corsi/Fenwick, puck location data)



Calculating AGV

$$AGV_i = \sum_{k=1}^K \Delta_k - \frac{\sum_{j=1}^J \Delta_j}{J} \cdot K$$

$$\Delta_k = P_{t_k+1}(w) - P_{t_k}(w)$$

$$\Delta_j = P_{t_j+1}(w) - P_{t_j}(w)$$

AGV_i : average goal value for player i

Δ_k, Δ_j : change in win probability resulting from goal scored by player i and by someone who is not player i

t_k, t_j : time at which goal k or j was scored

K, J : total number of goals scored by player i and players other than i

Mechanics of the win probability metric

$$P_t(w) = P_t(w | \delta_t + 1) \cdot \Lambda(\gamma_h \cdot \nu_t) + P_t(w | \delta_t - 1) \cdot \Lambda(\gamma_a \cdot \nu_t) + P_t(w | \delta_t) (1 - \Lambda(\gamma_h \cdot \nu_t))(1 - \Lambda(\gamma_a \cdot \nu_t))$$

$P_t(w)$: probability at time t that home team wins game

δ_t : score differential (home minus away) at time t

γ_h : vector of goal-scoring rates (goals per second) for home team at 5-on-4, 5-on-3, 4-on-3, 3-on-4, 3-on-5, and 4-on-5

γ_a : same as γ_h except reversed in order so that the values correspond with away team rates

ν_t : vector of seconds remaining at each of the six non-even strength situations at time t

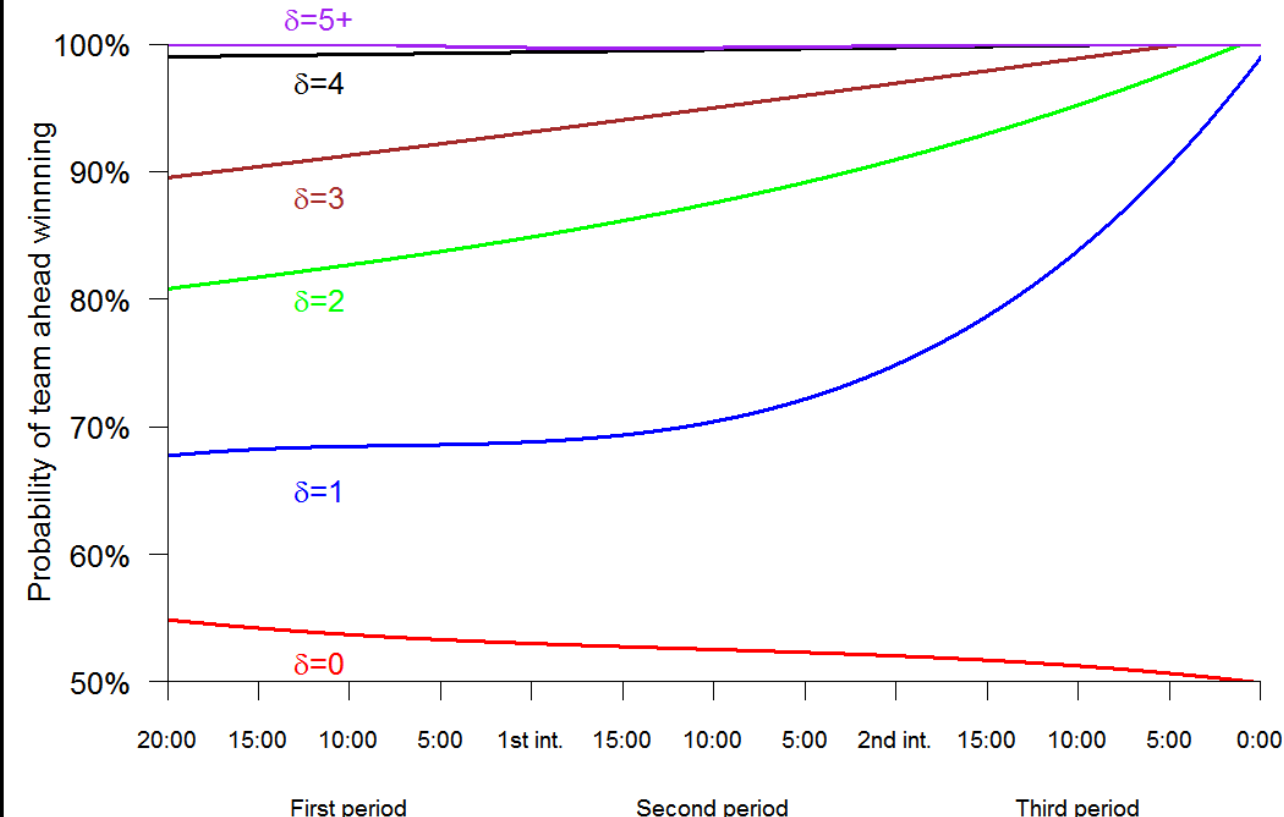
$\Lambda(\cdot)$: the PMF of the Poisson distribution, evaluated at $P(x=1)$

Intuition for Added Goal Value

- Not all goals have equal importance
- A tie breaking goal in the final minute is more valuable than the 6th goal in a 6-0 game
- Averaging over the change in win probability that results from a player's goals tells us how "clutch" that player is in offensive situations

Inputs for metric based on empirical data

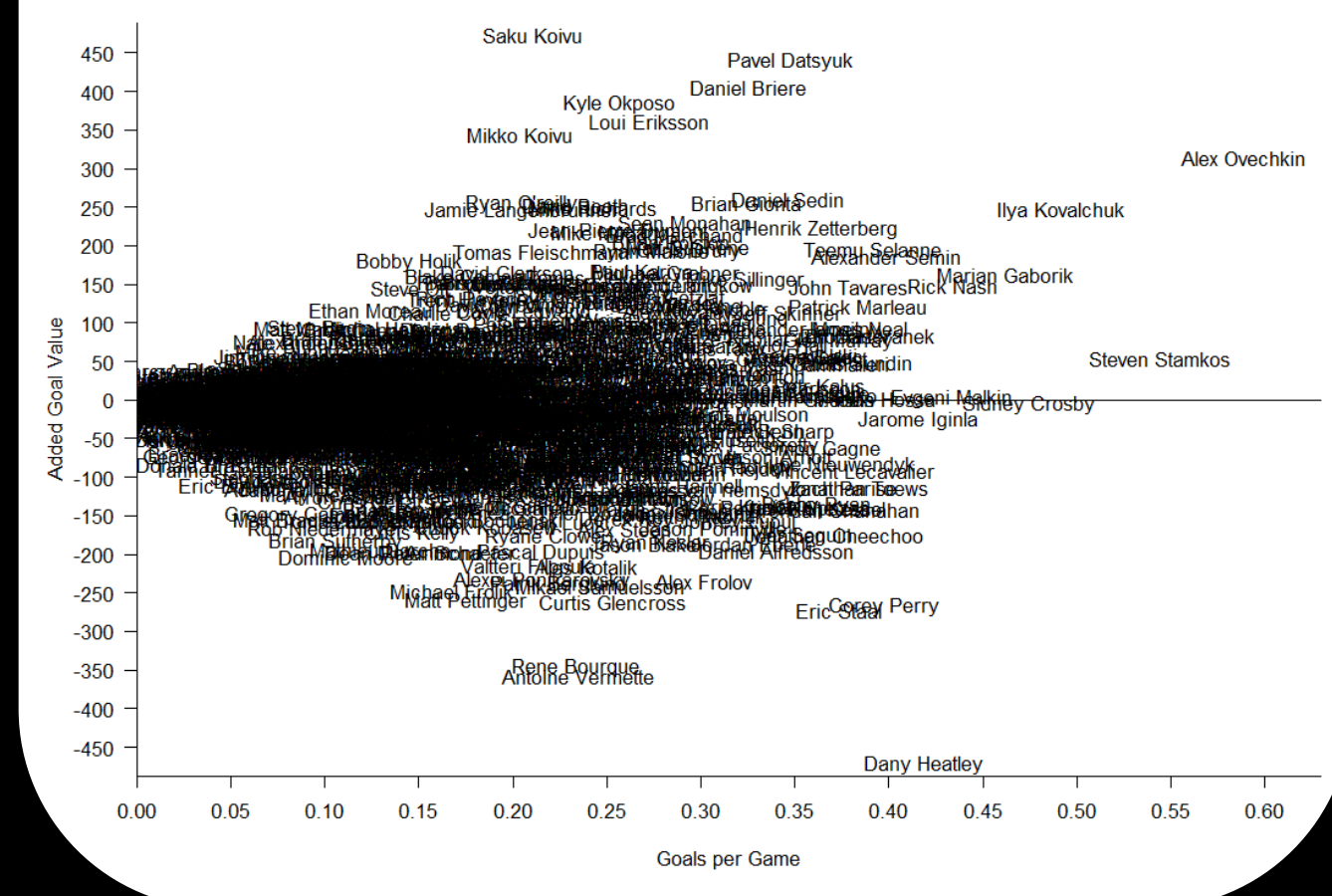
$$P_t(w | \delta_t)$$



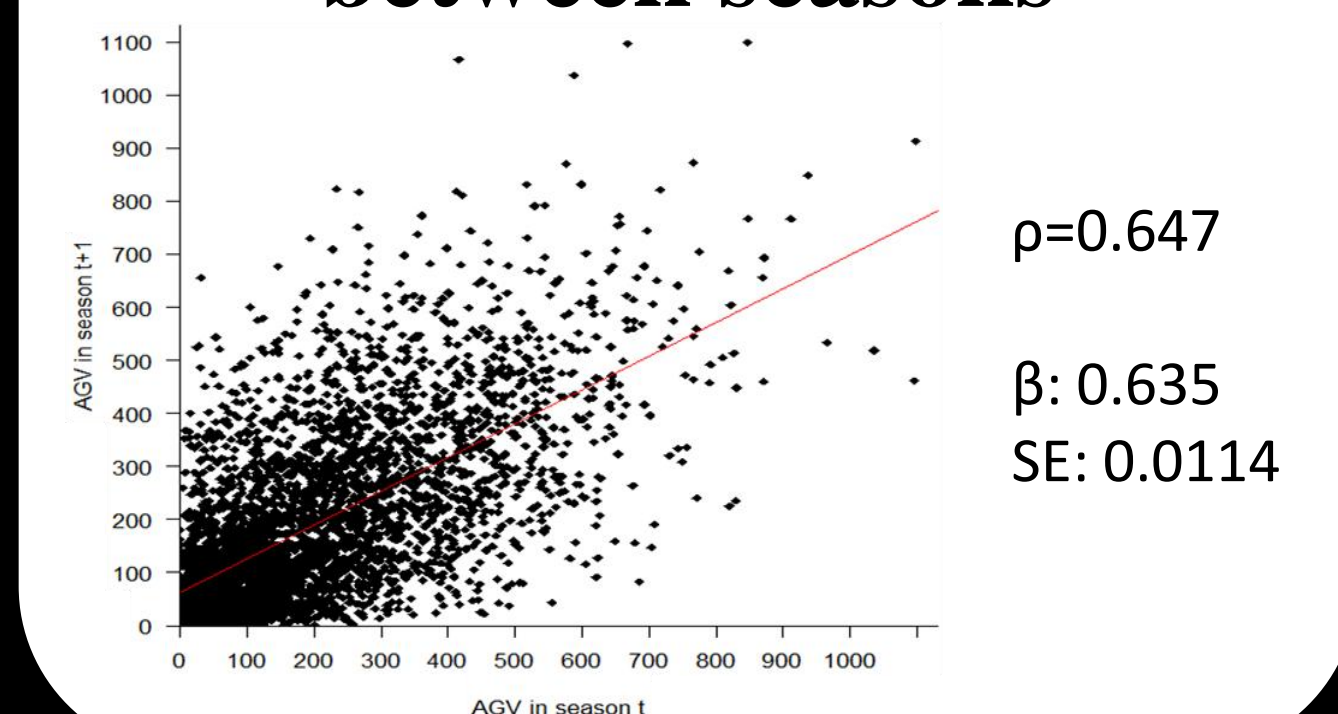
ν_t

Penalty Situation	Powerplay goals per min.	Shorthanded goals per min.
5-on-4	0.103217	0.014336
5-on-3	0.314708	0.006052
4-on-3	0.149954	0.010302

Added Goal Value for all forwards since 2005-06



Correlation of AGV between seasons



AGV per game (2013-14)

$$AGVG_i = \frac{\sum_{k=1}^K \Delta_k}{g_i}$$

g_i : number of games played by player i

Player	AGV per game	Goals	Games played
Alex Ovechkin	13.68	51	78
Steven Stamkos	13.03	25	37
Jeff Skinner	10.28	33	71
Corey Perry	10.09	43	81
James Neal	9.54	27	59
Gustav Nyquist	9.15	28	57
Sidney Crosby	8.93	36	80
Phil Kessel	8.67	37	82
Max Pacioretty	8.61	39	73
Joe Pavelski	8.34	41	82
Jeff Carter	8.2	27	72
Mike Cammalleri	8.06	26	63
Evgeni Malkin	7.85	23	60
Pavel Datsyuk	7.68	17	45

Future extensions

- Incorporate other sources of data into the win probability metric (Corsi/Fenwick, zone starts, puck/player location data, etc.)
- Second-by-second playoff qualification probabilities
- Incorporating assists into AGV
- Adapting AGV to assess shootout efficiency of shooters and goalies