Quantifying Chemistry Through Roster Makeup

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Agenda

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2. Fractionality
3. Data
4. Model
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   - Defensive Performance

Introduction

- Diversity in the NHL has increased dramatically:
  - Inaugural 1916–17 season: Canada, USA, Great Britain
  - 1974–75: 19 countries
  - 2012–2013: 42 countries
- Question: Does there exist a positive chemistry effect on teams with more players from the same country?

Measuring Team Diversity: Fractionality

- Borrowed from existing literature, such as Esteban and Ray (2008) and Alesina et al. (2002).
- Calculate s_n for each nationality n on team i: what fraction of the total number of games played by all players on a team can be attributed to nationality n?

$$s_n = \sum_{p \in P_{i,n}} \frac{p_{gamesplayed}}{t_{i,totalgamesplayed}}$$

Measuring Team Diversity: Fractionality

- Using all of the s_n, we calculate fractionality:

$$F_i = 1 - \sum_{n \in N} s_{i,n}^2$$

- A **higher** fractionality means **more** diversity, leading to **less** chemistry.

- Fractionality is minimized if all players on a team have the same nationality.
- As the number of nationalities increases, F increases.
- For a given number of nationalities, F is maximized if each nationality has an equal share s.

Examples of Fractionality Measures

# of Nat.	Shares of Nat.	Fractionality
1	$\{1\}$	0.000
3	$\{\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\}$	$\frac{2}{3} \approx 0.667$
3	$\{0.5, 0.25, 0.25\}$	0.625
6	$\{0.47, 0.34, 0.11, 0.01, 0.02, 0.04\}$	0.649*
7	$\{0.54, 0.05, 0.05, 0.21, 0.05, 0.07, 0.04\}$	0.650**

* Actual data from the 2009 Anaheim Ducks.

** Actual data from the 2007 Boston Bruins.

Can Fractionality Change?

Table: Fractionality for the Boston Bruins under Peter Chiarelli

	2005 – 2014	2005 – 2009	2009 – 2014
Mean	0.581	0.648	0.513
SD	0.085	0.020	0.028

- 2009–10: $F = 0.62$. Six nationalities, Canadians forming 58% of the team.
- 2010–11: $F = 0.51$. Six nationalities, Canadians forming 67% of the team.
- Change of 0.11 in just **one season**. Why? 21 more Canadian-games, 114 less non-Canadian games.

Other Noteable Changes

Team	Year	Change from Previous Year
San Jose Sharks	2009–10	−0.226
Chicago Blackhawks	2008–09	−0.156
Tampa Bay Lightening	2011–12	−0.141
Tampa Bay Lightening	2012–13	0.148
Philadelphia Flyers	2010–12	0.153
Minnesota Wild	2012–13	0.214

Data

- Data for 29 teams across nine seasons from 2005–06 to 2013–14.
  - Winnipeg Jets / Atlanta Thrashers excluded from dataset due to issues with controls.
- Team performance indicators from NHL.com, player information from QuantHockey.com, draft information from Hockey-Reference.com, advanced statistics from HockeyAnalysis.com, and GM/coach information from teams' websites.

Model

$$p_{i,gm,t} = \beta_0 + \beta_1 fractionality_{i,gm,t} + \zeta_{i,gm,t} + \delta_{i,gm} + \gamma_i + \epsilon_{i,gm,t}$$

- Performance as a function of: fractionality, controls, GM effects, team effects, and a random shock.
- Performance measured overall (points percentage), offensively, defensively, and with advanced statistics (possession).
- Fixed effects model with team-GM panels.
  - GM is responsible for drafting and roster.
  - Isolate each particular "era" for a given team.
  - Fractionality should not differ significantly between coaches.

Controls

- We want to isolate the effect of fractionalization from other effects, most importantly individual player skill.
- Main condition: the control cannot be directly related to the current team's fractionality.
- Construct three controls for skill:
  1. Average draft position of (drafted) players.
  2. Average share of players' share of season total points on previous team-GM combination.
  3. Average players' points per game on previous team-GM combination.

Results: Overall Performance

Table: Regression Results for Points Percentage

	(1)	(2)	(3)
fractionality	-0.075	-0.010*	-0.134**
	(-1.08)	(-1.69)	(-2.09)
Controls		X	X
Fixed Effects			X
N	232	232	232
R^2	0.001	0.081	0.067

t statistics in parentheses. Standard errors are clustered by *team*.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results: Overall Performance

- Perspective: 0.25 decrease in fractionality means 3.35% increase in points percentage.
- In every season dating back to 2003–2004, at least one team in the East or West would have moved into the final playoff position with a 3.35% increase in points percentage.
- We saw "unintentional" changes in fractionality that could reach this level.

Results: Offensive Performance

Table: Regression Results for Offensive Measures of Performance

	ggp	sgp	pp	fvffa
fractionality	-0.41	-5.47**	-0.32	-0.35*
	(-1.47)	(-2.45)	(-0.11)	(-1.91)
N	232	232	232	232
R^2	0.04	0.06	0.02	0.09

All regressions use a fixed effects model and include controls.

- Perspective: With a 10% shooting percentage, decreasing fractionality by 0.5 means scoring 26 more goals. In 2013-2014, first and seventh place teams separated by 26 goals.

Results: Defensive Performance

Table: Regression Results for Defensive Measures of Performance

	gagp	sagp	pk
fractionality	0.47	-1.92	-2.54
	(1.16)	(-0.70)	(-0.83)
N	232	232	232
R^2	0.06	0.02	0.03

All regressions use a fixed effects model and include controls.

Results: Advanced Statistics

Table: Regression Results for Advanced Measures of Performance

	(1) ff60	(2) fa60	(3) cf60	(4) ca60
fractionality	-7.945**	-5.351	-11.53**	-5.262
	(-2.05)	(-1.19)	(-2.19)	(-0.83)
N	203	203	203	203
R^2	0.065	0.029	0.085	0.015

All regressions use a fixed effects model and include controls.

- Reenforces earlier results showing positive effect on offence, no effect on defence.

Conclusions

- Fractionality is important for overall team performance but GMs are not currently (very) aware of this.
- Lower fractionality is correlated with higher offense and advanced possession metrics.
- Nothing to say regarding defensive metrics – might need a better model, might be there's nothing to say.
- Next steps: fractionalization along other dimensions, such as league played in prior to joining NHL.

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