Tournament Survey
Results Section

6th May 2017

0.1 Overview

Return to the intuition: We're trying to understand the causal mechanisms of bonding, so the question is what mechanisms lie below the surface of explicit bonding? There is something going on with this pre-reflective vibe or "click" that is important...underneath this may be basal socio-cognitive tendenceies for coordinating movement with others.

1. two components of performance lead to bonding, and can be explained by this sensation of action "clicking" - this implicit sense of coordination.

0.2 Predictions

I made the following predictions regarding the relationship between performance, team coordination, and social bonding:

1. Athletes that perceive greater success in joint-action will experience higher levels of "team click."

2. Athletes who experience more positive violation of expectation around team performance will experience higher levels of team click.

3. Athletes who experience higher levels of team click will report higher levels of social bonding.

4. Higher perceived success in joint-action will predict higher levels of social bonding.

5. Greter positive violation of expectations around team performance will predict higher leves of social bonding.

6. Team click will mediate the positive relationship between joint-action success and social bonding.

0.3 Analysis

0.3.1 Overview of Analysis

I decided to begin to look for evidence of these predictions in the post-Tournament survey responses. Following the completion of a high-level professional rugby Tournament, and after controlling for measures of objective performance and individual

performance, was there any statistical evidence for a relationship between perceived quality of joint-action, feelings of "team click," and social bonding? Following a close analysis of the post-Tournament data, I will proceed to an anlaysis of these same relationships throughout the entire data set. In particular, I am interested in evidence of pre-post Tournament changes in outcome variables (click, social bonding), and their possible predictors (performance, coordination, click), as well as evidence for significant overall relationships between these variables throughout the tournament.

0.3.2 Analysis of Post-Tournament Survey

Summary Statistics

Table 1: post-Tournament measures of technical competence (objective and subjective)

Statistic	N	Mean	St. Dev.	Min	Max
yearsTeam	120	3.167	2.124	0	7
trainingAge	120	4.400	2.346	0	13
startingAvg	171	0.566	0.367	0.000	1.000
age	121	21.669	3.264	16	32
abilityTeammates	120	19.450	20.136	−40	50
abilityChinesePros	120	15.783	19.592	−35	50
abilityInternationalPros	120	18.458	26.187	−44	50
teamAbilityChineseProvinces	120	22.475	22.903	−40	50

Table 2: post-Tournament measures of performance (individual and team)

Statistic	N	Mean	St. Dev.	Min	Max
indPerformanceExpected	118	56.356	23.474	0	100
passingTech	118	58.407	24.255	0	100
supportAttack	118	62.619	22.704	0	100
indDefense	118	57.644	23.570	0	100
effectContact	118	62.153	24.810	0	100
decisionAttack	118	61.220	21.432	0	100
teamPerformanceExpected	118	64.364	23.610	0	100
teamDefense	118	62.424	22.501	0	100
teamAttack	118	65.331	20.260	0	100
teamSupportPlay	118	65.754	19.716	0	100
teamCommunication	118	65.254	21.260	0	100

Table 3: post-Tournament measures team click

Statistic	N	Mean	St. Dev.	Min	Max
unspokenUnderstanding	118	72.720	19.946	0	100
generalAtmosphere	118	78.449	21.339	0	100
clickPictorial	118	3.932	1.036	1	5
reliabilityOfOthers	118	68.000	23.093	0	100
reliabilityForOthers	118	63.449	25.798	0	100
abilityExtendedByTeammates	118	72.254	19.266	0	100

Table 4: post-Tournament measures social bonding

Statistic	N	Mean	St. Dev.	Min	Max
emotionalSupport	118	79.669	18.839	0	100
sharedGoal	118	86.000	15.560	29	100
groupIdentification	118	4.292	0.672	1.500	5.000
fusionVerbal	118	4.004	0.709	1.429	5.000
fusionPictorialTeam	118	4.331	1.192	0	5

Table 5: post-Tournament measures fatigue and exertion

Statistic	N	Mean	St. Dev.	Min	Max
fatigue	118	69.271	21.241	0	100
physical rpe	118	14.966	2.663	6	20
mental rpe	118	6.076	2.467	−4	10
injuryStatus	118	76.144	26.910	0	100

Correlation Matrices

Table 6: Correlation Matrix: post-Tournament Technical Competence

	yearsTeam	trainingAge	startingAvg	age	abilityTeammates	abilityChinesePros	abilityInternationalPros	teamAbilityChineseProvinces
yearsTeam	1	0.527	0.145	0.580	0.046	0.102	0.105	0.243
trainingAge	0.527	1	0.258	0.687	0.104	0.200	0.199	0.208
startingAvg	0.145	0.258	1	0.157	0.018	0.086	0.024	0.110
age	0.580	0.687	0.157	1	0.124	0.099	0.148	0.217
abilityTeammates	0.046	0.104	0.018	0.124	1	0.432	0.396	0.432
abilityChinesePros	0.102	0.200	0.086	0.099	0.432	1	0.702	0.271
abilityInternationalPros	0.105	0.199	0.024	0.148	0.396	0.702	1	0.221
teamAbilityChineseProvinces	0.243	0.208	0.110	0.217	0.432	0.271	0.221	1

Table 7: Correlation Matrix: Individual Performance

	indPerformance	passingTech	supportAttack	indDefense	effectContact	decisionAttack
indPerformanceExpected	1	0.412	0.375	0.311	0.263	0.286
passingTech	0.412	1	0.658	0.510	0.508	0.607
supportAttack	0.375	0.658	1	0.658	0.641	0.734
indDefense	0.311	0.510	0.658	1	0.590	0.525
effectContact	0.263	0.508	0.641	0.590	1	0.713
decisionAttack	0.286	0.607	0.734	0.525	0.713	1

Table 8: Correlation Matrix: Team Performance

	teamPerformance	teamDefense	teamAttack	teamSupportPlay	teamCommunication
teamPerformanceExpected	1	0.643	0.619	0.469	0.540
teamDefense	0.643	1	0.834	0.643	0.721
teamAttack	0.619	0.834	1	0.740	0.713
teamSupportPlay	0.469	0.643	0.740	1	0.715
teamCommunication	0.540	0.721	0.713	0.715	1

Table 9: Correlation Matrix: post-Tournament Team Click

	unspokenUnderstanding	generalAtmosphere	clickPictorial	reliabilityOfOthers	reliabilityF...
unspokenUnderstanding	1	0.626	0.508	0.275	0.25
generalAtmosphere	0.626	1	0.385	0.301	0.27
clickPictorial	0.508	0.385	1	0.282	0.02
reliabilityOfOthers	0.275	0.301	0.282	1	0.27
reliabilityForOthers	0.230	0.276	0.021	0.276	1
abilityExtended	0.375	0.265	0.213	0.544	0.37

Table 10: Correlation Matrix: post-Tournament Social Bonding

	emotionalSupport	sharedGoal	groupId	fusionVerbal	fusionPictorialT...
emotionalSupport	1	0.619	0.079	0.331	0.349
sharedGoal	0.619	1	0.061	0.246	0.395
groupId	0.079	0.061	1	0.358	0.081
fusionVerbal	0.331	0.246	0.358	1	0.220
fusionPictorialTeam	0.349	0.395	0.081	0.220	1

Table 11: Correlation Matrix: post-Tournament Fatigue

	fatigue	prpe	mental	injury
fatigue	1	0.665	0.510	-0.090
prpe	0.665	1	0.523	-0.009
mental	0.510	0.523	1	0.040
injury	-0.090	-0.009	0.040	1

Data Reduction via Exploratory Factor Analysis

Data reduction was required to reduce survey items to key variables of interest. Exploratory Factor Analysis (EFA) was performed for survey items relating to technical competence, component performance, team click, social bonding, and fatigue. [Explain EFA - "varimax" rotation (oblique)]

Technical Competence All eight items relavent to technical competence were analysed in a correlation matrix to assess relatedness. High correlations among measures of objective competence (three out of four items correlated at ¿ .3) and among measures of subjective competence (all items except for team competence measure correlated at ¿ .3) suggested that the data could be explained by two underlying factors. teamAbilityChineseProvinces was dropped from analysis due to low correlation with related variables, and due to the fact that the item did not ask directly about an individual's technical competence.

An EFA revealed that items of interest loaded on two factors, except for startingReserve, which failed to load on either factor. startingAvg was thus dropped from analysis. Measures of objective competence (yearsTeam, trainingAge, and Age) loaded on the first factor, labelled "objective competence," and explained 26.4% of the total variance. The remaining measures of subjective competence (abilityTeammates, abilityChinesePros, abilityInternationalPros) loaded on the remaining factor, labelled "subjective competence", and explained 23.8% of the variance. Various statistics, including KMO = .67, corrtest Bartlett: $\chi^2 = 239.71$, $p < .001$ and $G6\alpha = .74$ and $Cronbach's\alpha = (.67)$ indicated that the data reduction was appropriate.

Component Performance First, items concerning component performance were isolated from perceptions of overall performance relative to prior individual expectations for further data reduction. Given that the predictions of this dissertation concentrate in particular on athlete perceptions of joint-action, individual and team components of performance were separately analysed so that perceptions of individual component performance could be used as a statistical control for feelings about team component performance.

team component performance: Items concerning team component performance (team defense, team attack, team support play, and onfield communication) were subjected to EFA. Correlations between team component performance items was very high (all ¿ .5), which suggested that one factor would be appropriate. One factor, labelled "teamComponentPerformance" was appropriate, $\chi^2(df = 2) = 14.81$, $p < .001$, and explained 72.8% of the overall variance. Various statistics, includ-

ing $KMO = 0.79$, corrtest Bartlett: $\chi^2 = 342.14$, $p < .001$ and $G6\alpha = .9$ and $Cronbach's\alpha = (.91)$ indicated that the data reduction was appropriate.

team component performance: Items concerning individual component perform-ance (passing technique, suport play in attack, 1on1 defense, and decision making in attack) were subjected to an EFA. Correlations between individual component per-formance items was also very high (all ¿ .5), which suggested that one factor would be appropriate. One factor, labelled "indComponentPerformance" was appropriate, $\chi^2(df = 5) = 15.47$, $p < .01$, and explained 62.1% of the overall variance. Various statistics, including $KMO = 0.84$, corrtest Bartlett: $\chi^2 = 326.38$, $p < .001$ and $G6\alpha = .88$ and $Cronbach's\alpha = .89$ indicated that the data reduction was appropri-ate.

Team Click Survey items related to perceptions of "team click" were separately analysed for the purposes of data reduction. EFA was performed on click items, imposing one factor labelled "teamClick", and which explained 34.5% of the overall variance ($\chi^2(df = 9) = 46.36$, $p < .001$). Various statistics, including $KMO = 0.69$, corrtest Bartlett: $\chi^2 = 182.73$, $p < .001$ and $G6\alpha = .76$ and $Cronbach's\alpha = .75$ indicated that the data reduction was appropriate.

Social Bonding Survey items related to perceptions of social bonding to the tar-get in-group were separately analysed for the purposes of data reduction. Group Identification was excluded from factor analysis due to low correlations with other variables except for the (related) item of fusionVerbal. Thus, EFA was performed on 6 remaining items, imposing one factor labelled "teamClick", and which explained 34.5% of the overall variance. Various statistics, including $KMO = 0.65$, corrtest Bartlett: $\chi^2 = 108.22$, $p < .001$ and $G6\alpha = .66$ and $Cronbach's\alpha = .65$ indicated that the data reduction was appropriate.

Fatigue Finally, survey items related to perceptions of fatigue and exertion were separately analysed for the purposes of data reduction. Due to difficulty completing questions related to arousal in the online and in-person surveys, mood-related items were excluded from analysis. In addition, it was clear from correlation values that in-jury did not strongly corerlate with other items relevant to fatigue and exertion, and was excluded from subsequent analysis. Thus, an EFA was performed on 3 remaining items (fatigue, physical perceived exertion, and mental perceived exertion), impos-ing one factor Correlations labelled "fatigue", which explained 57.8% of the overall variance. Various statistics, including $KMO = 0.69$, corrtest Bartlett: $\chi^2 = 111.93$,

$p < .001$ and $G6\alpha = .73$ and $Cronbach's\alpha = .80$ indicated that the data reduction was appropriate.

Summary Statistics of Post-Tournament Variables

Table 12: Post Tournament Variables

Statistic	N	Mean	St. Dev.	Min	Max
objectiveCompetence	118	−0.001	0.945	−2.002	2.940
subjectiveCompetence	118	−0.010	0.958	−2.588	1.795
indPerformance	118	56.356	23.474	0	100
indPerformanceComponents	118	0.000	0.951	−2.956	1.695
teamPerformance	118	64.364	23.610	0	100
teamPerformanceComponents	118	−0.000	0.964	−3.278	1.792
teamClick	118	−0.000	0.901	−3.056	1.424
socialBonding	118	0.000	0.887	−3.077	1.077
fatigue	118	−0.000	0.907	−3.401	1.674

Table 13: Post Tournament Variables Correlation Matrix

	objComp	subjComp	indPerf	indPerfComp	teamPerf	teamPerfComp	teamClick	socBond	fat
objectiveCompetence	1	-0.229	-0.045	-0.091	0.069	-0.134	-0.141	-0.077	-0.058
subjectiveCompetence	-0.229	1	-0.064	-0.148	-0.029	-0.049	0.173	0.195	0.059
indPerformance	-0.045	-0.064	1	0.456	0.508	0.351	0.329	0.239	0.291
indPerformanceComponents	-0.091	-0.148	0.456	1	0.422	0.490	0.378	0.194	0.282
teamPerformance	0.069	-0.029	0.508	0.422	1	0.665	0.578	0.354	0.311
teamPerformanceComponents	-0.134	-0.049	0.351	0.490	0.665	1	0.686	0.424	0.261
teamClick	-0.141	0.173	0.329	0.378	0.578	0.686	1	0.711	0.277
socialBonding	-0.077	0.195	0.239	0.194	0.354	0.424	0.711	1	0.180
fatigue	-0.058	0.059	0.291	0.282	0.311	0.261	0.277	0.180	1

Models

Once variables of interest were reduced to factors, it was possible to use these variables to test the specific predictions of this study. Statistical modeling was conducted to further understand the relationship between perceptions of joint-action (component performance and performance relative to prior expectations), outcome variables of social bonding and fatigue, and the extent to which this relationship was conditioned by feelings of "team click" and/or technical competence (objective and subjective measures).

Data Structure The multilevel structure of the data (athletes are nested within teams; teams in turn are nested within the men's and women's competitions) suggests dependency in the data, whereby residuals of within-group observations could be correlated. In addition, the data available for analysis were unbalanced, meaning that there were an uneven number of observations for each of the 15 teams. As such, intra-class correlations (ICC) were calculated to compare within-group variance and between-group variance and thus determine the suitability of a hierarchical analysis.

Initial analysis of the data revealed team-level differences in 1.COMPETENCE: no differences 2.PERFORMANCE: - team and individual component performance showed significant group-level variance - team performance relative to prior expectations was significant by team, but indPerformance7 did not vary significantly accross teams. CLICK: team level differences in click, no sex level differences BONDING: FATIGUE:

Sex-differences were also identifiable in rating of individual performance, but otherwise there were no clear dependencies in the outcome variables relating to variables of click, bonding, or fatigue.

It was decided that, due to the dependency in the data, where it appeared that there was clustering by group for variables relating to performance, click, bonding, and fatigue, a two-level structure would be used to account for this group-level variance, with individual observations nested within team. the prevalence of missing values lent itself to a multilevel approach.

For the following analyses, multilevel general linear models were fit using the lme4 package in R. Maximum Likelihood parameter estimation method and first order autoregressive AR(1) covariance structure were used. Team (and the predictor variables of interest were included as random effects, and their slopes and intercepts were allowed to vary in order to more accurately account for the residual variance in the model. Control and moderator variables were introduced into the model in a

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stepwise fashion, and model fit was judged on the Akaike Information Criteria (AIC), using a chi-squared test based on -2Log Likelihood results for each model.

1.a: jointActionSuccess predicts team Click

$$
\begin{aligned}
teamClick =\ & jointActionSuccess \\
& + objectiveCompetence + subjectiveCompetence \\
& + individualComponentPerformance \\
& + objectiveperformancemeasures
\end{aligned}
$$

1.b teamPerformanceExpectations predict teamClick

$$
\begin{aligned}
teamClick =\ & teamPerformanceExpectations \\
& + objectiveCompetence + subjectiveCompetence \\
& + individualPerformanceExpectations \\
& + objectiveperformancemeasures
\end{aligned}
$$

1.c teamPerformanceExpectations moderates the effect of jointActionSuccess on team Click   Note: interaction not significant

2.a teamClick predicts socialBonding

3.a jointActionSuccess predicts socialBonding

3.b teamPerformanceExpectations -¿ socialBonding

Mediation analysis: jointActionSuccess predicts socialBonding, moderated by teamClick   5. Pre-post measures

6. Overall relationships? Deal with toys out of the pram, the mid-Tournament drop in performance.

Table 14: teamClick ∼ jointActionSuccess

	Dependent variable:		
	teamClick		
	(1)	(2)	(3)
Constant	−0.04	0.02	−0.87**
	(0.15)	(0.07)	(0.44)
jointActionSuccess		0.65***	0.69***
		(0.10)	(0.11)
objectiveCompetence			0.05
			(0.08)
subjectiveCompetence			0.10
			(0.07)
indPerformanceComponents			−0.02
			(0.09)
finalRank			0.12
			(0.09)
minutesTotal			0.01*
			(0.003)
totalWL			−0.07
			(0.06)
pointsTotal			0.01
			(0.01)
Observations	118	118	97
Log Likelihood	−146.53	−112.76	−92.11
Akaike Inf. Crit.	299.06	237.51	210.22
Bayesian Inf. Crit.	307.37	254.14	243.69
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 15: teamClick   teamPerformanceExpectations

	Dependent variable:		
	clickPostFactor		
	(1)	(2)	(3)
Constant	−0.04	−1.30***	−2.18***
	(0.15)	(0.22)	(0.61)
teamPerformance7		0.02***	0.02***
		(0.003)	(0.004)
objectiveCompetenceFactor			0.03
			(0.09)
subjectiveCompetenceFactor			0.13*
			(0.08)
indPerformance7			−0.0002
			(0.003)
finalRank			0.11
			(0.11)
minutesTotal			0.003
			(0.004)
totalWL			−0.02
			(0.08)
pointsTotal			0.002
			(0.01)
Observations	118	118	97
Log Likelihood	−146.53	−131.43	−105.55
Akaike Inf. Crit.	299.06	270.85	233.11
Bayesian Inf. Crit.	307.37	281.94	261.43

Note: *p<0.1; **p<0.05; ***p<0.01

Table 16: teamClick ∼ jointActionSuccess * teamPerformanceExpectations

	Dependent variable:
	clickPostFactor
Constant	−1.42***
	(0.50)
teamPerformanceComponentsFactorPost	0.60***
	(0.20)
teamPerformance7	0.01
	(0.004)
objectiveCompetenceFactor	0.07
	(0.09)
subjectiveCompetenceFactor	0.11
	(0.07)
indPerformance7	−0.001
	(0.003)
indPerformanceComponentsFactorPost	−0.03
	(0.10)
finalRank	0.16*
	(0.09)
minutesTotal	0.005
	(0.004)
totalWL	−0.09
	(0.06)
pointsTotal	0.01
	(0.01)
teamPerformanceComponentsFactorPost:teamPerformance7	−0.0004
	(0.003)

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Observations	97
Log Likelihood	−92.15
Akaike Inf. Crit.	212.31
Bayesian Inf. Crit.	248.36

Note:	*p<0.1; **p<0.05; ***p<0.01

Table 17: socialBonding   teamCLick

| | Dependent variable: | | |
| | bondingPostFactor | | |
	(1)	(2)	(3)
Constant	−0.01	0.00	−0.16
	(0.10)	(0.06)	(0.54)
clickPostFactor		0.65***	0.75***
		(0.07)	(0.11)
objectiveCompetenceFactor			0.02
			(0.09)
subjectiveCompetenceFactor			0.10
			(0.07)
teamPerformance7			−0.004
			(0.005)
indPerformance7			0.003
			(0.003)
teamPerformanceComponentsFactorPost			−0.04
			(0.13)
indPerformanceComponentsFactorPost			0.003
			(0.10)
finalRank			0.11
			(0.09)
minutesTotal			−0.005
			(0.004)
totalWL			−0.08
			(0.07)
pointsTotal	16		−0.002
			(0.01)
Observations	118	118	97
Log Likelihood	−151.95	−119.15	−95.80
Akaike Inf. Crit.	309.90	246.29	219.60
Bayesian Inf. Crit.	318.21	257.38	255.65

Table 18: socialBonding   jointActionSuccess

	Dependent variable:
	bondingPostFactor
Constant	−0.54
	(0.48)
teamPerformanceComponentsFactorPost	0.39***
	(0.13)
indPerformanceComponentsFactorPost	0.08
	(0.10)
minutesTotal	0.002
	(0.004)
totalWL	−0.06
	(0.07)
pointsTotal	−0.001
	(0.01)
finalRank	0.10
	(0.09)
Observations	116
Log Likelihood	−133.05
Akaike Inf. Crit.	288.10
Bayesian Inf. Crit.	318.39
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 19: socialBonding　teamPerformanceExpectations

	Dependent variable:
	bondingPostFactor
Constant	−1.43**
	(0.62)
teamPerformance7	0.01*
	(0.01)
indPerformance7	0.004
	(0.004)
minutesTotal	0.001
	(0.004)
totalWL	−0.04
	(0.07)
pointsTotal	−0.001
	(0.01)
finalRank	0.10
	(0.10)
Observations	116
Log Likelihood	−138.62
Akaike Inf. Crit.	299.23
Bayesian Inf. Crit.	329.52
Note:	*p<0.1; **p<0.05; ***p<0.01