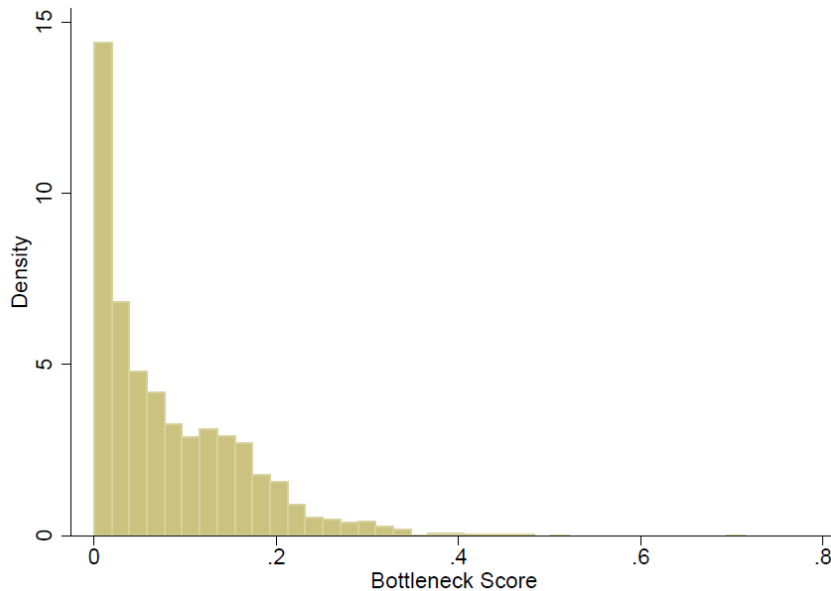


**Online Supplement:**

**“Team Familiarity and Productivity in Cardiac Surgery Operations: The Effect of Dispersion, Bottlenecks and Task Complexity”**

**Figure S1: Distribution of Bottleneck scores**



**Table S1. The number of surgeries by type in our sample**

	CABG	Valve Repair /Replacement	Congenital	Heart Failure	Tumor Removal	Routine	Other Normal	Double	Triple
Mild	951	237	41	0	8	96	20	0	0
Medium	2182	672	40	14	10	89	34	0	0
Severe	140	415	5	56	2	0	24	965	128
Total	3273	1324	86	70	20	185	78	965	128

**Additional tests for variable operationalization:** One potential issue with regards to our dependent variable is that shorter surgery durations might be argued to have a negative impact on the clinical outcome of the surgery. However, after interviewing hospital staff and analyzing our data, we have concluded that this is not the case. Specifically, there is no correlation between in-hospital mortality and the duration of the operation. Also, other than the clinical condition of the patient before the operation (i.e, severe), none of the variables have significant association with in-hospital mortality. In addition, we also investigate for any systematic statistical relationship between in-hospital mortality and our dependent (i.e. duration) and all independent and control variables (e.g., those at patient, surgeon, or team level). In order to examine this, we group our severe operations into two, those where in-hospital mortality occurred, and those where it did not. We then conduct a t-test to examine any potential relationship between in-hospital mortality and our independent and control variables. Our

results indicate that there is no statistical difference between these two groups (i.e., mortality vs non-mortality group) in terms of the averages of the variables of interest such as duration, familiarity, etc. Finally, we have also examined for any association between surgery durations and surgeon assignments. In order to check this, we grouped our surgeries into four categories according to their durations by using 25<sup>th</sup> percentile, the median, and 75<sup>th</sup> percentile as cut-offs, and then examined lead surgeons' assignments to these groups with a chi-square test. Our results indicate that they are evenly spread. Moreover, prior research has shown that shorter surgery durations can actually improve the quality of the operations outcome (Pisano et al. 2001) whereas longer surgical durations have been associated with higher probabilities of a surgical site infection (SSI) in several surgery types including cardiac operations (Gaynes et al. 2001, Gibbons et al. 2011). As a result, in contrast to the argument suggesting that shorter surgery durations may be associated with worse clinical outcomes; previous research suggests that they are actually associated with better clinical outcomes.

**Table S2. Regression of Team Familiarity on Surgery Duration using Range for Team Familiarity Dispersion**

Variable	Duration	
	Model: (1)	(2)
Team Familiarity Dispersion	0.00003** (0.00001)	0.00003** (0.00001)
Bottleneck-Pair	0.01507** (0.00340)	0.01538** (0.00341)
Severe Familiarity Percentage	-0.40677** (0.11473)	-0.40508** (0.11586)
Average Team Familiarity	-0.03214* (0.01290)	-0.02885* (0.01283)
Average Team Familiarity x Severe		-0.02898* (0.01239)
Individual Average Direct Experience	-0.05512** (0.01394)	-0.05604** (0.01392)
Team Size	0.04075** (0.00641)	0.04160** (0.00643)
Severe	0.02479+ (0.01430)	0.16449** (0.06001)
Mild	-0.01156+ (0.00599)	-0.01121+ (0.00599)
Constant	5.81310** (0.08224)	5.30034** (0.08243)
Observations (N)	6129	6129
Adjusted R <sup>2</sup>	0.478	0.479
BIC	-1521.933	-1525.260
AIC	-1730.348	-1740.398
Quarter Fixed Effect	Yes	Yes

Lead Surgeon Fixed Effect	Yes	Yes
Procedure Fixed Effect	Yes	Yes
Day of the Week Fixed Effect	Yes	Yes

+, \* and \*\* denote significance at 10%, 5% and 1% levels respectively

**Table S3. Regression of Team Familiarity on Surgery Duration using Coefficient of Variation for Team Familiarity Dispersion**

Variable	Duration	
	Model: (1)	(2)
Team Familiarity Dispersion	0.4047** (0.0750)	0.3971** (0.0748)
Bottleneck-Pair	0.0167** (0.0034)	0.0170** (0.0034)
Severe Familiarity Percentage	-0.4566** (0.1167)	-0.4538** (0.1176)
Average Team Familiarity	-0.0566** (0.0144)	-0.0529** (0.0143)
Average Team Familiarity x Severe		-0.0270* (0.0123)
Individual Average Direct Experience	-0.0249* (0.0112)	-0.0265* (0.0112)
Team Size	0.0512** (0.0068)	0.0518** (0.0069)
Severe	0.0230* (0.0098)	0.1534* (0.0597)
Mild	-0.0112+ (0.0060)	-0.0108+ (0.0060)
Constant	5.1534** (0.0902)	5.1396** (0.0904)
Observations (N)	6129	6129
Adjusted R <sup>2</sup>	0.481	0.482
BIC	-1556.211	-1558.024
AIC	-1764.626	-1773.163
Quarter Fixed Effect	Yes	Yes
Lead Surgeon Fixed Effect	Yes	Yes
Procedure Fixed Effect	Yes	Yes
Day of the Week Fixed Effect	Yes	Yes

+, \* and \*\* denote significance at 10%, 5% and 1% levels respectively

**Table S4. Regression of Team Familiarity on Surgery Duration using three dummy variables for Bottleneck-Pair**

Variable	Duration
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	Model: (1)	(2)
Team Familiarity Dispersion	0.0002** (0.0000)	0.0002** (0.0000)
25th Dummy	0.0565** (0.0109)	0.0569** (0.0109)
50th Dummy	0.0198* (0.0089)	0.0210* (0.0089)
75th Dummy	0.0041 (0.0083)	0.0046 (0.0083)
Severe Familiarity Percentage	-0.4255** (0.1146)	-0.4231** (0.1156)
Average Team Familiarity	-0.0470** (0.0142)	-0.0435** (0.0141)
Average Team Familiarity x Severe		-0.0277* (0.0124)
Individual Average Direct Experience	-0.0463** (0.0146)	-0.0474** (0.0145)
Team Size	0.0463** (0.0065)	0.0470** (0.0066)
Severe	0.0242* (0.0098)	0.1576** (0.0600)
Mild	-0.0117+ (0.0060)	-0.0113+ (0.0060)
Constant	5.3196** (0.0822)	5.3028** (0.0824)
Observations (N)	6129	6129
Adjusted R <sup>2</sup>	0.479	0.480
BIC	-1523.859	-1526.135
AIC	-1745.7201	-1754.719
Quarter Fixed Effect	Yes	Yes
Lead Surgeon Fixed Effect	Yes	Yes
Procedure Fixed Effect	Yes	Yes
Day of the Week Fixed Effect	Yes	Yes

+, \* and \*\* denote significance at 10%, 5% and 1% levels respectively

**Table S5. Regression of Team Familiarity on Surgery Duration using nine dummy variables for Bottleneck-Pair**

Variable	Duration	
	Model: (1)	(2)
Team Familiarity Dispersion	0.0002** (0.0000)	0.0002** (0.0000)
10th Dummy	0.0802** (0.0151)	0.0815** (0.0151)
20th Dummy	0.0724**	0.0735**

	(0.0157)	(0.0157)
30th Dummy	0.0608**	0.0605**
	(0.0178)	(0.0178)
40th Dummy	0.0441*	0.0448*
	(0.0186)	(0.0184)
50th Dummy	0.0342+	0.0344+
	(0.0192)	(0.0192)
60th Dummy	0.0214	0.0210
	(0.0185)	(0.0185)
70th Dummy	0.0163	0.0159
	(0.0177)	(0.0176)
80th Dummy	0.0101	0.0101
	(0.0173)	(0.0173)
90th Dummy	0.0095	0.0094
	(0.0179)	(0.0179)
Team Severe Familiarity Percentage	-0.4282**	-0.4257**
	(0.1193)	(0.1192)
Average Team Familiarity	-0.0511**	-0.0476**
	(0.0105)	(0.0105)
Average Team Familiarity x Severe		-0.0282**
		(0.0084)
Individual Average Direct Experience	-0.0449**	-0.0460**
	(0.0103)	(0.0103)
Team Size	0.0494**	0.0502**
	(0.0047)	(0.0047)
Severe	0.0232*	0.1591**
	(0.0098)	(0.0415)
Mild	-0.0120+	-0.0116+
	(0.0067)	(0.0067)
Constant	5.401**	5.385**
	(0.0696)	(0.0697)
Observations (N)	6129	6129
Adjusted R <sup>2</sup>	0.480	0.481
BIC	-1529.113	-1530.171
AIC	-1755.979	-1756.412
Quarter Fixed Effect	Yes	Yes
Lead Surgeon Fixed Effect	Yes	Yes
Procedure Fixed Effect	Yes	Yes
Day of the Week Fixed Effect	Yes	Yes

+, \* and \*\* denote significance at 10%, 5% and 1% levels respectively

**Table S6. Regression of Team Familiarity on Surgery Duration using distance from mean for Bottleneck-Pair**

Variable	Duration	
	Model: (1)	(2)

Team Familiarity Dispersion	0.0001** (0.0000)	0.0001** (0.0000)
Bottleneck-Pair	0.0002** (0.0000)	0.0002** (0.0000)
Severe Familiarity Percentage	-0.2915** (0.1112)	-0.2891** (0.1122)
Average Team Familiarity	-0.0385** (0.0125)	-0.0347** (0.0125)
Average Team Familiarity x Severe		-0.0275* (0.0121)
Individual Average Direct Experience	-0.0310+ (0.0159)	-0.0440** (0.0159)
Team Size	0.0462** (0.0061)	0.0469** (0.0062)
Severe	0.0221* (0.0097)	0.1544** (0.0586)
Mild	-0.0112+ (0.0059)	-0.0109+ (0.0059)
Constant	5.2331** (0.0810)	5.2171** (0.0814)
Observations (N)	6129	6129
Adjusted R <sup>2</sup>	0.487	0.488
BIC	-1632.978	-1635.268
AIC	-1841.393	-1851.406
Quarter Fixed Effect	Yes	Yes
Lead Surgeon Fixed Effect	Yes	Yes
Procedure Fixed Effect	Yes	Yes
Day of the Week Fixed Effect	Yes	Yes

+, \* and \*\* denote significance at 10%, 5% and 1% levels respectively

**Table S7. Regression of Team Familiarity on Surgery Duration after removing the first 24 months**

Variable	Duration	
	Model: (1)	(2)
Team Familiarity Dispersion	0.0002** (0.0000)	0.0002** (0.0000)
Bottleneck-Pair	0.0161** (0.0041)	0.0165** (0.0041)
Severe Familiarity Percentage	-0.2615* (0.1117)	-0.2590* (0.1122)
Average Team Familiarity	-0.0425* (0.0173)	-0.0396* (0.0173)
Average Team Familiarity x Severe		-0.0234* (0.0096)

Individual Average Direct Experience	-0.0390*	-0.0398*
	(0.0179)	(0.0178)
Team Size	0.0418**	0.0425**
	(0.0074)	(0.0074)
Severe	0.0217*	0.1117*
	(0.0108)	(0.0471)
Mild	-0.0082	-0.0077
	(0.0064)	(0.0064)
Constant	5.3632**	5.3471**
	(0.1000)	(0.1003)
Observations (N)	4460	4460
Adjusted R <sup>2</sup>	0.466	0.467
BIC	-1430.825	-1433.273
AIC	-1601.766	-1605.823
Quarter Fixed Effect	Yes	Yes
Lead Surgeon Fixed Effect	Yes	Yes
Procedure Fixed Effect	Yes	Yes
Day of the Week Fixed Effect	Yes	Yes

+, \* and \*\* denote significance at 10%, 5% and 1% levels respectively

**Table S8. Regression of Team Familiarity on Surgery Duration with alternative specification of task complexity**

Variable	Duration
	Model: (1)
Team Familiarity Dispersion	0.0002**
	(0.0000)
Bottleneck-Pair	0.0179**
	(0.0033)
Team Severe Familiarity Percentage	-0.4082**
	(0.1192)
Average Team Familiarity	-0.0265*
	(0.0128)
Average Team Familiarity x Patient	-0.0112*
	(0.0044)
Individual Average Direct Experience	-0.0479**
	(0.0103)
Team Size	0.0467**
	(0.0046)
Patient	0.0705**
	(0.0221)
Constant	5.170**
	(0.0793)
Observations (N)	6128
Adjusted R <sup>2</sup>	0.480

BIC	-1521.1060
AIC	-1742.9680
Quarter Fixed Effect	Yes
Lead Surgeon Fixed Effect	Yes
Procedure Fixed Effect	Yes
Day of the Week Fixed Effect	Yes

+, \* and \*\* denote significance at 10%, 5% and 1% levels respectively

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