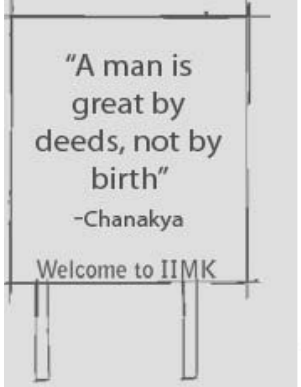

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Cognitive perspective to Organizational Innovation: Evidence from F1 racing

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Abstract

The study aims to study the link between cognition structure of individual decision makers and strategic decisions of organizations. Specifically, the impact of positive affect and cognitive anxiety on the innovative quotient of organizations. The study is based on the context of formula one car racing teams due to their heavy reliance on cutting edge technology for performance. Data for top ten racing teams over a period of three years is analyzed. The findings suggest a positive relation between positive affect and innovation and negative relation between cognitive anxiety and innovation. The study contributes towards the literature on micro foundations of strategic decision making.

Introduction

Strategic decision-making has been a topic of interest among management researchers since many decades now. It is also an established fact that cognition level of the decision-makers plays important role on the decisions made (Rumelhart & Norman, 1985). Hence understanding the cognitive underpinning of strategic decision-making process is crucial for success. Although many attempts have been made earlier to enhance such understanding, they were fragmented between the psychology and management literature streams. Furthermore, some Strategic decisions such as innovative activities of an organization are difficult to identify and measure accurately in order to be linked with the cognitive structure of the decision-makers. The current paper thus attempts to study the link between managerial cognition and innovation level of an organization in a more measurable context of sports. Another issue addressed in this paper is the issue of homogeneity bias among the sampled firms in earlier studies. The empirical studies done so far consider the firms in their sample to be similar to each other in terms of their organizational capabilities. Basing the empirical investigation in the sports context where every team is almost homogeneous with the rest of the teams in its organizational capabilities, helps control the homogeneity bias.

Like any other organization, sports organizations too face many situations which calls for complex decision making. These situations include both on field and off field decisions. The extant literature mainly focuses on the on-field decisions such as task performance (Cordovil et al., 2009). Feinstein (1990) developed a decision tree for a proposed drug-testing program of student athletes at Santa Clara University. Hurley (1998) assessed the timing and sequencing of decisions made during crucial junctures in football. The off-field decisions are also related to task performance on field such as (Sackrowitz, 2000) discussed extra point strategy in American football, determining when a riskier two-point conversion ought to be attempted. However very few studies concentrated on the cognitive abilities associated with such decision-making process. Some of the few available works advocates the use of cognitive models to understand sports decision making(Johnson, 2006). Few others studies also calls to further investigate the role of cognitive elements such as self-efficacy empirically(Hepler & Chase, 2008). However, such calls are not met with sound inferences yet. Specially, the cognitive ability of coaches and managers are a less explored area whereas it plays very crucial role in important decisions related to sports organizations.

This study therefore tries to understand the impact of cognitive structure of coach/managers on the innovative behaviour of sports organizations. As established by earlier literature innovative practices of sports organizations lead to better performance of team. Hence any element contributing to better decision making towards innovation is of paramount importance.

We intend to do a content analysis of the interviews given by coaches and managers to understand particularly two cognitive attributes – Positive Affect and Cognitive anxiety. We will then map the innovative practices of their respective teams to the cognitive structure derived. For identifying the innovative behaviour of the sports organizations, we will use the secondary sources such as newspaper articles, reports, web content, interviews and other publicly available information. We will measure the count of such activities and will attempt to understand its pattern with respect to the cognitive structure of the coaches and managers. We will base the study in the context of Formula1(F1) racing which is known for using cutting-edge innovative technology in their races. One of the crucial ingredients of performance of a formula one team is its race car. Hence equipping the race car with latest automobile technology has become an essential part of each Formula one team. Since our study aims to understand the pattern of innovations within teams, Formula one serves best the purpose.

THEORY AND HYPOTHESES

Traditionally, Strategy literature has been known to focus on the macro level of firm elements such as performance, resources, routines and capabilities(McGahan & Porter, 1997). The focus of these studies is either at firm level or levels higher than that such as industries or geographic locations. Furthermore, the firm elements such as organizational routines, firm capabilities and organizational knowledge are considered as an aggregate for the firm rather than considering at their constituent level. Individual actions and mindset contributing towards the aggregate level constructs are often ignored. Empirical studies of Strategic management have almost always taken dependent and independent variables at the firm or higher levels (competitive advantage, financial performance, innovation). Felin and Foss (2006) and Foss (2011) point out one probable reason of such dearth of micro analysis of strategic constructs is the common notion of strategy researchers that any question needing microlevel research should be left to "relevant" disciplines such as psychology or Organization behaviour. The other probable reason attributed is the difficulty of theoretically linking micro and macro issues.

Nevertheless, one can strongly argue the importance of microlevel analysis of the strategy constructs (Abell et al., 2008; Foss, 2010a, 2010b). One argument establishes Individual actions as a necessary element of any Strategic actions of a firm. The decisions taken by firms can ultimately be drilled down to the perceptions and mental models of the individual decision makers. Hence the firm capabilities are a visible manifestation of the underlying complex processes of individual actions and interactions (Abell et al., 2008; Foss, 2011). As noted by Felin and Foss (2006), organizations cannot be analysed by ignoring the human element involved within, which forms the unavoidable part of them. These arguments imply Strategic management researchers should equally concentrate on the human actions and interactions which forms the foundations of crucial strategic phenomena (Abell et al., 2008; Loon et al., 2020; Nayak et al., 2019)

There has been a recent increase in the micro level research in the strategy field. However, those studies are mainly based in survey method and hence suffer from the self-reporting bias about the individual characteristics. The current paper thus addresses this gap of understanding of micro-foundation of strategy research through unobtrusive method of content analysis of the recorded interview of managers/coaches of F1 team to understand the capabilities of their respective teams.

To be specific, we will try to study the impact of decision makers cognition on the innovative activities of the team.
Literature asserts positive affect and cognitive anxiety as two important elements influencing cognitive structure of an individual (Forgas, 2001; Lyubomirsky et al., 2005). The current study focuses on these two aspects of an individual on their effect on innovative capability.

Various fields of studies such as social psychology, organizational behaviour suggests a relationship between creativity and affect (Barsade & Gibson, 2007; Brief & Weiss, 2002). Particularly, positive moods or feelings (i.e., positive affect) have been found to positively impact creativity(Ashby et al., 1999; Lyubomirsky et al., 2005). However, contradictory evidence of such relationship have also been asserted(George & Zhou, 2007; Kaufmann & Vosburg, 2002), Hence ambiguity surrounding the relation positive affect—creativity still prevails.

Creativity has been assumed to influence the innovative nature of a firm. Despite little empirical evidence of this relationship, there is theoretical grounds for such claim(Sarooghi et al., 2015). In the entrepreneurship literature, creativity is often considered the essential element of innovation culture, but not sufficient though, since creative ideas so not automatically mean commercially viable ones (McMullen & Shepherd, 2006; Ward, 2004). Therefore, we argue that there is theoretical ground suggesting that positive affect enhances entrepreneurs' creativity, and that enhanced creativity, in turn, can encourage firm-level innovation.

We propose our first hypothesis as

Hypothesis 1. The higher the manager' level of positive affect, the greater the number of innovations adopted by the respective firm.

Furthermore, anxiety forms another significant aspect of one's cognitive structure. People become anxious when they can only partly interpret the events surrounding them and had to act based on it(Viney & Westbrook, 1976). Such cognitive anxiety has been established as showing a negative correlation to positive emotions(Viney, 1983). However, there is not much empirical support for it. Since understanding the cognitive underpinnings of organizational decisions is crucial for their effectiveness, empirical knowledge about influence of cognitive anxiety on decision making will contribute towards the micro foundations' literature. It would hence be interesting to see how an individual take decision under the influence of cognitive anxiety.

As cognitive anxiety will limit the comprehension of one's information handling capacity, we argue that people will become more risk averse in such situations and hence avoid being innovative.

We propose our second hypothesis as

Hypothesis 2. The higher the manager' level of cognitive anxiety, the lesser the number of innovations adopted by the respective firm.

DATA AND METHODOLOGY

The context of Formula one racing is chosen for the study due to its characteristic dependence on cutting edge technology as one of the primary sources of competitive advantage. Furthermore, these innovations are easily identifiable and measurable in Formula one racing teams in comparison to the other corporate organizations. Additionally, the context gives a sound reason to apply the assumption of homogeneity across all the organisation as all the teams are similar to each other which cannot be claimed for other corporate organizations.

We collected our panel of data for top ten Formula one teams through three years period 2017-2019. The reason behind choosing the starting period as 2017 is the drastic change of technical regulations for the car design. For estimating the cognitive structure (positive affect and cognitive anxiety) of the team principals of the Formula one teams, we relied on the pre-season video interviews of them available online(www.formula1.com and youtube). The extent of innovations adopted by each team is measured in terms of innovations in the car design for each year sourced from various online mediums (www.fia.com, www.formula1.com and You tube channel 'Let's talk F1'). The details of the measurement method of each variable are explained in the following paragraph. The top ten Formula one teams (as per the pre-season 2020 ranking) are selected for the study and listed in table 1. We deploy a random effect panel regression model to analyse our data. Random effect model is chosen over fixed effect model depending on the result of the Hausman test(Hausman, 1978).

LIST OF TEAMS
MERCEDES
FERRARI
RED BULL
FORCE INDIA
WILLIAMS
RENAULT
TORO ROSSO
HAAS
MCLAREN

SAUBER

Table 1: The list of the formula one teams studied

Dependent Variable

Innovation This variable is measured based on Fédération Internationale de l'Automobile (FIA) technical rules across six core technology areas: chassis, engine, tires, mechanics, electronics, and aerodynamics for the racing car(Marino et al., 2015). The measure is developed by analysing each team's car design for the season in comparison to regulatory release for the season. We assign the value 0 if no other change other than what is required as per the regulation is implemented, value 3 if radical changes are implemented apart from those mandated. The values 1 and 2 are assigned as per the degree of changes in each of the selected technological areas. Finally, the average of all the six scores is considered as the value for the variable 'innovation' for the team, for that season.

Independent Variable

Positive affect We implemented Gottschalk-Gleser scales(Gottschalk & Gleser, 1979) to measure the positive affect of the team principals. Video interviews of the team principals are transcribed. The scale involves measuring positive affect experienced by the individual. A score of 1 is given whenever the person expresses positive feelings. Even if several feelings are expressed at one go, only a score of 1 is given. No weightage is given to the scores as it is difficult to differentiate one positive affect from other (e.g. pride, happiness, excitement etc.). The scores are then summed (Total score) and square root transformation is applied to the Gottschalk-Gleser scales (Westbrook, 1976) to avoid positive skew of the distribution.

PA = $\sqrt{}$((Total score * CF) + ½ CF) where PA is the positive affect score and CF is the correction factor measured as the number of words in the sample divided by 100. Some examples of the positive affect part sentences are as below:

I was happy (thrilled, excited, delighted, pleased, overjoyed).
I love the job
I feel honoured/proud

Cognitive anxiety We implemented Gottschalk-Gleser scales(Gottschalk & Gleser, 1979) to measure the cognitive anxiety of the team principals. Video interviews of the team principals are transcribed. The scale involves measuring anxiety experienced by the individual. A score of 1 is given whenever the person expresses feelings of anxiety. Even if several feelings are expressed at one go, only a score of 1 is given. No weightage is given to the scores as it is difficult to differentiate one anxiety from other (e.g. stress, sadness, dissapointment.). The scores are then summed (Total score) and square root transformation is applied to the Gottschalk-Gleser scales (Westbrook, 1976) to avoid positive skew of the distribution.

CA = √((Total score * CF) + ½ CF) where CA is the cognitive anxiety score and CF is the correction factor measured as the number of words in the sample divided by 100. Some examples of the cognitive anxiety part sentences are as below:

I was worried (scared/tensed)

I was disappointed

It was a difficult situation

Control variables

Change in Technical regulation This variable is measured based on Fédération Internationale de l'Automobile (FIA) technical rules across six core technology areas: chassis, engine, tires, mechanics, electronics, and aerodynamics for the racing car(Marino et al., 2015). The measure is developed by analysing each of the regulatory release for the season. We assign the value 0 if no change with respect to the previous season is implemented, value 3 if radical changes are implemented with respect to the prevailing one. The values 1 and 2 are assigned as per the degree of changes in each of the selected technological areas with respect to the prevailing regulations of the previous season. Finally, the average of all the six scores is considered as the value for the variable 'Change in Technological regulation' for the team, for that season.

Change in Chief Engineer This is a binary variable holding a value 0 if there is no new hiring for the chief engineer position and 1 otherwise. This variable takes care of any spurious effect of new chief engineer on innovation.

Team budget This variable holds the amount of money allocated by each F1 team in respective years in million Euros. Introducing this control avoids any probable spurious effect of monetary benefits of the team.

The descriptive statistics of all the variables are listed below

Variable	Obs	Mean	Std. Dev.	Min	Max
year	29	2017.966	.8230066	2017	2019
techregula~g	29	1.017241	.8514051	.3333333	2.166667
budgetmile~s	29	208.2248	112.0526	103	440.92
innovation~g	29	.3275862	.2538699	0	.8333333
positiveaf~t	29	8.241379	7.124681	2	30
pascore	29	12.69512	16.11403	1.962142	66.85638
cascore	29	11.45894	13.42514	1.290349	57.42278
changeofen~r	29	.2413793	.4354942	0	1

RESULTS AND DISCUSSION

As mentioned earlier, we deploy the random effect panel regression model in Stata to analyse the data set. As our data set have time invariant variable across years, random effect model is more appropriate. We further deploy Hausman test (Hausman, 1978) to decide on the model. With significant P-value at 1%, the null is rejected favouring random effect model for our analysis.

The result of the random effect analysis of our panel data is listed below

```
Random-effects GLS regression                   Number of obs     =         29
Group variable: id                              Number of groups  =         11

R-sq:                                           Obs per group:
     within  = 0.6538                                         min =          1
     between = 0.3131                                         avg =        2.6
     overall = 0.5963                                         max =          3

                                                Wald chi2(5)      =      34.12
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

innovationavg	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
pascore	.0378571	.0085561	4.42	0.000	.0210874	.0546269
cascore	-.0450494	.0101469	-4.44	0.000	-.064937	-.0251618
changeofengineer	-.0748392	.082043	-0.91	0.362	-.2356405	.085962
budgetmileuros	-.0001485	.0003733	-0.40	0.691	-.0008801	.0005831
techregulationavg	.1078871	.0419141	2.57	0.010	.0257369	.1900372
_cons	.3002108	.1038039	2.89	0.004	.096759	.5036627
sigma_u	.04400912					
sigma_e	.153787					
rho	.07569406	(fraction of variance due to u_i)				

The above result provides support for both our hypotheses suggesting a positive relation between positive affect and innovation and negative relation between cognitive anxiety and innovation. Our findings can be extended to the organizational context suggesting that the cognitive structure of an individual decision maker plays an important role in the innovative nature of the organizations.

CONCLUSION

Our study contributes towards the literature concerning the micro foundation of the strategic decisions within organizations. Furthermore, the findings have practical implication on capability building of organizations. The top management can generate ideas to encourage innovations within organizations by inculcating a positive affect inducing environment. Our study however suffers from the limitation of small sample period. Due to unavailability of reliable interview data we could not extend it beyond three years. Future studies can build on this study to further improve the contributions. Furthermore, due to the same scarcity of interview data we had to rely on different sources and different types of interviews of the team

principals to draw our data set. The heterogeneity across the interview data sources can introduce bias in our results. Overall, the study contributes towards the much needed linking between cognition and strategic decision making.

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