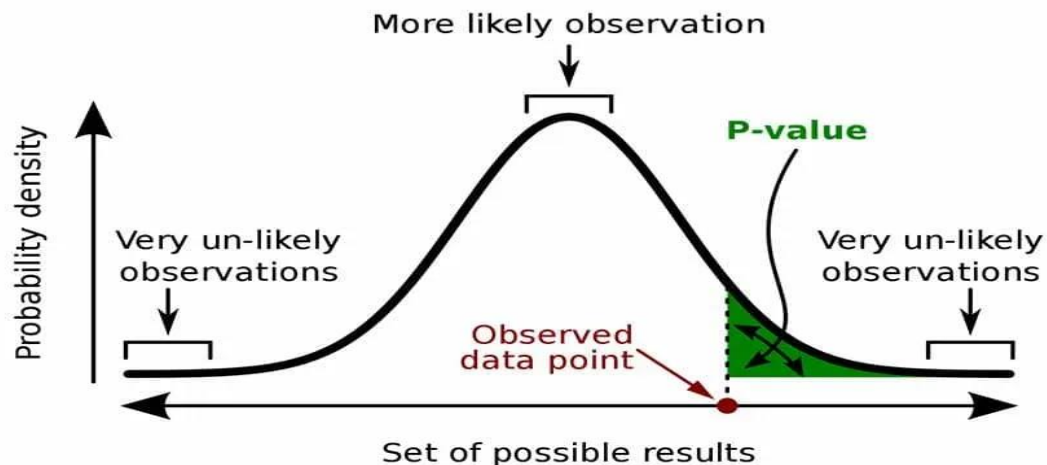


PRACTICAL HYPOTHESIS TESTING

What a p -value tells you about statistical significance

By [Dr. Saul McLeod](#), published 2019



A **p-value** (shaded green area) is the probability of an observed (or more extreme) result assuming that the null hypothesis is true.

When you perform a statistical test a p -value helps you determine the significance of your results in relation to the null hypothesis.

The null hypothesis states that there is no relationship between the [two variables being studied](#) (one variable does not affect the other). It states the results are due to chance and are not significant in terms of supporting the idea being investigated. Thus, the null hypothesis assumes that whatever you are trying to prove did not happen.

What a p -value tells you about statistical significance

The alternative hypothesis is the one you would believe if the null hypothesis is concluded to be untrue.

The alternative hypothesis states that the independent variable did affect the dependent variable, and the results are significant in terms of supporting the theory being investigated (i.e. not due to chance).

How do you know if a p -value is statistically significant?

A p -value, or probability value, is a number describing how likely it is that your data would have occurred by random chance (i.e. that the null hypothesis is true).

The level of statistical significance is often expressed as a p -value between 0 and 1. The smaller the p -value, the stronger the evidence that you should reject the null hypothesis.

- A p -value less than 0.05 (typically ≤ 0.05) is statistically significant. It indicates strong evidence against the null hypothesis, as there is less than a 5% probability the null is

correct (and the results are random). Therefore, we reject the null hypothesis, and accept the alternative hypothesis.

However, if the p -value is below your threshold of significance (typically $p < 0.05$), you can reject the null hypothesis, but this does not mean that there is a 95% probability that the alternative hypothesis is true. The p -value is conditional upon the null hypothesis being true, but is unrelated to the truth or falsity of the alternative hypothesis.

- A p -value higher than 0.05 (> 0.05) is not statistically significant and indicates strong evidence for the null hypothesis. This means we retain the null hypothesis and reject the alternative hypothesis. You should note that you cannot accept the null hypothesis, we can only reject the null or fail to reject it.

A statistically significant result cannot prove that a research hypothesis is correct (as this implies 100% certainty).

Instead, we may state our results “provide support for” or “give evidence for” our research hypothesis (as there is still a slight probability that the results occurred by chance and the null hypothesis was correct – e.g. less than 5%).

How to report a p -value APA style

The 6th edition of the APA style manual (American Psychological Association, 2010) states the following on the topic of reporting p -values:

“When reporting p values, report exact p values (e.g., $p = .031$) to two or three decimal places. However, report p values less than .001 as $p < .001$. The tradition of reporting p values in the form $p < .10$, $p < .05$, $p < .01$, and so forth, was appropriate in a time when only limited tables of critical values were available.” (p. 114)

Note:

- Do not use 0 before the decimal point for the statistical value p as it cannot equal 1, in other words, write $p = .001$ instead of $p = 0.001$.
- Please pay attention to issues of italics (p is always italicized) and spacing (either side of the = sign).
- $p = .000$ (as outputted by some statistical packages such as SPSS) is impossible and should be written as $p < .001$.
- The opposite of significant is "nonsignificant", not "insignificant".

Why the p -value is not enough

A lower p -value is sometimes interpreted as meaning there is a stronger relationship between two variables. However, statistical significance means that it is unlikely that the null hypothesis is true (less than 5%).

To understand the strength of the difference between two groups (control vs. experimental) a researcher needs to calculate the [effect size](#).

Note

$P < 0.01$ Strong evidence against H_0

$0.01 < P < 0.05$ Moderate evidence against

$P > 0.10$ Little or no evidence against H_0

$P < 0.01$	Strong evidence against H_0 (hence reject the null)
$0.01 < P < 0.05$	Moderate evidence against H_0 (hence accept the null)
$P > 0.10$	Little or no evidence against H_0 (hence accept the null)

How to reference this article:

McLeod, S. A. (2019, May 20). *What a p-value tells you about statistical significance*. Simply Psychology. www.simplypsychology.org/p-value.html

Further Information

[P-values and significance tests \(Kahn Academy\)](#)

[Hypothesis testing and p-values \(Kahn](#)

[Academy\)](#) Wasserstein, R. L., Schirm, A. L., & Lazar, N. A. (2019). Moving to a world

beyond " $p < 0.05$ ". Criticism of using the " $p < 0.05$ ". Effect Size (why the p -value is not

enough) Type I and Type II Errors What is a Normal Distribution in Statistics? Z-Score:

[Definition, Calculation and Interpretation](#) Confidence Intervals Statistics for

[Psychology](#) Publication manual of the American Psychological Association Statistics for

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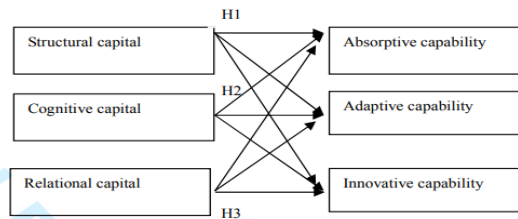


Figure 1 The proposed model about family business social capital, dynamic capabilities, and business performance

different network stakeholders as a result of frequent interactions is conducive to mutual

communication, hence facilitating innovation decisions, even those on radical innovation. Based on the above discussion and the general findings available in the literature, one main and three sub-hypotheses are proposed:

H1: Family business structural capital is positively related to dynamic capabilities of the firm, i.e. absorptive capability, adaptive capability and innovative capability.

H1a: Family business structural capital is positively related to the firm's absorptive capability.

H1b: Family business structural capital is positively related to the firm's adaptive capability.

H1c: Family business structural capital is positively related to the firm's innovative capability.

conjunction with structural capital and relational capital. However the results show no significant impact of cognitive capital on innovation. The reason for the insignificant impact may be that cognitive capital overlaps with relational capital and when relational capital influences innovation at a significant level, cognitive capital cannot demonstrate an extra influencing power (Zheng, 2010). Based on the above discussion, the following hypothesis and sub-hypotheses are proposed:

H2: Family business cognitive capital is positively related to dynamic capabilities of the firm, i.e. absorptive capability, adaptive capability and innovative capability.

H2a: Family business cognitive capital is positively related to the firm's absorptive capability.

H2b: Family business cognitive capital is positively related to the firm's adaptive capability.

H2c: Family business cognitive capital is positively related to the firm's innovative capability.

Relational capital and dynamic capabilities

Relational capital in the family business context refers to trust, norms, obligations and expectations (Hoffman *et al.*, 2006). However in the literature of relational capital-business capability relationship, research effort focuses on trust and norms (Zheng, 2010). Interpersonal trust in family firms is often built upon family relationships, shared values and historical interactions (Eddleston *et al.*, 2010). This is the reason why family members often

the arena of norms-business capability, Zheng (2010) indicated that the studies on norms are divergent because of the inconsistent use of terminologies. Hence it is often difficult to compare and contrast research findings or make any generalisations upon these studies. On the basis of the above debates and taking into account the major findings from the literature, the following main hypothesis and three sub-hypotheses are put forward:

H3: Family business relational capital is positively related to dynamic capabilities of the firm, i.e. absorptive capability, adaptive capability and innovative capability.

H3a: Family business relational capital is positively related to the firm's absorptive capability.

H3b: Family business relational capital is positively related to the firm's adaptive capability.

H3c: Family business relational capital is positively related to the firm's innovative capability.

Insert Figure 1 here

Research Methodology

Table 4 Regression analysis of social capital and dynamic capabilities

	Absorptive capability						Adaptive capability						Innovative capability					
	Model 1			Model 2			Model 1			Model 2			Model 1			Model 2		
	B	t	VIF	B	t	VIF	B	t	VIF	B	t	VIF	B	t	VIF	B	t	VIF
Business size	0.001	1.949	1.153	0.001	1.831	1.129	0.002	2.237*	1.150	0.001	2.113*	1.125	0.002	2.978**	1.147	0.002	2.979**	1.122
Business age	0.040	2.316*	1.153	0.017	1.035	1.162	0.085	4.299**	1.150	0.047	2.585*	1.160	0.052	2.466*	1.147	0.027	1.310	1.155
Structural capital				0.106	2.731**	1.151				0.131	3.018**	1.148				0.146	2.986**	1.149
Cognitive capital				0.140	4.008**	1.395				0.238	6.097**	1.392				0.162	3.683**	1.394
Innovative capital				0.203	7.589**	1.290				0.234	7.839**	1.288				0.206	6.113**	1.292
R ²		0.023			0.231			0.054			0.309			0.037			0.204	
Adjust R ²		0.020			0.225			0.051			0.304			0.033			0.197	
ANOVA F		7.180			36.176			17.504			53.829			11.587			30.647	
Sig. F		0.001**			0.000***			0.000***			0.000***			0.000***			0.000***	

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

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3 In the full model for absorptive capability, the independent variables, i.e. structural,
4 cognitive, and relational capital respectively, have a significant impact on the dependent
5 variable ($B=.106, p<.01$; $B=.140, p<.01$; $B=.203, p<.01$ respectively; see Table 4), supporting
6 hypotheses H1a, H2a and H3a. This implies that the more structural, cognitive and relational
7 capital possessed by the firm, the more likely the firm will be equipped with competitive
8 absorptive capability. Business age in the restricted model was identified as significant with
9 absorptive capability, but in the full model this relationship was veiled by the three
10 dimensions of social capital. The fact that the explanatory power of the model represented by
11 R^2 increases from 2.0% in the restricted model to 22.5% in the full model implies that
12 absorptive capability is primarily related to social capital. In the full model for adaptive
13 capability, research results further support hypotheses H1b, H2b and H3b ($B=.131, p<.01$;
14 $B=.238, p<.01$; $B=.234, p<.01$ respectively), which implies that the more structural, cognitive
15 and relational capital possessed by the firm, the more competent adaptive capability the firm
16 will show. Business size and age were both recognised to be related to adaptive capability,
17 but the fact that the explanatory power increases from 5.1% in the restricted model to 30.4%
18 in the full model indicates that adaptive capability is predominantly associated with social
19 capital. For innovative capability, all independent variables are significant ($B=.146, p<.01$;
20 $B=.162, p<.01$; $B=.206, p<.01$ respectively), supporting hypotheses H1c, H2c, and H3c. The
21 control variable business size was found to have a positive relationship with innovative
22 capability. Nevertheless, since the explanatory power represented by R^2 increases from 3.3%
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