

Psychological capital, innovators' DNA and innovative behaviour



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Orientation: This study was positioned within the field of positive psychology, specifically positive organisational behaviour scholarship (POBS).

Research purpose: The aim of the research was to investigate the relationship between psychological capital (PsyCap), employees' innovative thinking and their innovative behaviour.

Motivation for the study: Psychological capital has been associated with many positive organisational behaviour outcomes, but relatively little previous research has addressed the relationship between PsyCap and innovation in South Africa. In a similar vein, there is much interest in the Innovator's DNA model, but it too has received little research scrutiny. Combining these variables into a single model, provided an opportunity to address both these research gaps.

Research approach/design and method: The research design was quantitative in nature. The model of innovative behaviour was tested on a sample of 485 employees from the travel and automotive industries in South Africa.

Main findings: The model of innovative behaviour was mostly supported by the data. Significant relationships between PsyCap, innovators' DNA (innovative thinking) and innovative behaviour were found.

Practical/managerial implications: The characteristics that underpin both PsyCap and innovative thinking have been shown in previous research to be malleable and trainable. The current research found that both these variables contributed significantly to the variance in innovative thinking. Managers seeking employees who engage in innovative behaviours would do well to spend time and effort in the training and development of both PsyCap and innovative thinking.

Contribution/value-add: This study contributes to the limited amount of research on employee innovative behaviour in South Africa. Specifically, the study established a link between employees' cognitive skills, psychological skills and innovative behaviour.

Keywords: psychological capital; innovative thinking; innovative behaviour; positive psychology; Innovator's DNA Model.

Introduction

Orientation

In recent years, increasing attention has been paid to the role of positive psychology in the workplace. Positive psychology focuses on enhancing humans' ability to thrive and the individual strengths and virtues that contribute to their positive well-being (Sheldon & King, 2001). Positive psychology positioned itself in direct contrast to mainstream psychology, which tended to focus on negative psychological functioning such as distress and debility. Based on the work of the positive psychology movement, Luthans (2002) coined the term 'positive organisational behaviour', which is the application of positive psychology to the workplace. This study is located within this positive psychology framework.

Luthans and Youssef (2004, 2007) identified four constructs (confidence, optimism, hope and resilience) that met the criteria of positive organisational behaviour, which they termed 'Positive Psychological Capital'. Psychological Capital (PsyCap) has been an important construct for the workplace because it has been linked to increased production, satisfaction, organisational citizenship behaviours and reduced stress (Avey et al., 2011). This article continues this line of research, specifically focusing on individual innovation – the innovative thinking and behaviour exhibited by organisational members.

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There has been a fair amount of research addressing the link between PsyCap and innovative behaviour around the world, including India (Jafri, 2012); China (Yan et al., 2020) and Nigeria (Babalola, 2009). There appears to be relatively little research, however, within corporate South Africa. Research on this topic is important in South Africa. The challenging economic climate in South Africa, where there is a relatively small pool of skilled employees and immense pressure to increase the competitiveness of local companies, makes innovative behaviour a particularly salient issue to investigate.

Another promising variable that may impact innovative behaviour is innovative thinking. Dyer et al. (2009) identified a series of thinking skills, termed the innovator's DNA, which underpinned the behaviour of the top entrepreneurial innovators globally. There has been relatively little follow-up research on the innovator's DNA and its role in the innovative behaviour of ordinary employees. This study addresses this gap in the literature by including innovative thinking as an additional potential predictor of innovative behaviour in this study.

Research purpose and objectives

The aim of this research was to assess the relationship between PsyCap, innovative thinking and innovative behaviour.

Literature review

Innovative thinking

In a groundbreaking study reported in the *Harvard Business Review* in 2009, Dyer et al. (2009) identified what they termed the innovator's DNA – the characteristics that distinguish the top innovative entrepreneurs from other executives and business owners. The article was based on the results of a 6-year study, which included interviews with high profile innovative entrepreneurs, including Pierre Omidyar (eBay), Jeff Bezos (Amazon.com), Michael Dell (Dell), Mike Lazaridis (Research-in-Motion) and Peter Thiel (PayPal); as well as a quantitative study where a number of propositions emerging from the interviews were tested on a sample of 512 managers and executives (Dyer et al., 2008). They established five distinct skills – associating, questioning, observing, experimenting and networking – innovative entrepreneurs use in generating creative, disruptive business models, strategies and products. They named these five skills the innovator's DNA.

Associating is the backbone of Dyer et al.'s (2009) Innovator's DNA model. It is a higher order cognitive skill that enables the recognition of patterns in seemingly unrelated concepts by allowing new knowledge to emerge. The second innovation skill is questioning. This skill refers to the ability to interrogate accepted wisdom and critically examine the assumptions underlying conventional ways of doing things. The third skill is observing – carefully and intentionally focusing on the details of how people behave and what problems or constraints they have that could be addressed through changing or introducing a product, service or method. The fourth skill is

experimenting – thought experiments, mechanical tinkering, and trying out new places and ideas to see what might happen. The final skill is networking. This involves engaging with people from diverse backgrounds who view the world in different ways.

Despite the immense popular success of Dyer et al.'s (2009) model, there appears to be relatively little further empirical research that has been undertaken to test these ideas. This is unfortunate because one of the most promising elements of the model is Dyer et al.'s (2009) assertion that these skills are not innate. They are malleable skills that can be developed and honed through practice and therefore warrant additional research scrutiny. Understanding how these skills impact individual innovative behaviour in contexts different from the original Dyer et al.'s (2009) research is important. Barak et al. (2019) regard the innovator's DNA to be a set of cognitive skills that can lead to innovative behaviour through a mental process that stimulates the realisation of new ideas and outcomes that is innovative thinking. In addition to these cognitive skills, this study sought to assess a set of psychological skills – operationalised as PsyCap – in relation to individual innovative behaviour in three South African organisations.

PsyCap

Psychological capital is a positive organisational behaviour construct developed by Fred Luthans and his colleagues over a series of research studies. The construct is designed to be similar to financial capital or social capital – a resource that employees can accumulate and draw on when needed. It comprises four components – efficacy, optimism, hope and resilience – and is defined as:

[A]n individual's positive psychological state of development characterised by: (1) having confidence (efficacy) to take on and put in the necessary effort to succeed at challenging tasks; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering toward goals and, when necessary, redirecting paths to goals (hope) in order to succeed; and (4) when beset by problems and adversity, sustaining and bouncing back, and even beyond (resilience) to attain success. (Luthans et al., 2011, p. 3)

Each of the components of PsyCap is state-like in nature. In other words, they are neither transient nor stable but can be nurtured and changed. The four components each have their own theoretical and empirical base, but there is substantial evidence to suggest that the higher order construct of PsyCap, all four PsyCap factors combined, is a stronger predictor of outcomes than the individual factors on their own (Nolzen, 2018). Luthans et al. (2007) define this PsyCap higher order construct as an individual's 'positive appraisal of circumstances and probability for success based on motivated effort and perseverance' (p. 550).

The link between PsyCap and innovation rests on the proposition that high levels of PsyCap stimulate positive emotions (Nolzen, 2018), and that such positive emotions

broaden people's response repertoires. Negative emotions narrow people's focus, ensuring that they are able to respond quickly and decisively to any perceived threat. Positive emotions, on the other hand, enable people to expand their thinking and mindsets to allow for new possibilities and solutions:

Having a momentarily broadened mindset is not a key ingredient in the recipe for any quick survival maneuver. It is, however, in the recipe for discovery, discovery of new knowledge, new alliances, and new skills. (Fredrickson, 2013, p. 15)

Fredrickson's use of the term 'discovery' links directly to Dyer et al.'s (2009) Innovator's DNA Model, where the five innovation thinking skills (associating, questioning, observing, experimenting and networking) are also sometimes described as 'discovery skills' (Dyer et al., 2009, p. 2). This study seeks to establish the extent to which these two elements of discovery – discovery through a broadened mindset and discovery through key thinking skills combine to predict individual innovative behaviour.

Individual innovative behaviour

All innovations, regardless of how and where they emerge, begin as a set of innovative behaviours. For the purposes of this research, individual innovative behaviour is defined as 'all individual actions directed at the generation, introduction and or application of beneficial novelty at any organisational level' (Kleynen & Street, 2001, p. 285). According to Kleynen and Street (2001), research on innovation typically assessed only one dimension of innovative behaviour – the development of new ideas (Kleynen & Street, 2001). However, the development of new ideas is not the full sum of what constitutes innovative behaviour in the workplace. Rather, they argue that individual innovative behaviour in organisations involves exploration (of new opportunities), generation (of new ideas), formative investigation (of the viability and relevance of the innovation), championship (of the innovative ideas and outcomes) and application. Ever since the notion of innovation as an isolated case of brilliance has been debunked, individual innovative behaviours, as depicted in this section have become highly desirable in organisations. Unsurprisingly, there has been a substantial amount of research devoted to this topic. This

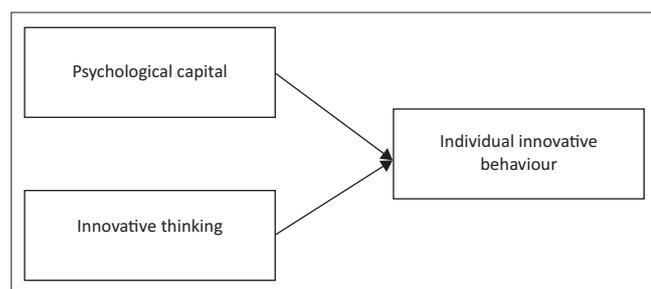


FIGURE 1: Psychological capital, innovative thinking and individual innovative behaviour model.

research adds to this body of knowledge, by assessing whether there is a predictive relationship between PsyCap, innovative thinking and individual innovative behaviour. The nature of the relationships explored in this study is presented in Figure 1. The model depicted in Figure 1 is intended to show the combined effect of PsyCap and innovative thinking on innovative behaviour, rather than the individual relationships between the respective variables.

Research design

Research approach and method

The research design of this study was quantitative, non-experimental and cross-sectional. This design allows for relationships between variables to be identified but causality cannot be established.

Research participants

The sampling strategy of this research study was non-probability convenience sampling. The sample was drawn from three organisations: a tourism company, travel agency and a company in the automotive industry. The choice of these companies was driven by our ability to access their employees, not as a result of any assumptions about the nature of these industries. The tourism company employed approximately 600 employees, the automotive company employed approximately 120 employees, and the travel agency employed 14 employees. Thus, the total population was $N = 734$. All employees across the three organisations were invited to participate in the study. Data were collected via an online link that was emailed to all employees in the three companies. A total of 678 employees answered the questionnaire. However, some responses were incomplete and excluded from the study. The final sample size was $N = 485$ (66% response rate). The demographic details of the sample are presented in Table 1.

Measuring instruments

The following measuring instruments were used to collect the data:

Psychological capital was measured using the 24 item PsyCap questionnaire developed by Luthans et al. (2007). Permission to use the scale was obtained from Mind Garden. Responses are recorded on a 6-point Likert scale ranging from one (strongly disagree) to six (strongly agree). A high score indicates high levels of PsyCap. This questionnaire has four subscales (self-efficacy, optimism, hope and resilience). Previous studies have confirmed the psychometric properties of the scale and its subscales both internationally (Luthans et al., 2007) and in South Africa (Görgens-Ekermans & Herbert, 2013).

Innovator's thinking was measured using a 13-item measure of innovative thinking developed by Barak et al. (2019). The

TABLE 1: Descriptive data for sample.

Variable	Frequency	Percentage (%)
Gender†		
Male	102	21
Female	376	77.5
I prefer not to say	4	0.8
Other	2	0.4
Age†		
20 and younger	3	0.6
21–30	102	22.1
31–40	188	38.8
41–50	132	27.2
51–60	34	7
60 and older	10	2.1
Race†		
African	165	34
Mixed race	72	14.8
Indian	48	9.9
White	193	39.8
Other	5	1
Marital status†		
Married	224	46.2
Divorced	46	9.5
Unmarried	211	43.5
Job level†		
Entry level	72	14.8
Intermediate	225	46.4
Junior management	54	11.1
Middle management	100	20.6
Upper management	15	3.1
Executive	8	1.6
Tenure: Position†		
Less than a year	72	14.7
More than a year, less than 5 years	153	31.4
More than 5 years, less than 8 years	62	12.8
More than 8 years, less than 10 years	48	9.7
10 Years or more	44	29.3
Tenure: Organisation†		
Less than a year	89	18.2
More than a year, less than 5 years	203	41.7
More than 5 years, less than 8 years	70	14.4
More than 8 years, less than 10 years	38	7.8
Ten years or more	83	16.9

Note: †, Not all participants answered this item.

scale was specifically developed to measure the Innovator's DNA Model. Responses are on a Likert type scale ranging from 'strongly disagree' to 'strongly agree'. A high score indicates high levels of innovative thinking. The questionnaire has four subscales (observing, questioning, networking and experimenting). Barak et al. (2019) established the validity of the scale and subscales through exploratory and confirmatory factor analysis (Barak et al., 2019). The innovative thinking subscales were found to have moderate to high internal consistency reliabilities – observing (0.79), questioning (0.73), networking (0.81) and experimenting (0.81). Barak et al.'s (2019) scale was developed for use with engineering students. Minor changes to the scale were therefore made for the purposes of this study, replacing the term 'learning' in all the items, with 'working'.

Although the innovator's thinking scale looked at the four aspects of the Innovator's DNA Model (observing, questioning, networking and experimenting), associating was not included. Thus, an additional subscale was used to measure associating – the 9-item associating subscale of the modes of problem-solving scale (Jabri, 1991). Responses are recorded on a 6-point Likert scale that ranging from one, ('extremely unlikely to enjoy') to six, ('extremely likely to enjoy'). A high score indicates high levels of associating. This measure has been used across a variety of studies and has been found to have high internal consistency reliability (0.83–0.87) (Gilson & Shalley, 2004; Jabri, 1991; Ko & Butler, 2006).

Innovative behaviour was measured using a self-report measure developed by Kleysen and Street (2001). This scale has 14 items and is answered on a 6-point Likert scale that ranges from one, which states 'never', to six, which states 'always'. These 14 items consisted of five innovative behaviours (opportunity exploration, application, generativity, championing and formative investigation). A high score indicates high levels of innovative behaviour. Kleysen and Street (2001) performed a factor analysis, which confirmed all the items of the scale loading onto one factor. This indicated the suitability of using an overall score. This measure was found to have very high internal consistency reliability (0.94) and good construct validity (Kleysen & Street, 2001). This measure has also been validated by De Jong and Den Hartog (2010), with high internal consistency reliability (0.83), and been used in South Africa (De Bruin & Steyn, 2019; Steyn, 2019). In a South African study, De Bruin and Steyn found a high reliability of 0.95 for the scale.

Research procedure and ethical considerations

Data were collected via a secure encrypted web link sent by the HR managers of all the companies that granted access for the study to all their employees. Informed consent was included for all participants.

Statistical analysis

Once the data collection was completed, the URL of the questionnaire was closed, and the data were downloaded onto an Excel spreadsheet. The data were then cleaned and assessed for any missing information or errors. Once the data were assessed, it were exported to the Statistical Package for Social Sciences (SPSS) computer program (IBM version 25, 2017) for analysis.

Once the factor structure was established, the reliabilities of all the scales were assessed and found to be acceptable (Cronbach's alpha above 0.6). Pearson's correlations and multiple regression analysis were then used to answer the remainder of the research questions. The variables were entered together into the multiple regression analysis in order to assess their combined impact on innovative behaviour.

Ethical considerations

Ethical clearance for this study was obtained from the University of the Witwatersrand Human Research Ethics Committee (non-medical), reference number: MORG/19/001 1H.

Results

Descriptive statistics were used to calculate the mean, standard deviation, minimum values and maximum values of the variables that were treated as interval data. Skewness and Kurtosis were also calculated to test if the responses were normally distributed, to determine if a non-parametric or parametric test should be used for the correlation and regression. The descriptive statistics for the variables in the study are presented in Table 2. The reliabilities for all the measures used in the study were also assessed – these are presented in Table 3.

Initially, Total PsyCap had a Skewness of -1.08 and Kurtosis of 4.23 , and Hope had a Skewness of -1.11 and Kurtosis of 3.54 . This indicated that Total PsyCap and Hope were not normally distributed. Thus, a log transformation was conducted, and it resulted in the coefficients falling in the required range of -1 and $+1$ (Table 2). Normality was also examined through histograms, which indicated that the variables were

approximately normally distributed. The reliability analyses indicated that all the measuring instruments had acceptably high alpha coefficients.

Once the assumption of normality and the reliability of the measuring instruments were established, Pearson correlations and multiple regression analyses were conducted to assess the relationship between PsyCap, innovative thinking and innovative behaviours. The correlations are presented in Table 4.

As seen in Table 4, all the correlations are significant and positive. Most of the correlations are moderate with some large correlations. The effect sizes (Table 5) for all the correlations with innovative behaviour were also calculated. The effect sizes indicated that self-efficacy explains 23% of the variability in innovative behaviour, hope explains 20%, optimism explains 17%, resilience explains 11% and total PsyCap explains 27% of the variability in innovative behaviour. With regard to innovation thinking, questioning explains 30% of the variance in innovative behaviour; networking explains 32%, experimenting explains 42%, associating explains 20% and in total innovative thinking explains a relatively high 49%.

The effect sizes (practical significance) of the correlations were calculated by squaring the correlation coefficients for all the correlation analyses. Table 5 indicates that Total PsyCap and total innovative thinking explain 27% and 49% of the variance in innovative behaviour, respectively. The PsyCap subscales of hope, optimism and resilience demonstrated a statistically significant relationship with innovative behaviour but the effect sizes were quite low – explaining 20%, 17% and 11% of the variance in innovative behaviour, respectively. The innovative thinking scales of questioning, networking, experimenting and associating were also found to be statistically significant in relation to innovative behaviour. They each explained between 20% (associating) and 42% (experimenting) of the variance in innovative behaviour.

Subsequent to the correlations, two multiple regression analyses were undertaken, one using the total PsyCap and total innovation thinking scales on innovation behaviour, the second using the subscales of the PsyCap and innovation thinking scales on innovation behaviour. The results are presented in Table 6 and Table 7.

The combined regression model of PsyCap and innovative thinking is statistically significant, $F(2, 482) = 259.31$, $p < 0.05$ (Table 6). This model accounts for 52% (a large effect size) (Field, 2009) of the variance of innovative behaviour. In combination, PsyCap and innovative thinking are both significant in predicting innovative behaviour.

The combined regression model of PsyCap and innovative thinking subscales is statistically significant, $F(9, 475) =$

TABLE 2: Descriptive statistics, skewness and kurtosis coefficients.

Variable	N	Min	Max	Mean	Standard deviation	Skewness coefficient	Kurtosis coefficient
PsyCap	485	1	6	4.74	0.52	-0.11	0.62
Self-efficacy	485	2	6	4.89	0.68	-0.16	-0.24
Hope	485	1	6	4.80	0.68	-0.15	0.23
Optimism	485	1	6	4.53	0.63	-0.27	0.38
Resilience	485	1	6	4.71	0.61	-0.23	0.30
Innovative behaviour	485	1	6	4.08	0.97	-0.64	-0.28
Innovative thinking	485	1	6	4.09	0.82	-0.37	0.42
Observing	485	1	6	4.45	0.89	-0.37	0.36
Questioning	485	1	6	4.26	1.03	-0.54	0.39
Networking	485	1	6	3.91	1.14	-0.37	-0.18
Experimenting	485	1	6	4.11	1.03	-0.31	0.39
Associating	485	1	6	4.16	0.81	-0.42	0.60

PsyCap, psychological capital.

TABLE 3: Reliability of measuring instruments.

Variable	Cronbach's alpha
Psychological capital	0.90
Self-efficacy	0.82
Hope	0.83
Optimism	0.71
Resilience	0.68
Innovative behaviour	0.95
Innovative thinking	0.93
Observing	0.87
Questioning	0.82
Networking	0.84
Experimenting	0.88
Associating	0.90

TABLE 4: Pearson’s correlation matrix.

Variable	Sub-variable	Self-efficacy	Hope	Resilience	Optimism	Total PsyCap	Total: innovators’ thinking	Observing	Question	Networking	Experimenting	Associating	Total: innovative behaviour
Self-efficacy	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>N</i>	485	-	-	-	-	-	-	-	-	-	-	-
Hope	-	0.612**	-	-	-	-	-	-	-	-	-	-	-
	Sig. (2-tailed)	< 0.001	-	-	-	-	-	-	-	-	-	-	-
Resilience	-	0.492**	0.502**	-	-	-	-	-	-	-	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	-	-	-	-	-	-	-	-	-	-
Optimism	-	0.462**	0.606**	0.477**	-	-	-	-	-	-	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	-	-	-	-	-	-	-	-	-
Total PsyCap	-	0.807**	0.854**	0.759**	0.789**	-	-	-	-	-	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	-	-	-	-	-	-	-	-
Total innovation thinking	-	0.479**	0.443**	0.323**	0.390**	0.512**	-	-	-	-	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	-	-	-	-	-	-	-
Observing	-	0.450**	0.447**	0.342**	0.396**	0.511**	0.805**	-	-	-	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	-	-	-	-	-	-
Question	-	0.382**	0.316**	0.254**	0.218**	0.367**	0.784**	0.589**	-	-	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	-	-	-	-	-
Network	-	0.392**	0.337**	0.247**	0.326**	0.408**	0.858**	0.540**	0.517**	-	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	-	-	-	-
Experiment	-	0.373**	0.388**	0.246**	0.354**	0.426**	0.855**	0.627**	0.565**	0.647**	-	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	-	-	-
Associating	-	0.315**	0.270**	0.298**	0.266**	0.358**	0.534**	0.424**	0.420**	0.440**	0.484**	-	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	-	-
Total: innovator’s behaviour	-	0.490**	0.429**	0.293**	0.387**	0.501**	0.743**	0.642**	0.543**	0.619**	0.658**	0.453**	-
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	-
	<i>N</i>	485	485	485	485	485	485	485	485	485	485	485	485

** , Correlation is significant at the 0.01 level (2-tailed).
PsyCap, psychological capital.

TABLE 5: Effect sizes for correlations with innovative behaviour.

Scale	Effect size
Total PsyCap	0.27
Hope	0.20
Optimism	0.17
Resilience	0.11
Total innovative thinking	0.49
Questioning	0.30
Networking	0.32
Experimenting	0.42
Associating	0.20

PsyCap, psychological capital.

TABLE 6a: Total psychological capital and total innovative thinking combined model.

<i>Df</i>	<i>F</i>	Sig (<i>p</i>)	Adjusted <i>R</i> ²
2	259.31	0.00	0.52
482	-	-	-

PsyCap, psychological capital.

TABLE 6b: Total psychological capital and total innovative thinking combined model.

Variable	Coefficients	
	<i>B</i>	Sig (<i>p</i>)
(Constant)	-0.32	0.23
Total PsyCap	0.18	0.00
Total innovative thinking	0.57	0.00

PsyCap, psychological capital.

72.69, *p* < 0.05 (Table 7). This model accounts for 57% (a large effect size) of the variance of innovative behaviour.

Self-efficacy was the only PsyCap construct that had a predictive effect on innovative behaviour. The innovative thinking subscales of observing, networking and experimenting were also found to have a predictive effect on innovative behaviour.

TABLE 7a: Psychological capital subscales and innovative thinking subscales combined model.

<i>Df</i>	<i>F</i>	<i>Sig (p)</i>	<i>Adjusted R²</i>
9	72.69	0.00	0.57
475	-	-	-

PsyCap, psychological capital.

TABLE 7b: Psychological capital subscales and innovative thinking subscales combined model.

Variable	Coefficients	
	<i>B</i>	<i>Sig</i>
(Constant)	-0.25	0.41
PsyCap subscales		
Self-efficacy	0.38	0.00
Hope	0.12	0.36
Optimism	0.09	0.48
Resilience	-0.09	0.49
Innovative thinking subscales		
Observing	1.17	0.00
Questioning	0.39	0.05
Networking	0.52	0.01
Experimenting	1.28	0.00
Associating	0.11	0.16

PsyCap, psychological capital.

Discussion

Outline of the results

To date, despite the popularity of Dyer et al.'s (2009) Innovator's DNA Model, there has been minimal research on this model. Dyer et al.'s original research, which led to the identification of the Innovator's DNA Model, was conducted over an extensive time-period with established, high-profile innovators, using a case study methodology. We aimed to extend Dyer et al.'s (2009) research by adding PsyCap to the potential predictors of innovative behaviour, as well as examining the relationships between the components of the innovator's DNA (innovative thinking) and innovative behaviour in a sample of ordinary employees.

The results supported the hypothesised relationships presented in Figure 1 – establishing that higher levels of PsyCap, together with higher levels of innovative thinking are associated with higher levels of innovative behaviour. These findings are in line with both the theoretical and empirical literature relating to both of the individual variables. What these findings suggest is that people who score high on PsyCap, have the confidence (self-efficacy), perseverance (hope and resilience) and belief in the future (optimism) that enables innovative behaviour. When tested in combination, however, only self-efficacy remained a significant predictor. Given that innovative behaviour, by definition, involves going beyond the safety of the status quo, the importance of this form of self-belief is key. Overall, these findings suggest that PsyCap, as a higher order construct, is a stronger predictor than the individual PsyCap components on their own; and of the individual components, self-efficacy is the key variable to address.

Innovative thinking also contributed to the variance in innovative behaviour, together with PsyCap. Like PsyCap,

innovative thinking as a total score predicted innovative behaviour better than its individual components. Separated into their component parts, observing, networking and experimenting were the three innovative thinking skills that remained significantly associated with innovative behaviour. Associating was not a significant predictor of innovative behaviour on its own, lending some support to Barak et al.'s (2019) contention that associating is not an innovative thinking skill on its own, and instead is an outcome of the four other innovative thinking skills. Additional research is needed to clarify the relationship between associating and the other thinking skills in order to fully interpret this finding. Questioning was the other innovation thinking skill that did not emerge as a significant predictor of innovative behaviour.

The findings from this study could only show associations rather than causality. They do however lend partial support to the role that the Innovator's DNA Model plays in innovative behaviour. People who regard themselves as observant, as willing to experiment, and take risks and to engage with people with differing views are more likely to report that they engage in innovative behaviour.

Practical implications

Both PsyCap and innovative thinking have been shown in previous research to be malleable and trainable. The current research found that both of these variables contribute significantly to the variance in innovative behaviour. Given that all innovations start with people engaging in innovative behaviours, managers seeking to create more innovative organisations, need to start by developing individual employees' PsyCap and innovative thinking. There is some evidence emerging (Luthans et al., 2006; Luthans et al., 2008) that PsyCap can be developed through micro-interventions to build hope, self-efficacy, resilience and optimism. Psychological capital interventions typically involve goalsetting processes, together with finding divergent pathways to meeting these goals (hope); building confidence in employees' ability to meet these goals (efficacy); recognising the obstacles are not pervasive and personal and can be overcome (optimism); and identifying personal and other resources for meeting these goals in the face of setbacks (resilience) (Lupşa et al., 2020). Recently, Corbu et al. (2021) found that micro coaching can also be used to build employees' PsyCap. What is useful about these interventions is that they do not require extensive time commitment and can be highly cost effective (Carter & Youssef-Morgan, 2022).

Innovative thinking skills can be developed in similar ways. They require conscious and intentional practice. Companies (or individual employees themselves) need to create innovation challenges and encourage employees to actively use their innovative thinking skills by interrogating their and others' assumptions about the challenge (questioning); paying close attention to those affected by the challenges (observation);

engaging with diverse stakeholders and others in relation to the challenges (networking); trying out different solutions to the challenge (experimenting) and combining the insights gained from the use of all these skills to create something new (associating).

This study has shown that a specific set of cognitive skills (innovative thinking) and psychological skills (PsyCap) together contribute to individuals' innovative behaviour in organisations. These specific skills were chosen for this study because they are not innate characteristics. They can be taught and developed. Based on the findings of the present study, developing employees' PsyCap and innovative thinking skills will contribute to increasing innovative behaviour in organisations.

Limitations and recommendations

There are three key limitations of this study. Firstly, the sample was very narrow – only two industries were included, and the sample was neither representative of these industries nor of the broader South African workforce. One recommendation for future research is to undertake this research in a broader spectrum of workplaces. Some industries, organisations and departments are more focused on innovation than others and it would be useful to compare these relationships and see if the model remains valid across different corporate entities and occupations. Secondly, the research design was of cross-sectional nature. The data were collected at one point in time, and it was therefore impossible to infer causality from the results. Future research could include more experimental, longitudinal designs, which include interventions to develop PsyCap and innovative thinking skills and assess whether innovative behaviour increases as a result. Thirdly, the data were of self-reporting nature. The data collection process was entirely reliant on the research participants' own estimation of their innovative behaviour. Future research could use more objective, measures (such as managers' performance evaluations in relation to innovation or innovative work behaviour [IWB] measuring instruments that have an employee and supervisor rating) to assess the impact of the variables on actual innovative behaviour.

The innovative thinking scale and its subscales have not been used in many previous studies.

Conclusion

The importance of innovation for organisational competitiveness and survival is difficult to overstate. This research has tested a model of innovative behaviour, which is an important construct in creating more innovative organisations. The findings of this study suggest that assisting employees to develop psychological skills (PsyCap) and cognitive skills (innovative thinking) is one way to improve innovative behaviour. Given the immense challenges facing the South African economy at present, it is hoped that this research can also provide a prompt for developing a South African knowledge base on innovation that is locally relevant.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

K.M.M. and N.C. have both contributed significantly to the work and preparation of the work, and they have seen and approved the content, authorship and affiliations and order of author representation.

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Data availability

The data that support the findings of this study are not openly available because of ethics requirement that only the researchers will have access to the data. Upon reasonable request with appropriate ethics permissions and guidelines in place, data will be shared.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

References

- Avey, J.B., Reichard, R.J., Luthans, F., & Mhatre, K.H. (2011). Meta-analysis of the impact of positive psychological capital on employee attitudes, behaviors, and performance. *Human Resource Development Quarterly*, 22(2), 127–152. <https://doi.org/10.1002/hrdq.20070>
- Babalola, S.S. (2009). Women entrepreneurial innovative behaviour: The role of psychological capital. *International Journal of Business and Management*, 4(11), 184–192. <https://doi.org/10.5539/ijbm.v4n11p184>
- Barak, M., Watted, A., & Haick, H. (2019). Establishing the validity and reliability of a modified tool for assessing innovative thinking of engineering students. *Assessment & Evaluation in Higher Education*, 45(2), 212–223. <https://doi.org/10.1080/02602938.2019.1620680>
- Carter, J.W., & Youssef-Morgan, C. (2022). Psychological capital development effectiveness of face-to-face, online, and micro-learning interventions. *Education and Information Technologies*, 27(5), 6553–6575. <https://doi.org/10.1007/s10639-021-10824-5>
- Corbu, A., Peláez Zuberbühler, M.J., & Salanova, M. (2021). Positive psychology micro-coaching intervention: Effects on psychological capital and goal-related self-efficacy. *Frontiers in Psychology*, 12, 566293. <https://doi.org/10.3389/fpsyg.2021.566293>
- De Bruin, G., & Steyn, R. (2019). The structural validity of the innovative work behaviour questionnaire: Comparing competing factorial models. *The Southern African Journal of Entrepreneurship and Small Business Management*, 11(1), 1–11. <https://doi.org/10.4102/sajesbm.v11i1.291>
- De Jong, J., & Den Hartog, D. (2010). Measuring innovative work behaviour. *Creativity and Innovation Management*, 19(1), 23–36. <https://doi.org/10.1111/j.1467-8691.2010.00547.x>
- Dyer, J.H., Gregersen, H.B., & Christensen, C. (2008). Entrepreneur behaviors, opportunity recognition, and the origins of innovative ventures. *Strategic Entrepreneurship Journal*, 2(4), 317–338. <https://doi.org/10.1002/sej.59>
- Dyer, J.H., Gregersen, H.B., & Christensen, C. (2009). *The innovator's DNA*. Retrieved from <https://hbr.org/2009/12/the-innovators-dna>
- Field, A. (2009). *Discovering Statistics using SPSS*. London: SAGE Publications.
- Fredrickson, B.L. (2013). Positive Emotions Broaden and Build. In P. Devine, & A. Plant (Eds.), *Advances in Experimental Social Psychology* Vol. 47 (pp. 1–53). Academic Press.
- Gilson, L.L., & Shalley, C.E. (2004). A little creativity goes a long way: An examination of teams' engagement in creative processes. *Journal of Management*, 30(4), 453–470. <https://doi.org/10.1016/j.jm.2003.07.001>

- Görgens-Ekermans, G., & Herbert, M. (2013). Psychological capital: Internal and external validity of the Psychological Capital Questionnaire (PCQ-24) on a South African sample. *SA Journal of Industrial Psychology*, 39(2), 1–12. <https://doi.org/10.4102/sajip.v39i2.1131>
- Jabri, M.M. (1991). The development of conceptually independent components in the measurement of modes of problem solving. *Educational and Psychological Measurement*, 51(4), 975–983. <https://doi.org/10.1177/001316449105100417>
- Jafri, M.H. (2012). Psychological capital and innovative behaviour: An empirical study on apparel fashion industry. *Journal of Contemporary Management Research*, 6(1), 42.
- Kleysen, R.F., & Street, C.T. (2001). Toward a multi-dimensional measure of individual innovative behavior. *Journal of Intellectual Capital*, 2(3), 284–296. <https://doi.org/10.1108/eum000000005660>
- Ko, S., & Butler, J.E. (2006). Prior knowledge, bisociative mode of thinking and entrepreneurial opportunity identification. *International Journal of Entrepreneurship and Small Business*, 3(1), 3. <https://doi.org/10.1504/ijesb.2006.008659>
- Lupşa, D., Vîrğa, D., Maricuţoiu, L.P., & Rusu, A. (2020). Increasing psychological capital: A pre-registered meta-analysis of controlled interventions. *Applied Psychology*, 69(4), 1506–1556. <https://doi.org/10.1111/apps.12219>
- Luthans, F. (2002). Positive organizational behavior: Developing and managing psychological strengths. *Academy of Management Perspectives*, 16(1), 57–72. <https://doi.org/10.5465/ame.2002.6640181>
- Luthans, F., Avey, J.B., Avolio, B.J., Norman, S.M., & Combs, G.M. (2006). Psychological capital development: Toward a micro-intervention. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, 27(3), 387–393. <https://doi.org/10.1002/job.373>
- Luthans, F., Avey, J.B., & Patera, J.L. (2008). Experimental analysis of a web-based training intervention to develop positive psychological capital. *Academy of Management Learning & Education*, 7(2), 209–221. <https://doi.org/10.5465/ame.2008.32712618>
- Luthans, F., Avolio, B.J., Avey, J.B., & Norman, S.M. (2007). Positive psychological capital: Measurement and relationship with performance and satisfaction. *Personnel Psychology*, 60(3), 541–572. <https://doi.org/10.1111/j.1744-6570.2007.00083.x>
- Luthans, F., & Youssef, C.M. (2004). Human, social, and now positive psychological capital management. *Organizational Dynamics*, 33(2), 143–160. <https://doi.org/10.1016/j.orgdyn.2004.01.003>
- Luthans, F., & Youssef, C.M. (2007). Emerging positive organizational behavior. *Journal of Management*, 33(3), 321–349. <https://doi.org/10.1177/0149206307300814>
- Luthans, F., Youssef, C.M., & Rawski, S.L. (2011). A tale of two paradigms: The impact of psychological capital and reinforcing feedback on problem solving and innovation. *Journal of Organizational Behavior Management*, 31(4), 333–350. <https://doi.org/10.1080/01608061.2011.619421>
- Nolzen, N. (2018). The concept of psychological capital: A comprehensive review. *Management Review Quarterly*, 68(3), 237–277. <https://doi.org/10.1007/s11301-018-0138-6>
- Sheldon, K.M., & King, L. (2001). Why positive psychology is necessary. *American Psychologist*, 56(3), 216–217. <https://doi.org/10.1037/0003-066x.56.3.216>
- Steyn, R. (2019). Proactive personality in the workplace and its relevance in South Africa. *African Journal of Hospitality*, 8(3), 1–12.
- Yan, D., Wen, F., Li, X., & Zhang, Y. (2020). The relationship between psychological capital and innovation behaviour in Chinese nurses. *Journal of Nursing Management*, 28(3), 471–479. <https://doi.org/10.1111/jonm.12926>