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Gender differences in the relationship between innovation and its antecedents

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Purpose: The aim of this study was to go beyond measurement invariance and assess whether innovation and its antecedents relate to each other in the same way for men as for women when using measurement invariant instruments.

Design/methodology/approach: The sample represents 52 South African organisations, with 60 employees from each, amounting to 3143 respondents, of which 56.4% were men and 43.6% women. Four instruments, of which the measurement invariance across gender has been determined, were included in the study. The relationship between innovation and its antecedents was assessed by performing both correlation and regression analyses for men and women separately, and comparing the findings. Thereafter, gender was introduced as moderator between innovation and its antecedents.

Findings/results: The results reveal that the relationships between innovation and its antecedents do not differ practically across gender, nor does gender moderate the relationship between these variables.

Practical implications: Although gender and gender diversity are often associated with innovation, this research reveals that gender does not alter the way the antecedents to innovation influence innovation at an individual level.

Originality/value: Through applying quantitative and sophisticated methodologies this research contributes to an evidence-based debate on gender in the workplace.

Keywords: Gender; innovation; psychometrics; differences; innovative work behaviour.

Background

The facilitating role of gender diversity in innovation is generally accepted, although empirically unresolved, as some researchers have found a link between gender diversity and innovation (PR Newswire US, 2013; Ruiz-Jiménez, Fuentes-Fuentes, & Ruiz-Arroyo, 2014), while others suggest that such findings are context specific (Parrotta, Pozzoli, & Pytlikova, 2014), 'neither direct nor definitive' (McMahon, 2010, p. 44). Others, meanwhile, report that groups of women 'were no more innovative than all-male teams, nor were there any significant differences in the variety of alternative solutions' they produced (Fila & Purzer, 2014, p. 1405). Some researchers argue that the 'diversity can be either conducive or detrimental to team innovation' (Mitchell & Boyle, 2015, p. 873), while Fernández (2015) and Sastre (2014) posit that an inverted-U relationship exist between gender diversity and innovation outputs, but did not find this under all circumstances. The prevalence of mixed findings from diversity studies implies that the business case for the benefits of diversity is not conclusive (Tatli, 2011; Wentling, 2004).

This research is not about gender diversity, but rather about a more contentious issue – that of the differences between men and women actors when engaging in innovation. Previous innovation research has focused on gender differences regarding characteristics and motivations, leadership style, strategic choices, obstacles and results (Pablo-Martí, García-Tabuenca, & Crespo-Espert, 2014). Sonfield, Lussier, Corman and McKinney (2001) state that results of prior research pertaining to gender and innovation are mixed, as is the case with gender diversity. Differences were found on some aspects, such as motivations and intentions, (Pablo-Martí et al., 2014; Sánchez-Escobedo, Díaz-Casero, Díaz-Aunión, & Hernández-Mogollón, 2014), overall satisfaction (Sonfield et al., 2001), commitment to product and service innovation (Pablo-Martí et al., 2014) and resilience (Cañizares & García, 2010). On other aspects, such as the strategies applied (Sonfield et al., 2001) and reasons for success and survival (Pablo-Martí et al., 2014), men and women reported substantially in the same manner. Lee and Marvel (2014) question past research findings which have reported gendered outcomes, and conclude that resource and context characteristics fully

mediate the gender-innovation relationship. On the other hand, Kvidal and Ljunggren (2014) confidently report that gender is a non-issue in terms of innovation.

Important to this study is the measurement of innovation and the antecedents thereto. Assessment may play an important role in gender research, as gender is significant in how profiles are perceived (Sánchez-Escobedo, Díaz-Casero, Hernández-Mogollón, & Postigo-Jiménez, 2011). Alsos, Ljunggren and Hytti (2013) claim that, when analysing gender and innovation, it is possible to interpret innovation as a gender-biased phenomenon. When using a gender-aware operationalisation of innovation, no significant difference in innovativeness was found between men and women (Nählinder, Tillmar, & Wigren, 2015). Research on innovation should consider the gender neutrality of the operationalisation used in the study (Nählinder et al., 2015), and Alsos et al. (2013) state that it is imperative to develop and apply new methodological approaches, as well as new operationalisations of innovation and innovators.

This research will focus on such new methodologies. It will not attempt to produce gender-aware operationalisation versions of the standardised measures used in this study, but will rather seek assurance that the measures used are measurement invariant. Measurement invariance (MI) reflects the extent to which an observed score on a measurement is reflective of an individual's standing on a construct, independent of their group membership (Mellenbergh, 1989; Meredith, 1993; Meredith & Millsap, 1992; Wu, Li, & Zumbo, 2007). Once MI is achieved, substantive gender-based comparisons resulting from the measurement should be done (Salzberger, Newton, & Ewing, 2014).

In this research, gender differences in the relationship between innovation and its antecedents will be assessed, making use of instruments tested to be measurement invariant. This type of research is rare in the organisational behaviour domain, and although gender is often included as a variable in studies (Eagly, Johannesen-Schmidt, & Van Engen, 2003; Reuvers, Van Engen, Vinkenburg, & Wilson-Evered, 2008), only a few researchers engage with the matter of MI (Xu, Wubbena, & Stewart, 2016) before conducting further analyses. In some studies, such as the study conducted by Steyn and De Bruin (2020), it was found that often used measurement instruments are not gender-neutral. The study aims to contribute to management science by specifying the importance of the gender of individual employees when facilitating innovation within the organisation and when applying managerial actions such as implementing the most suitable leadership style and human resources practices, and creating an organisational climate conducive to innovation.

Literature review

Innovation in the workplace, which could be described as the propensity of an organisation to deviate from conventional industry practices by creating or adopting new products, processes or systems (Overstreet, Hanna, Byrd, Cegielski, & Hazen, 2013), is an essential component for competitiveness and survival (Gunday, Ulusoy, Kilic, & Alpkan, 2011), and considered by many scholars as one of the most important determinants of firm performance (Adegoke, Walumbwa, & Myers, 2012; Durán-Vázquez, Lorenzo-Valdés, & Moreno-Quezada, 2012; Grant, 2012). From a managerial perspective, it is important to identify the antecedents to innovation, differentiate between important and less important drivers of innovation, and manage these drivers in an effective manner (Bigliardi, 2013; Ndregjoni & Elmazi, 2012). According to Yen (2013), the facilitation of innovation is an essential management function of managers, as it is interconnected with organisational performance.

Research findings on the antecedents to innovation within organisations are readily available. Reports indicate that the nature of human resource management (HRM) practices (Sanz-Valle & Jiménez-Jiménez, 2018; Veenendaal, 2015) could predict innovation. Leadership (Atitumpong & Badir, 2017; De Jong & Den Hartog, 2007; Scott & Bruce, 1994) and specific leadership styles (Reuvers et al., 2008; Vargas, 2015) have also been linked to innovation. Along similar lines, organisational culture and climate has been linked to innovation (Baer & Frese, 2003; Goodale, Kuratko, Hornsby, & Covin, 2011; Hornsby, Kuratko, & Zahra, 2002; Lukes & Stephan, 2017; Sethibe & Steyn, 2016). More complex models, involving leadership style, climate and innovation (Sarros, Cooper, & Santora, 2008; Sethibe & Steyn, 2018), HRM, organisational culture and innovation (Al-Bahussin & Elgaraihy, 2013; Fellnhofer, 2018) have been tested, linking these variables.

Within the organisational behaviour context, 'literature on diversity in organisations is limited' and more specifically to this study, 'even fewer studies investigate its impact on innovation' (Díaz-García, González-Moreno, & Sáez-Martínez, 2013, p. 149). Although there seems to be consensus in the literature that certain antecedents drive innovation, the research on this relationship involving or including gender is limited (Eagly et al., 2003; Reuvers et al., 2008). This scarcity of research focusing on gender is widespread in academic publishing, but peculiar 'given the centrality of gender in human life' (Byrne, 2015, n.p.). Most of the research on the antecedents to innovation is void from an individual gender angle. This is worrisome, as gender is often associated with innovation in organisations (Nählinder et al., 2015). An exception to this may be the research of Reuvers et al. (2008) which reports a positive and significant relationship between transformational leadership and innovative work behaviour, and that the gender of the manager moderated the latter relationship, with employees being more innovative when the transformational leadership is displayed by men, compared to women managers. Mahto, McDowell, Kudlats, and Dunne (2018) found that the gender of the manager did not moderate antecedent-innovation relationships, nor did Pretorius, Millard, and Kruger (2005) find any gender moderation. In none of these cases was MI considered. Within the innovation domain, only the previously mentioned Xu

et al. (2016) conducted MI analyses before comparing groups, which is the approach to be followed in this research.

In summarising the present literature on antecedents to innovation, it could be said that a multitude of studies specify these variables, and in many cases specify the importance of each variable relative to others. However, research focusing on the gender of those employees who are to be influenced to act innovatively is sparse. This sparsity of research linking antecedents to innovation and also including a gender angle – and specifically the dearth of gender-related MI in such studies – explains the length of this literature review, as well as the importance of conducting original research of this nature.

Theoretical stance

From a meta-theoretical perspective critical rationalism is at the core of this research, where the researcher starts off with a biased idea (men and women react in the same manner), and tests this idea to confirm or reject its truth (Higgs & Smith, 2006). The notion of the bias idea is that of relativism (Adamopoulos & Lonner, 1994), where correspondence in human experiences of the world is denied. Given this stance, even after finding an answer, true scientists will remain sceptical of the findings, and will guard against falsificationism (see Hung, 1997).

At a theoretical level, general systems theory is applicable, which emphasises 'wholeness' and systems which work as a unit of integrated parts (Von Bertalanffy, 1968), incorporative of input-throughput-output reasoning (Kast & Rosenzweig, 1972), where antecedents influence outcomes (see Wright & McMahan, 1992; Wright & Snell, 1998) and a feedback loop where outcomes in turn influence antecedents (see Kast & Rosenzweig, 1972; Von Bertalanffy, 1968). It is a deterministic model (Teece, 2018), as systems and subsystems inevitably respond to each other, and where any change in the system has a knock-on effect across the system (Dostal, Cloete, & Jaros, 2007). In this research such an interchange between gender, antecedents to innovation and innovative work behaviour is thus assumed, and workplace behaviour is perceived as a 'network or system of sequential and interdependent decisions' (Cascio & Aguinis, 2014, p. 43). The systems theory is preferred above behavioural or resource-based theories, as these archetypally describe closed systems and use simple linear processes to link inputs to outputs (Shin & Konrad, 2017).

Method

A cross-sectional survey design was used to collect quantitative data. In this section, the population and sampling, the instruments for collecting data, as well as the way the data were analysed, are discussed.

Population and sampling

The population targeted all employees in South Africa. Conveniently, 52 organisations were sorted to participate in the study. In each of the organisations, random samples were drawn until complete data from 60 respondents were collected. The organisations selected included a broad spectrum of government and private sector organisations, each with more than 60 employees. Both men and women were represented adequately in the sample and details in this regard are presented in the findings section.

Measurement instruments

Seven instruments were administered, namely the Brief Corporate Entrepreneurship Assessment Instrument (BCEAI) (Hornsby et al., 2002; Strydom, 2013), the Human Resources Practices Scale (HRPS) (Nyawose, 2009; Steyn, 2012), the Multifactor Leadership Questionnaire (MLQ) (Avolio, Bass, & Jung, 1995, 1999), the Individual Pro-activeness (IPA) (Bateman & Crant, 1993), employee engagement (UWES-9) (Schaufeli, Bakker, & Salanova, 2006), Organizational Commitment Scale (OCS) (Allen & Meyer, 1990) and the innovative work behaviour (IWB) (Kleysen & Street, 2001). After testing for measurement invariance across gender (see Steyn & De Bruin, 2020), only the BCEAI, HRPS, MLQ and the IWB were retained as these instruments showed measurement invariance. A short description of each of the retained instruments is presented below.

The CEAI was developed by Hornsby et al. (2002), who are important authors with regard to the conceptualisation and measurement of an organisational climate associated with innovation in the workplace. They developed a 48-item questionnaire to assess five factors that influence innovation in the workplace: level of management support, work discretion or autonomy, rewards and reinforcement, time availability and organisational boundaries (Hornsby et al. 2002). Strydom (2013) developed a brief version of the instrument, using only 20 items, four per factor. Strydom reports alphas of 0.731, 0.825, 0.742, 0.689 and 0.574 for the subscales and a reliability coefficient of 0.810 for the entire instrument. Strydom also reports information on the predictive validity of the instrument. Steyn and De Bruin (2018b) were able to replicate the factorial structure as proposed by Strydom across gender (equal latent means invariance; CFI = 0.91 and RMSEA = 0.043). They report the Cronbach's alpha for the total questionnaire to be 0.762, with 0.762 for men and 0.755 for women.

The HRPS (Nyawose, 2009) was developed on a rational basis by examining the literature on different HRM practices. Seven HRM practices were measured in this study, and the questionnaire consisted of 21 items. The HRPS has a hierarchical structure, with each of the seven factors consisting of three items. The factors are training and development, remuneration, performance management, supervisor support, staffing, diversity management and communication. Nyawose (2009) reported reliabilities varying from 0.74 to 0.93, while Steyn (2012) reported Cronbach's alphas of 0.74–0.88. Nyawose and Steyn both report results pertaining to the predictive validity of the

HRPS. Steyn and De Bruin (2018a) were able to replicate the factorial structure as proposed by both Nyawose and Steyn across gender (equal latent means invariance; CFI = 0.97 and RMSEA = 0.042), and report reliabilities for the seven scales which were 'uniformly satisfactory and similar across men and women', varying from 0.735 to 0.845 for men and from 0.710 to 0.853 for women.

The MLQ (Avolio et al., 1995, 1999) is one of the most frequently used measures of leadership styles (Lowe, Kroeck, & Sivasubramaniam, 1996) and measures transformational, transactional and laissez-faire leadership styles using 21 items. Dumdum, Lowe, and Avolio (2002) report acceptable reliability and validity for the MLQ in their meta-analysis, Ridder (2015), also following a meta-analysis, reports that that the MLQ shows a 'consistent pattern of results [and] is reassuring considering the results are similar across time, not tied to one particular version of the MLQ or influenced by particular outcome variables' (p. 25). Steyn and De Bruin (2020) were able to replicate the differentiated leadership types as proposed in the MLQ across gender (equal latent means invariance; CFI = 0.92 and RMSEA = 0.070), and report acceptable Cronbach's alphas of 0.942 (men) and 0.952 (women) for transformational leadership, 0.821 (men) and 0.831 (women) for transactional leadership and low reliability for the laissez-faire leadership style, with 0.530 for men and 0.570 for women.

The 14 IWB items present elements descriptive of individual innovation, namely opportunity exploration, generativity, information investigation, championing and application (Kleysen & Street, 2001). Hebenstreit (2003) reports an alpha of 0.948 when using all the items. Lu and Li (2010) could not replicate a five-factor structure, and report Cronbach's alpha values of 0.860 for the two factors they extracted. Wojtczuk-Turek and Turek (2013) also report on a two-factor solution, with values of 0.880 and 0.890. Although empirical support for the theorised structure was mixed, Kleysen and Street (2001) suggest the use of the items as a single measure of innovation behaviour, as did Hebenstreit (2003). Steyn and De Bruin (2019) were able to replicate the five-factor structure of IWB as proposed by Kleysen and Street. Steyn and De Bruin (2020) also demonstrated that the measure was invariant across gender (equal latent means invariance; CFI = 0.973 and RMSEA = 0.057) and report alphas coefficients of 0.947 (men) and 0.954 (women).

The instruments included in these analyses were selected on the basis that they were measurement invariant across gender. It is important to note that the IPA (Bateman & Crant, 1993), UWES-9 (Schaufeli et al., 2006) and OCS (Allen & Meyer, 1990) did not show MI. Instruments biased in the way they assess the selected antecedents to innovative work behaviour were thus excluded.

Statistical analyses

As stated above, the instruments included in these analyses were selected on the basis that they were measurement invariant across gender in this sample. Thus, no test of MI was performed here. The focus of the analyses was on gender differences in the way the MI variables relate to each other, specifically with IWB as an outcome. Three types of analyses were performed.

Firstly the correlation between the independent variables and IWB was calculated for both men and women. *Z*-observed scores were calculated to determine if these correlations differ significantly from each other. *Z*-observed = $(Z_1–Z_2)$/ square root of $[(1/N_1–3) + (1/N_2–3)]$, with Z_1 and Z_2 the *Z*-scores for the correlation and N_1 and N_2 the size of Group 1 and Group 2 (Field, 2009). In this case, Group 1 would be men and Group 2 women. *Z*-observed scores between (+/–) 1.64 and 1.96 are indicative of significant differences in the correlations at $p < 0.05$, and *Z*-observed scores higher than (+/–) 1.96 are indicative of a significant between the correlations at $p < 0.01$ (Pallant, 2013). When Z-observed scores are thus smaller than (+/–) 1.64, it will be assumed that the differences in the correlations are not significant.

Using SPSS-25 (IBM SPSS Statistics, 2017), regression analyses were performed, where the subcomponents of the different measures were used as predictors of IWB, splitting the file along gender lines. Here, the aim was to test if the models fitted equally well for men and women (considering the coefficient of determination – R^2), and to identify possible differences in the extent to which the subcomponents predict IWB along gender lines. An R^2 greater than 0.02 was deemed a significant difference. Subcomponents were deemed similar when the significance of the loadings was similar. As the sample sizes are relatively large ($N > 1000$), the more stringent cut-off of 0.01 for p was used to indicate significance.

Moderation was tested as per the procedures suggested by MacKinnon (2010). This involves doing a regression without including the moderator as a variable in the regression (Model 1), and only then adding the moderator (gender; Model 2), and finally adding the moderator and the interaction effect (predictor variable × moderator; Model 3). In general, the interest is in ΔR^2, using Model 1 as a baseline model. If ΔR^2 is positive and significant across models, this suggests improved models, and the specific importance of adding the additional variable. In the later models, the significance of the beta values is interpreted. Should gender directly predict IWB (Model 2), this is indicative of a direct effect, making it an antecedent to IWB. This also implies that the intercepts of the regression lines differ per gender. Should the interaction between gender and any subcomponent be significant (Model 3), this is indicative of gender moderating the relationship between that subcomponent and IWB. This implies that the slopes of regression lines differ per gender. ΔR^2 greater than 0.02 and beta scores with p less than 0.01 were considered significant.

Ethical consideration

This article followed all widely accepted ethical standards for conducting this type of research. Ethical clearance number: 2014_SBL_018_CA dated 27 February 2014.

Results

Demographics

Data were collected from 1773 men and 1370 women, across more than 52 organisations. The respondents were representative of all racial and/or ethnic groups in South Africa, with a mean age of 37.8 years (standard deviation 9.1). The mean for tenure was 9.0 years (standard deviation 7.5). The pool of respondents was heterogeneous, including diversity regarding gender, race, age and tenure, and relatively free from any particular context, which would make them appropriate for use in assessing bias and equivalence (Els, Mostert, & Brouwers, 2016).

Mean scores and mean score differences

Mean scores and mean score differences are presented in Table 1. The most significant difference in mean scores was found at IWB, with a mean difference of 2.631 ($t(3141) = 5.572$, $p < 0.001$) in favour of men, which represents 20% of one standard deviation (Cohen $d = 0.200$). Mean differences were also found at CEAIF1, with a mean difference of 0.228 ($t(3141) = 2.108$, $p = 0.035$), which represents 7.5% of one standard deviation (Cohen $d = 0.075$). Lastly, a significant mean difference was found at CEAITOTAL, with a mean difference of 0.671 ($t(3141) = 2.017$, $p = 0.044$), representing a 7.2% difference between mean scores (Cohen $d = 0.072$). In all the mentioned cases, men achieved higher scores than women.

It can be noted that, in three cases, mean differences between men and women were significant. As these measures showed measurement across gender, these differences could be seen as actual differences in the levels on which men and women perceive the prevalence of the specified constructs.

Reliability

The Cronbach's alpha reliability coefficients for IWB were 0.947 for men and 0.954 for women. With LSTForm they were 0.942 and 0.952, for LSRSact 0.821 and 0.831, and for LSLFair they were 0.530 and 0.570, listing the figure for the men first and then for the women. For HRTOTAL, the coefficients were 0.928 and 0.931 and for CEAITOTAL they were 0.762 and 0.755. The reliability coefficients for the men and the women were very similar and, with the exception of CEAITOTAL, marginally better for women.

Correlation coefficients

Table 2 presents the correlation between the independent variables and IWB, behaviour per gender, differences in the size of these correlations and the *Z*-observed scores, which were used to assess if these differences were practically significant.

From Table 2, it can be observed that, with the exception of CEAIF4, all the variables correlated significantly with IWB, irrespective of gender. When considering the Z-observed scores, not one exceeded the (+/–) 1.64 cut-off, indicating that the correlations between the individual variables and IWB did not differ significantly along gender lines.

TABLE 1: Mean scores and mean differences, as per Cohen *d*-values, per gender.

Test	Men		Women		Mean difference	Cohen's *d*
	Mean	Standard deviation	Mean	Standard deviation		
1. IWB	54.179	13.105	51.548	13.158	2.631	0.200†
2. LSTForm	2.316	0.871	2.336	0.912	-0.020	-0.022
3. LSTSact	2.523	0.975	2.488	1.020	0.035	0.035
4. LSLFair	2.180	0.831	2.235	0.874	-0.055	-0.064
5. HRG1T&D	11.367	3.130	11.311	2.949	0.036	0.011
6. HRG2Rem	9.025	3.091	8.961	3.148	0.064	0.020
7. HRG3Pm	9.992	2.787	9.961	2.759	0.031	0.011
8. HRG4Sup	10.583	2.889	10.520	2.967	0.063	0.021
9. HR5App	10.115	2.696	10.069	2.915	0.046	0.016
10. HR6Div	10.18	2.670	10.175	2.664	0.005	0.001
11. HR7Comm	10.100	2.943	10.040	2.898	0.060	0.020
12. HRTOTAL	71.366	15.363	71.039	16.194	0.327	0.020
13. CEAIF1	12.837	3.023	12.609	3.007	0.228	0.075†
14. CEAIF2	13.671	3.433	13.445	3.379	0.226	0.066
15. CEAIF3	13.397	3.148	13.322	3.053	0.075	0.024
16. CEAIF4	11.183	3.000	11.039	3.105	0.144	0.047
17. CEAIF5	14.98	2.505	14.981	2.724	-0.001	-0.001
18. CEAITOTAL	66.069	9.320	65.398	9.175	0.671	0.072†

CEAIF1, management support; CEAIF2, work discretion or autonomy; CEAIF3, rewards and reinforcement; CEAIF4, time availability; CEAIF5, organisational boundaries; IWB, innovative work behaviour; LSLFair, Laissez-faire leadership; LSTForm, transformational leadership; LSTSact, transactional leadership; HRG1T&D, training and development; HRG2Rem, remuneration; HRG3Pm, performance management; HRG4Sup, supervisor support; HR5App, staffing; HR6Div, diversity management; HR7Comm, communication; HRM, human resource management.

†, practically significant differences in mean scores.

TABLE 2: The correlation between various variables and innovative work behaviour.

Test	Men ($N = 1773$)	Women ($N = 1370$)	Difference in *r*	*Z*-observed
Leadership style				
LSTForm	0.262*	0.236*	0.026	0.722
LSTSact	0.257*	0.259*	-0.002	-0.055
LSLFair	0.066*	0.100*	-0.034	-0.944
PRM practices				
HRG1T&D	0.281*	0.224*	0.057	1.583
HRG2Rem	0.244*	0.240*	0.004	0.111
HRG3Pm	0.270*	0.216*	0.054	1.499
HRG4Sup	0.239*	0.207*	0.032	0.888
HR5App	0.293*	0.246*	0.047	1.305
HR6Div	0.253*	0.216*	0.037	1.027
HR7Comm	0.279*	0.225*	0.054	1.499
Innovation climate				
CEAIF1	0.255*	0.200*	0.055	1.527
CEAIF2	0.208*	0.189*	0.019	0.527
CEAIF3	0.209*	0.233*	-0.024	-0.666
CEAIF4	0.035	–0.012	0.047	1.305
CEAIF5	0.168*	0.159*	0.009	0.249
Complex model				
LSTForm	0.262*	0.236*	0.026	0.722
LSTSact	0.257*	0.259*	-0.002	-0.055
LSLFair	0.066*	0.100*	-0.034	-0.944
HRTOTAL	0.349*	0.296*	0.053	10.471
CEAITOTAL	0.288*	0.256*	0.032	0.888

CEAIF1, management support; CEAIF2, work discretion or autonomy; CEAIF3, rewards and reinforcement; CEAIF4, time availability; CEAIF5, organisational boundaries; LSLFair, Laissez-faire leadership; LSTForm, transformational leadership; LSTSact, transactional leadership; HRG1T&D, training and development; HRG2Rem, remuneration; HRG3Pm, performance management; HRG4Sup, supervisor support; HR5App, staffing; HR6Div, diversity management; HR7Comm, communication; HRM, human resource management.

*, Correlation is significant at the 0.01 level (two-tailed).

Regression analyses

The results of regression analyses with IWB as outcome, per gender, are presented in Table 3.

From the table, it is evident that, in all cases, the model fit was numerically better for men than women, as reflected in the R^2 values, which were larger for men than for women. The largest difference between R^2 values was found with HRM practices (R^2_{Men} = 0.124; R^2_{Women} = 0.087; $R^2_{Difference}$ = 0.037), which thus predicted 3.7% more of the variance in IWB for men than for women. The model fit of the complex model, where the leadership styles and the total scores for HRM practices and innovation climate were included, was also significantly better for men (R^2_{Men} = 0.142; R^2_{Women} = 0.111; $R^2_{Difference}$ = 0.031). Should we use the criteria set by MacKinnon (2010) for fit improvement ($\Delta R^2 > 0.02$; thus more than a 2% change), it should be assumed that these models fit men better than they do women.

Considering the subcomponents of the different models, and thus the significant beta values in Table 3, it is very interesting to note that transformational leadership was the primary driver for innovation for men, while it was transactional leadership for women. With HRM practices, the same subcomponents predicted IWB specifically and uniquely. Considering innovation climate, the subcomponents had similar values, with CEAIF5 being the exception, where it contributed uniquely to the variance for men, but not for women. Lastly, in the complex model, the predictors operated similarly across gender lines.

Moderation analyses

Models to demonstrate the effects of gender on the antecedents-IWB relationship are presented in Table 4. The models without gender or moderation tests are presented first, followed by the model including gender, and the moderation model is presented last.

Most important in interpreting the findings in Table 4 are the changes in the effectiveness of the different models, as reflected in ΔR^2. MacKinnon (2010) suggests that an improved fit occurs when ΔR^2 is greater than 0.02. This did not occur with any of the models that introduced gender. Given this criterion, gender is not a moderator in any of the antecedent-IWB relationships.

Also important in interpreting the findings in Table 4 are significant beta values for gender in Model 2, as well as gender or the interaction terms in Model 3. It can be observed that in all Model 2 cases, gender was a significant predictor of IWB, suggesting that gender is a predictor of IWB, thus an antecedent and not a moderator. Considering

TABLE 3: Regression analyses with innovative work behaviour as outcome.

Test	Men					Women				
	Standard Beta	*T*	*p*	R^2	*F*	Standard Beta	*t*	*p*	R^2	*F*
Leadership style	-	-	< 0.001	0.074	(3, 1769) = 48.17	-	-	< 0.001	0.066	(3, 1366) = 33.14
Constant	-	45.647	< 0.001***	-	-	-	39.238	< 0.001***	-	-
LSTForm	0.170	3.905	< 0.001***	-	-	0.049	0.934	0.350	-	-
LSTSact	0.136	3.112	0.002**	-	-	0.224	4.216	< 0.001***	-	-
LSLFair	-0.056	-2.241	0.025	-	-	-0.017	-0.591	0.554	-	-
HRM practices	-	-	< 0.001	0.124	(7, 1765) = 36.93	-	-	< 0.001	0.087	(7, 1362) = 19.71
Constant	-	22.519	< 0.001***	-	-	-	19.188	< 0.001***	-	-
HRG1T&D	0.127	4.622	< 0.001***	-	-	0.093	2.986	0.003**	-	-
HRG2Rem	0.035	1.171	0.242	-	-	0.094	2.548	0.011	-	-
HRG3Pm	0.028	0.800	0.424	-	-	-0.014	-0.353	0.724	-	-
HRG4Sup	0.042	1.472	0.141	-	-	0.062	1.929	0.054	-	-
HR5App	0.128	4.289	< 0.001***	-	-	0.101	2.862	0.004**	-	-
HR6Div	0.029	0.965	0.335	-	-	0.026	0.721	0.471	-	-
HR7Comm	0.075	2.304	0.021	-	-	0.036	0.958	0.338	-	-
Innovation climate	-	-	< 0.001	0.096	(5, 1767) = 38.84	-	-	< 0.001	0.084	(5, 1364) = 26.09
Constant	-	12.824	< 0.001***	-	-	-	11.413	< 0.001***	-	-
CEAIF1	0.164	6.353	< 0.001***	-	-	0.106	3.692	< 0.001***	-	-
CEAIF2	0.123	5.113	< 0.001***	-	-	0.105	3.772	< 0.001***	-	-
CEAIF3	0.091	3.587	< 0.001***	-	-	0.148	5.033	< 0.001***	-	-
CEAIF4	-0.021	-0.930	0.352	-	-	-0.049	-1.890	0.059	-	-
CEAIF5	0.078	3.272	0.001**	-	-	0.071	2.556	0.011	-	-
Complex model	-	-	< 0.001	0.142	(5, 1767) = 58.44	-	-	< 0.001	0.111	(5, 1364) = 34.07
Constant	-	12.132	< 0.001***	-	-	-	10.553	< 0.001***	-	-
LSTForm	0.085	2.001	0.046	-	-	-0.007	-0.128	0.898	-	-
LSTSact	0.018	0.426	0.670	-	-	0.126	2.363	0.018	-	-
LSLFair	-0.045	-1.859	0.063	-	-	-0.017	-0.610	0.542	-	-
HRTOTAL	0.234	8.084	< 0.001***	-	-	0.182	5.729	< 0.001***	-	-
CEAITOTAL	0.125	4.655	< 0.001***	-	-	0.109	3.427	0.001**	-	-

CEAIF1, management support; CEAIF2, work discretion or autonomy; CEAIF3, rewards and reinforcement; CEAIF4, time availability; CEAIF5, organisational boundaries; LSLFair, Laissez-faire leadership; LSTForm, transformational leadership; LSTSact, transactional leadership; HRG1T&D, training and development; HRG2Rem, remuneration; HRG3Pm, performance management; HRG4Sup, supervisor support; HR5App, staffing; HR6Div, diversity management; HR7Comm, communication; HRM, human resource management.

, p < 0.01; *, Beta coefficient is significant at the < 0.001 level.

TABLE 4: Regression analyses with innovative work behaviour as outcome.

Test	Model without gender or moderation					Model with gender						Model with gender or moderation					
	Standard Beta	*T*	*p*	R^2	*F*	Standard Beta	*T*	*p*	R^2	*F*	ΔR^2	Standard Beta	*t*	*P*	R^2	*F*	ΔR^2
Leadership style	-	-	< 0.001	0.068	(3, 3176) = 78.27	-	-	< 0.001	0.079	(4, 3142) = 68.18	0.011	-	-	< 0.001	0.079	(7, 3135) = 39.60	< 0.001
Constant	-	60.53	< 0.001***	-	-	-	59.937	< 0.001***	-	-	-	-	45.478	< 0.001***	-	-	-
LSTForm	0.107	3.212	0.001**	-	-	0.117	3.524	< 0.001***	-	-	-	0.172	3.89	< 0.001***	-	-	-
LSTSact	0.18	5.363	< 0.001***	-	-	0.172	5.113	< 0.001***	-	-	-	0.138	3.1	0.002**	-	-	-
LSLFair	-0.042	-2.212	0.027*	-	-	-0.038	-2.016	0.044*	-	-	-	-0.057	-2.233	0.026*	-	-	-
Gender	-	-	-	-	-	-0.096	-5.594	< 0.001***	-	-	-	-0.085	-1.519	0.129	-	-	-
LSTForm × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.183	-1.848	0.065	-	-	-
LSTSact × Gender	-	-	-	-	-	-	-	-	-	-	-	0.111	1.162	0.245	-	-	-
LSLFair × Gender	-	-	-	-	-	-	-	-	-	-	-	0.06	1.07	0.285	-	-	-
HRM practices	-	-	< 0.001	0.106	(7, 3171) = 55.11	-	-	< 0.001	0.117	(8, 3142) = 68.18	0.011	-	-	< 0.001	0.117	(15, 3127) = 28.68	< 0.001
Constant	-	29.624	< 0.001***	-	-	-	30.022	< 0.001***	-	-	-	-	22.274	< 0.001***	-	-	-
HRG1T&D	0.11	5.369	< 0.001***	-	-	0.113	5.524	< 0.001***	-	-	-	0.123	4.572	< 0.001***	-	-	-
HRG2Rem	0.056	2.42	0.016*	-	-	0.057	2.463	0.014*	-	-	-	0.035	1.159	0.247	-	-	-
HRG3Pm	0.012	0.473	0.636	-	-	0.011	0.42	0.674	-	-	-	0.028	0.791	0.429	-	-	-
HRG4Sup	0.05	2.367	0.018*	-	-	0.051	2.394	0.017*	-	-	-	0.042	1.456	0.146	-	-	-
HR5App	0.115	5.043	< 0.001***	-	-	0.116	5.113	< 0.001***	-	-	-	0.126	4.242	< 0.001***	-	-	-
HR6Div	0.028	1.221	0.222	-	-	0.028	1.197	0.232	-	-	-	0.029	0.954	0.34	-	-	-
HR7Comm	0.061	2.486	0.013*	-	-	0.059	2.391	0.017*	-	-	-	0.074	2.279	0.023*	-	-	-
Gender	-	-	-	-	-	-0.095	-5.672	< 0.001***	-	-	-	0.026	0.311	0.756	-	-	-
HRG1T&D × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.053	-0.651	0.515	-	-	-
HRG2Rem × Gender	-	-	-	-	-	-	-	-	-	-	-	0.091	1.227	0.22	-	-	-
HRG3Pm × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.079	-0.791	0.429	-	-	-
HRG4Sup × Gender	-	-	-	-	-	-	-	-	-	-	-	0.035	0.433	0.665	-	-	-
HR5App × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.046	-0.499	0.618	-	-	-
HR6Div × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.006	-0.065	0.948	-	-	-
HR7Comm × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.068	-0.747	0.455	-	-	-
Innovation climate	-	-	< 0.001	0.095	(5, 3174) = 11.58,	-	-	< 0.001	0.100	(6, 3142) = 59.01	0.005	-	-	< 0.001	0.100	(11, 3131) = 32.60	0.001
Constant	-	17.295	< 0.001***	-	-	-	17.572	< 0.001***	-	-	-	-	12.763	< 0.001***	-	-	-
CEAIF1	0.139	7.282	< 0.001***	-	-	0.137	7.205	< 0.001***	-	-	-	0.163	6.323	< 0.001***	-	-	-
CEAIF2	0.121	6.661	< 0.001***	-	-	0.115	6.329	< 0.001***	-	-	-	0.122	5.089	< 0.001***	-	-	-
CEAIF3	0.117	6.135	< 0.001***	-	-	0.115	6.04	< 0.001***	-	-	-	0.09	3.57	< 0.001***	-	-	-
CEAIF4	-0.035	-2.027	0.043*	-	-	-0.033	-1.951	0.051	-	-	-	-0.022	-0.926	0.355	-	-	-
CEAIF5	0.073	4.062	< 0.001***	-	-	0.077	4.316	< 0.001***	-	-	-	0.079	3.256	0.001**	-	-	-
Gender	-	-	-	-	-	-0.089	-5.277	< 0.001***	-	-	-	0.011	0.085	0.932	-	-	-
CEAIF1 × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.123	-1.476	0.14	-	-	-
CEAIF2 × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.034	-0.445	0.656	-	-	-
CEAIF3 × Gender	-	-	-	-	-	-	-	-	-	-	-	0.134	1.555	0.12	-	-	-
CEAIF4 × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.051	-0.777	0.437	-	-	-
CEAIF5 × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.031	-0.294	0.769	-	-	-
Complex model	-	-	< 0.001	0.125	(5, 3174) = 91.52	-	-	< 0.001	0.134	(6, 3142) = 81.93	0.009	-	-	< 0.001	0.134	(11, 3131) = 45.15	< 0.001
Constant	-	15.885	< 0.001***	-	-	-	16.494	< 0.001***	-	-	-	-	12.014	< 0.001***	-	-	-
LSTForm	0.035	1.086	0.278	-	-	0.047	1.428	0.154	-	-	-	0.086	1.982	0.048*	-	-	-
LSTSact	0.069	2.077	0.038*	-	-	0.063	1.883	0.06	-	-	-	0.019	0.422	0.673	-	-	-
LSLFair	-0.035	-1.878	0.061	-	-	-0.032	-1.761	0.078	-	-	-	-0.046	-1.841	0.066	-	-	-
HRTOTAL	0.207	9.758	< 0.001***	-	-	0.211	9.902	< 0.001***	-	-	-	0.232	8.006	< 0.001***	-	-	-
CEAITOTAL	0.128	6.285	< 0.001***	-	-	0.118	5.8	< 0.001***	-	-	-	0.124	4.609	< 0.001***	-	-	-
Gender	-	-	-	-	-	-0.091	-5.453	< 0.001***	-	-	-	0.026	0.211	0.833	-	-	-

Table 4 continues on the next page →

TABLE 4 (Continues ...): Regression analyses with innovative work behaviour as outcome.

Test	Model without gender or moderation					Model with gender						Model with gender or moderation					
	Standard Beta	*T*	*p*	R^2	*F*	Standard Beta	*T*	*p*	R^2	*F*	ΔR^2	Standard Beta	*t*	*P*	R^2	*F*	ΔR^2
LSTForm × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.136	-1.402	0.161	-	-	-
LSTSact × Gender	-	-	-	-	-	-	-	-	-	-	-	0.146	1.527	0.127	-	-	-
LSLFair × Gender	-	-	-	-	-	-	-	-	-	-	-	0.043	0.785	0.433	-	-	-
HRTOTAL × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.117	-1.139	0.255	-	-	-
CEAITOTAL × Gender	-	-	-	-	-	-	-	-	-	-	-	-0.051	-0.345	0.73	-	-	-

CEAIF1, management support; CEAIF2, work discretion or autonomy; CEAIF3, rewards and reinforcement; CEAIF4, time availability; CEAIF5, organisational boundaries; LSLFair, Laissez-faire leadership; LSTForm, transformational leadership; LSTSact, transactional leadership; HRG1T&D, training and development; HRG2Rem, remuneration; HRG3Pm, performance management; HRG4Sup, supervisor support; HR5App, staffing; HR6Div, diversity management; HR7Comm, communication; HRM, human resource management.

*, $p < 0.05$; **, $p < 0.01$; ***, Beta coefficient is significant at the < 0.001 level.

Model 3, none of the interaction terms' beta values were significant, indicating that moderation does not occur.

Discussion

In this study, the relationship between antecedents to innovation and IWB was assessed across gender. In the literature reviewed, many examples empirically linking these antecedents with IWB were found; however, instances of evidence of gender having a differential effect on the relationships are few. This study makes a significant contribution to the body of knowledge regarding the antecedents of IWB and gender, as it presents relational comparisons that are empirically sound, using only measures in which measurement invariance across gender was demonstrated prior to the analyses. In structural equation modelling terms, relations or paths were only tested once the measurement models were proven to be sound. Eliminating such bias before engaging in testing relationships is an aspect not often implemented and represents the primary contribution of this study.

The sample for this study was adequate for the analyses performed, presenting similar numbers of men and women, and resembling the employment statistics reported in the Quarterly Labour Force Survey (Statistics South Africa, 2019). The relatively large sample size necessitated the use of practical significance as indicator, as statistical significance often leads to unwarranted conclusions when using large samples (see Lin, Lucas, & Shmueli, 2013).

Of the seven instruments administered, only four showed MI across gender. Often-used instruments such as the UWES-9 (Schaufeli et al., 2006) and OCS (Allen & Meyer, 1990) were eliminated from the study, given the non-invariance across gender. In the end, only the MLQ (Avolio et al., 1995, 1999), HRPS (Nyawose, 2009; Steyn, 2012), BCEAI (Hornsby et al., 2002; Strydom, 2013) and the IWB (Kleysen & Street, 2001) were included in the study, as these instruments showed MI across gender.

Mean scores and mean score differences across gender were calculated. As these measurements were measurement invariant, the reported differences would present substantive differences (Bialosiewicz, Murphy, & Berry, 2013; Vandenberg & Lance, 2000) between men and women. Practically significant differences were detected in only three of the 18 mean scores calculated. The largest of these presented one-fifth of a standard deviation and related to IWB (see IWB in Table 1). As the IWB measure is invariant, it can be reported that men do report higher levels of innovative work behaviour. Men also experience more management support (see CEAIF1 in Table 1) and, in general, a more conducive environment to being innovative (see CEAIFTOTAL in Table 1). This may be an important finding, should the only difference be the perceived overall climate in the organisation and the level of managerial support men experience. Also important in this context is that on 15 of the 18 means reported, men and women did not differ in their reporting. Men and women thus experience the workplace in a very similar manner.

How the relationships between antecedents and IWB differed along gender lines was central to this research, rather than the mean differences between the genders. Data were thus primarily collected and analysed to answer questions such as the following:

- Does transformational leadership (a leadership style) influence innovative behaviour differently for men than it does for women?
- Does training and development (an HRM practice) influence innovative behaviour differently for men than it does for women?
- Does work discretion and autonomy (a climate for innovation element) influence innovative behaviour differently for men than it does for women?

Considering the most simple models (correlations), no gender differences were found in any of the 17 models tested. Thus, all three leadership styles, all seven HRM practices, and all five climate variables related similarly to IWB across gender (see Table 2). When using measurement invariant measures, the relationships between the variables were similar. It is interesting to note that being exposed to transformational leadership correlated the strongest with IWB for men, while in the case of women the strongest correlation was with being exposed to transactional leadership. This finding is remarkable as research focusing on men and women's leadership styles indicates that men tend to be more transactional and women

more transformational (Eagly et al., 2003; Xu et al., 2016). It would thus be fascinating to find out if men in leadership roles evoke IWB in women, and vice versa.

With regard to HRM practices, the fair management of the recruitment process (see HR5App in Table 2) related most strongly with IWB for both men and women. Considering climate, management support related strongly with IWB for men (see CEAIF1 in Table 2), and rewards and reinforcement for women (see CEAIF3 in Table 2). This finding regarding rewards and reinforcement (CEAIF3) and transactional leadership (for women), and management support (CEAIF3) and transformational leadership (for men), could be interpreted as complementing each other, given the nature of the different leadership styles.

The more complex regression models are presented in Table 3. In the leadership style model, and complementing the finding regarding the correlations, transactional leadership played a unique role in predicting IWB among women. With men, on the other hand, transformational leadership, and to a lesser extent transactional leadership, drove IWB. Training and development (see HRG2T&D), and fair management of the recruitment process (HR5App), contributed significantly and uniquely to IWB for both men and women. With regard to climate, the same variables were drivers of IWB, with the exception of organisational boundaries (CEAIF5), which was important to men only. Considering the complex model, HRM practices and climate, more than leadership styles, seem to be unique predictors of IWB. This model was also most predictive ($R^2_{Men} = 0.142$; $R^2_{Women} = 0.111$; $R^2_{Difference} = 0.031$), accounting for 14.2% and 11.1% of the variance in IWB.

In all the cases, the predictive power of the models (R^2) was larger for men. Others (see Sánchez-Escobedo et al., 2014) report the same tendency in a similar setting, reporting that the explanatory power of models linking gender and innovation (entrepreneurial intentions) are more conclusive for men than for women.

Lastly, testing for moderation was performed (see Table 4). In this analysis, the focus is primarily on how the models improve (ΔR^2), given the introduction of gender and gender-interaction as variables. As can be observed from Table 4, the introduction of gender improved the models by 1.1% (for the first two models), by 0.5% for the next model and by 0.9% for the last model. When gender-interaction was added (Model 2, the moderation model), the models improved by less than 0.1%. Given this, it may be concluded that gender does not moderate any of these relationships. The picture is, however, a little more complex than this would suggest. In the second model, in which (only) gender is added to the regression, gender contributes uniquely and significantly to the variance in IWB. This indicates that gender is not a moderator, as suggested, but rather a predictor of IWB, and thus an antecedent to IWB.

Practical and managerial implications

The findings presented here demonstrate that leadership style, but also, to a larger extent, HRM practices and a climate for innovation are antecedents to IWB. Managers should thus be aware of the significant role that these antecedents play: transactional leadership and rewards and reinforcement, for women, and transformational and management support for men. With regard to HRM practices, the fair management of the recruitment process was important to both men and women, in relation to IWB.

These antecedents contributed 12.5% to the variance in IWB, suggesting that other factors substantially influence IWB. Aspects such as proactive personality (Bateman & Crant, 1993) play an important role, as Steyn (2019) reports that 23.9% of the variance in IWB is explained by this individual characteristic. This points to the importance of selecting the correct individuals with the appropriate traits, as echoed in the present research, where men and women endorsed the importance of fair management of the recruitment process as being linked to IWB in organisations.

The role of gender in IWB was central to this study. It could be reported that although gender, statistically, seems to be a predictor of IWB, the effect of gender in practice is negligible. Gender explains about 1% of the variance in IWB. It would, therefore, be acceptable to concur with Kvidal and Ljunggren (2014) that gender is a non-issue in terms of innovation.

Contribution

This article contributes significantly to the body of knowledge regarding gender in the workplace, suggesting that at an individual employee level, men and women respond similarly to organisational variables (when the measures are invariant). This seems to be at odds with the popular notion that gender diversity contributes to innovation in teams. Gender at an individual level may therefore operate differently than gender as a variable in a group. Thus, the dynamics that drive innovation in groups may differ from those where the focus is on the individual employee.

Limitations and suggestions for future research

Some reviewers may judge the absence of structural equation modelling in this research as a limitation. While future researchers may choose to take that route, regression modelling was applied in this instance as the authors are of the opinion that the technique is more explicit in detailing the moderation effects.

The complexity of the research was limited because the mediator variables (engagement, Schaufeli et al. 2006; and organisational commitment, Allen & Meyer 1990) were eliminated because they were not measurement invariant across gender. Future researchers are advised to include more such variables when collecting data, both so as to avoid this predicament, and to enable them to test more complex models.

In line with the present custom in South Africa in most formal organisational settings, this research report refers to its respondents as (self-identified) men and women. Contemporary gender identification, however, is more fluid than this might suggest and identification as lesbian, gay, bisexual or transgender (LGBT) can have substantive consequences in the workplace (see Badgett, Lau, Sears, & Ho, 2007; Grant et al., 2011), a factor which may also influence the relationship between innovation and its antecedents. Researchers are encouraged to engage in this complex matter.

A further limitation to the study relates to the sample investigated. Respondents form both public and private organisations reported on their innovative behaviour. As these organisations may fundamentally differ (for example in structure), this element influences the interaction between antecedents and outcomes. As such, future researchers are encouraged to split their samples along these lines and present their results focusing on one or the other.

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Competing interests

The authors have declared that no competing interest exists.

Author's contributions

Both authors contributed the conceptualisation of the article with Professor R.S. mainly responsible for the literature review and conclusions and Professor G.d.B. for the statistical analysis discussion of the results.

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Data availability statement

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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.

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