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Article

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MANAGEMENT | RESEARCH ARTICLE

Linking self-leadership to proactive work behavior: A network analysis

Itsara Boonyarit^{1*}

Abstract: Proactive work behavior (PWB) is a complex phenomenon that individuals exhibit self-initiative and taking anticipatory action in multiple forms including taking charge, voice, individual innovation, and problem prevention. The current study used a network analysis approach to investigate the associations between self-leadership and the forms of PWB through the lens of the Performance Mechanism Model. Data were collected from 256 operational employees from a state-owned enterprise in Thailand, and a partial correlation network was estimated by using EBIC Graphical LASSO. Findings showed positive associations between self-leadership and two forms of PWB, i.e. taking charge and individual innovation, and also were positively related to psychological empowerment and role-breadth self-efficacy (RBSE). Centrality indices indicated that voice and individual innovation were the most central behaviors in the network. Furthermore, RBSE has emerged as a significant pathway in the link between self-leadership and PWB. Practical implications and future research are discussed.

Subjects: Organizational Theory & Behavior; Work & Organizational Psychology; Research Methods in Management; Leadership; Organizational Studies

Keywords: Self-leadership; proactive work behavior; network analysis; psychological empowerment; role-breadth self-efficacy

1. Introduction

The current world is fast changing. Organizations, regardless of their sizes, are affected by unpredictable and constantly changing situations such as the Covid-19 pandemic, trade competition, and changes in technology. Management scholars term these phenomena as the VUCA world, indicating that an organization's management has to face *volatility, uncertainty, complexity, and ambiguity* all the time (Mack & Khare, 2016). As a result, the organizations are required to quickly respond to changes through developing innovation. Due to the tendency of such demands, the organizations need their employees to be more initiative, ready for the future challenges, and take actions to bring about change. Therefore, organizational effectiveness relies on whether their employees are capable of developing innovation and taking a proactive approach in the pursuit of long-term goals (Parker & Liao, 2016). These actions are referred to as proactive work behavior (PWB).

PWB involves self-initiated and anticipatory actions to change the organizational environment (Parker & Collins, 2010). Individuals with PWB aim at bringing about change to the organizations such as proposing new ways of working and making themselves ready for future demands (Bindl & Parker, 2010). Previous studies found that PWB was positively related to successful performance both at the individual and organizational level (Parker & Liao, 2016; Yang & Chau, 2016).

To discover factors relating to PWB is greatly important. That is because stakeholders will be able to design practical interventions to promote PWB based on this knowledge. Wu and Parker (2013) suggested that PWB resulted from several contributing factors: (1) personal characteristics such as knowledge, ability, personality and (2) situational factors such as job characteristics, leadership, and organizational climate. In this study, I focus on self-leadership, which is a personal factor related to the initiative nature of PWB. It is a process in which an individual has an influence over oneself through behavioral and cognitive strategies using to direct and motivate oneself to execute tasks efficiently (Neck et al., 2020). The Performance Mechanism Model proposed by Neck and Houghton (2006) was applied to identify the link between self-leadership and PWB in the current study. This model conceptualizes that individuals who adapt self-directed strategies will be able to motivate themselves and strive to perform their tasks efficiently through the mediating effects of predictable outcomes such as self-efficacy, positive affects, independence, and psychological empowerment. This model attempts to link the component of self-leadership to an individual's work-related behaviors. Thus, it can be inferred that self-leadership may have the potential to be associated with positive work behaviors, such as proactive behavior at work (Neck & Houghton, 2006).

2. Literature review

2.1. Defining PWB

Scholars' viewpoints on PWB are diverse. Frese and Fay (2001) viewed PWB as the behaviors reflecting the self-starting aspect, an individual puts an effort to overcome difficulties to achieve the determined goals. In addition, Grant and Ashford (2008) proposed that these work behaviors are anticipatory actions that an employee acts on one's own initiative to transform oneself and the organization. The transformation is made based on two key behaviors: (1) future-oriented and self-initiated behaviors and (2) change-oriented behaviors. Bindl and Parker (2010) suggested people displaying proactive behaviors focused on changing situations such as proposing new work methods or organizational strategies. Besides, they also focused on the changes within oneself such as learning new skills to be prepared for future job demands. Thus, it can be concluded that PWB involves the actions of a self-initiated individual, one who anticipates work situations and initiates changes in personal work methods as well as in group and organization.

2.2. A behavioral perspective on PWB

As stated by Wu and Parker (2013), the perspectives focusing on the forms of proactive behaviors are more distinctive than the ones describing these behaviors as personality traits. Proactive behaviors, according to the behavioral perspective, are contingent on the work environment. Also, these behaviors were changeable through the effect of environmental factors. According to these perspectives, PWB is complex. Thus, the behavior should not be studied as a unidimensional attribute, but as various components or sets of proactive behaviors which are interconnected. The behavioral perspective explains that proactive behaviors are self-initiated acts that individuals exhibit in multiple forms. The key elements of the behaviors involve these aspects: being self-directed, anticipating long-term future challenges and opportunities, and then taking actions to be prepared for future change oneself and the organization. The studies on PWB applying this perspective focus on different forms of proactive behaviors. It is believed that these behaviors are interconnected (Wu & Parker, 2013). Therefore, PWB is not solely a single act but rather being a behavior exhibiting proactivity in multiple dimensions or components (Bindl & Parker, 2010). Based on earlier studies, Parker and Collins (2010) proposed that researchers, in general, studied proactive behavior that entailed multiple forms via different focuses, explanations of proactive behavior's actions, operationalization, and definitions. For example, the constructs related to proactive behavior that had been previously studied were comprised of voice behavior (LePine & Van Dyne, 1998), personal initiative (Frese & Fay, 2001), proactive problem solving and idea implementation (Parker et al., 2006), taking charge (Morrison & Phelps, 1999), proactive personality (Bateman & Crant, 1993). In brief, previous PWB researches looked at an individual's PWB characteristics as a particular type of behavior depending on their interests. Such proactive behaviors

were completely isolated; no attempt was made to investigate the behaviors as a set of potential interrelated behaviors (Luth, 2012).

Later on, researchers have shifted their focus to a multidimensional construct of PWB, as opposed to previous studies that looked at these behaviors separately. Factor analysis was performed to investigate the commonality among PWB, and the work behaviors were viewed as the manifestation of the common characteristics of proactive behaviors (Luth, 2012). For example, Parker and Collins (2010) conducted a factor analysis to examine factor structures of PWB among Australian managers; related higher-order factors were discovered. Additionally, this study suggested that individual-level PWB involved the behaviors aiming to bring about change in the organization and consisted of four PWB forms: (1) *Taking charge* refers to exhibiting constructive efforts to bring about organizational change and considering on how to establish work methods or procedures to improve organizational performance. (2) *Voice* refers to giving innovative suggestions to effect change, providing advice about how to improve work procedures although some co-workers may disagree, and communicating constructive ideas to bring about positive change to the organization. (3) *Individual innovation* refers to constructive actions, idea implementations, identifying opportunities for improvement, and generating new ideas and implemented them. And (4) *Problem prevention* refers to self-initiated behaviors, involving anticipation of future work problems and preventions.

2.3. Self-leadership and PWB

Individuals who manage themselves employ self-leadership strategies promoting behavioral awareness and intention, generating intrinsic task motivation, and having constructive thoughts (Houghton et al., 2012). Those who effectively lead themselves can plan and improve their work and situations, anticipate future outcomes, and increase intrinsic motivation to effect change (Hauschildt & Konradt, 2012). Neck and Houghton (2006) proposed that self-leadership entailed three strategies: (1) Behavior-focused strategies involve the processes that aimed to increase self-awareness and promote self-management, specifically behavioral management when facing undesirable tasks. (2) Natural reward strategies aim to create the situations in which an individual was motivated and rewarded from assigned activities or tasks. (3) Constructive thought pattern strategies involved the processes that an individual could steer their thoughts to be in the desirable directions or purposes. The importance of cultivating and maintaining positive, productive thinking was also emphasized (Neck et al., 2020).

Crant (2000) proposed that self-starting, a personal resource, is an important aspect in PWB that shows an individual is capable to proactively manage oneself. Self-leadership has an impact on work performance in a manner that an individual is capable to manage and motivate oneself is likely to display proactive behaviors such as anticipating future conditions (C. S. Lee et al., 2007) and preparing for changes in job duties (Grant & Ashford, 2008). Through self-leadership strategies, individuals can plan and improve their productivity. For example, using the cognitive strategy via mental imagery enables an individual to foresee future positive outcomes. Natural rewards increase intrinsic motivation which drives an individual to improve their work conditions. Behavior-focused strategies such as goal setting and self-reward enable an individual to follow proactive planning (Hauschildt & Konradt, 2012).

To my knowledge, there is no research on the association between self-leadership and PWB. However, previous findings revealed that self-leadership was linked with proactive-like performance (Knotts et al., 2021). Cranmer et al. (2019) found that self-leadership influences employees' proactivity. Moreover, Marques-Quinteiro and Curral (2012) found that self-leadership strategies had a direct effect on proactive work performance and played a mediator role in the relationship between learning goal orientation and work performance. The concepts and related studies mentioned above show that self-leadership may positively associate with PWB. Nevertheless, the previous studies merely investigated the connection with the overall PWB, multiple forms of PWB

have not yet been examined. Therefore, this study could provide evidence that demonstrates the link between self-leadership and PWB. Accordingly, I would like to propose that

H1: Self-leadership has a positive association with the forms of PWB, including taking charge; voice; individual innovation; and problem prevention.

2.4. Self-leadership, psychological empowerment, and role-breadth self-efficacy

Apart from examining the relationship between self-leadership and PWB, I select the variables that might be interrelated in the network of self-leadership and PWB based on the Performance Mechanism Model (Neck & Houghton, 2006). According to previous literature, two variables that are important for driving proactive performance at the individual level were included in the network: psychological empowerment and role-breadth self-efficacy.

Psychological empowerment is intrinsic task motivation that originates from four components of the cognitive process reflecting personal interest in one's own work role (Spreitzer, 1995): (1) Meaning, an individual's perception of their work as meaningful to oneself and organization. (2) Competence, an individual's perception of their own abilities to efficiently perform tasks with their own skills and has confidence in performing the given tasks proficiently. (3) Self-determination, an individual's perception of their autonomy in performing their tasks. (4) Impact, an individual's perception of the effect of their actions on the organization's strategies, operations, or work outcomes.

Neck et al. (2020) proposed that self-leadership is a process in which an individual possessed the skills in using strategies to direct one's own behaviors and thoughts. This is the key contributor to psychological empowerment and essential to successful work performance in autonomous situations. Self-leadership could be a factor encouraging psychological empowerment. An individual who adopted behavior-focused strategies (i.e. self-observation, self-goal setting, and self-reward) could cultivate feelings of self-determination and competence. Meanwhile, the natural reward strategies were related to the feelings of self-competence, self-control, and purpose. Moreover, cognitive strategies (i.e. mental imagery of successful tasks, self-talk, and evaluation of one's own beliefs and assumptions) had effects on psychological empowerment (Manz & Neck, 2004). Previous findings show a positive relationship between self-leadership and psychological empowerment (Amundsen & Martinsen, 2015; Lee & Kim, 2013; C. S. Lee et al., 2007). Based on the review of the aforementioned concepts and related studies, I proposed that

H2: Self-leadership has a positive association with psychological empowerment.

Another key factor of psychological motivation relating to PWB is role-breadth self-efficacy (RBSE: Axtell & Parker, 2003). It is an individual's confidence in performing operations in broader roles and executing proactive roles which are beyond the traditional work roles (Parker, 1998). Individuals with a high level of RBSE are likely to perceive that they have sufficient capacity to complete various tasks (Marler, 2008). Neck and Houghton (2006) proposed that the use of self-leadership strategies would stimulate psychological processes, the increased perceived self-efficacy in particular. This subsequently led to effective work behaviors. Accordingly, self-leadership is significantly related to an individual's self-efficacy.

To date, there has been no research tying self-leadership to RBSE in the context of PWB. However, there are previous empirical studies that link self-leadership with perceived self-efficacy on performance among various groups of participants such as undergraduates (Boonyarit, 2021) and private employees (Kotzé, 2017). Based on the aforementioned literature review, it can be inferred that self-leadership will have a positive relationship with RBSE. Accordingly, I would like to propose

H3: Self-leadership has a positive association with RBSE.

2.5. Psychological empowerment, RBSE, and PWB

Individuals experiencing psychological empowerment are likely to work enthusiastically, which leads to determination as well as perceive that they are capable of improving work performance and environment (Spreitzer, 1995). When experiencing psychological empowerment, individuals would likely display PWB that brings about change within oneself as well as the change to the unit and the organization (Luth, 2012). Therefore, psychological empowerment is an important process that promotes an individual's PWB (F. Liu et al., 2017). Findings from Searle (2011) revealed that psychological empowerment mediated the relationship between servant leadership, proactive personality, and PWB and it had positive direct effects on the forms of PWB, including taking charge; voice; individual innovation; and problem prevention. This is consistent with F. Liu et al. (2017) and Zhang et al. (2018)'s studies showing that psychological empowerment had a significant positive association with PWB. Based on the review of the aforementioned studies, I would like to propose that

H4: Psychological empowerment has a positive association with the forms of PWB, including taking charge; voice; individual innovation; and problem prevention.

Furthermore, previous literature highlighted that RBSE played a central role in the process of PWB. Crant (2000) suggested that RBSE is a disposition that stimulates an individual to exhibit PWB. Afterward, Parker et al. (2006) developed the model to describe the antecedents of PWB and mentioned that RBSE is a proactive cognitive-motivational state that functions as the proximal antecedent of PWB such as idea implementation and proactive problem-solving. Moreover, it also plays as a mediating role in the relationships between the distal antecedents (i.e. personal factors and work environment) on proactive behaviors. Thus, perceived control of oneself and ability to achieve in the future are highly related to the forms of PWB such as taking charge (Morrison & Phelps, 1999), individual innovation (Speier & Frese, 1997), and voice (Axtell & Parker, 2003). Previous findings revealed the relationship between RBSE and PWB (Parker et al., 2006; Strauss et al., 2009). Therefore, I proposed that

H5: RBSE has a positive association with the forms of PWB, including taking charge; voice; individual innovation; and problem prevention.

2.6. A psychological network approach to PWB construct

Previous studies focused on performing factor analysis to detect the components of PWB allowing the scholars to model the behaviors in which multiple factors or various forms of proactive behaviors act as manifest variables under the same higher-order latent named PWB (Parker & Collins, 2010). Factor analysis using the structural equation modeling (SEM) methodology has one drawback, psychological phenomena are typically viewed as latent variables (not directly observable) being constructed from observable and measurable indicators. According to this approach, its basic assumptions required the PWB indicators or these four behaviors could not be correlated (Schmittmann et al., 2013). Thus, based on this approach, the latent variable of PWB is comprised of unrelated indicators. Such model has weakness in a manner that they cannot explain the phenomenon concerning whether these behavioral indicators are interrelated or impact one another. In addition, these behaviors might be viewed as merely static manifestation. Thus, this approach does not allow scholars to conceptualize PWB as a complex phenomenon (Epskamp et al., 2018).

Currently, a new approach has been proposed to explain complex behaviors in psychology called psychological network modeling (Borsboom & Cramer, 2013). This approach assumes that, in

psychology, behaviors are complex systems in which observed variables are interrelated (Cramer, Waldorp, van der Mass, & Borsboom, 2010). It was built on graph theory and was first applied in investigating mental disorders. To date, statistical methods used to analyze this network modeling have been continuously developed and can be termed “psychological network” (Epskamp et al., 2018). In a network model, connections between observables are considered to be the consequences of a system with pairwise interactions between variables. These interactions can reflect the bidirectional association and presumably causative (Epskamp et al., 2018).

Accordingly, the examination of the structure of PWB from a network analysis approach does not have to be based on specifying into the same latent variable; rather, it should be based on the interactions among the observed variables, e.g. the interconnections among taking charge, voice, individual innovation, and problem prevention. Therefore, it provides room for the current study to investigate PWB entailing complex relationships among the forms of PWB regarding how these behaviors affect one another. This is consistent with recent findings demonstrating the interrelationships between the forms of PWB. For example, seeking feedback had positive relationships with taking charge and voice (Qian et al., 2018) and voice had a positive relationship with innovation (Guzman & Espejo, 2018).

Based on the review mentioned above, an important research question which has not yet been previously addressed by any scholar can be raised “Whether the forms of PWB will relate to one another as a result of the pairwise interaction among these forms (the network analysis model).” To apply the analysis based on the psychological network model would be beneficial in a manner that I can understand the interrelated systems of proactive behaviors in the workplace. Thus, in this study, PWB which consists of forms of behaviors would relate to one another, which then becomes the network model of PWB rather than merely the relationships among variables that underly the same latent variable. Accordingly, I propose that *the network model of PWB would be fit with the empirical data* (please see Figure 1).

3. The current study

Due to the aforementioned challenges, management researchers and organizational psychologists play an important role in providing empirical explanations about PWB and facilitate stakeholders involved in organizational management to understand factors linking to employees’ PWB. To gain an understanding of the network model linking self-leadership and PWB, I could clarify the study objectives as (1) to investigate the fit of the network model of PWB to empirical data, (2) to investigate the network of the relationships between the proposed variables in the Performance Mechanism Model (i.e. self-leadership, psychological empowerment and role-breadth self-efficacy) and forms of PWB (i.e. taking charge, voice, individual innovation, and problem prevention), and (3) to determine the most central variables in the PWB network model.

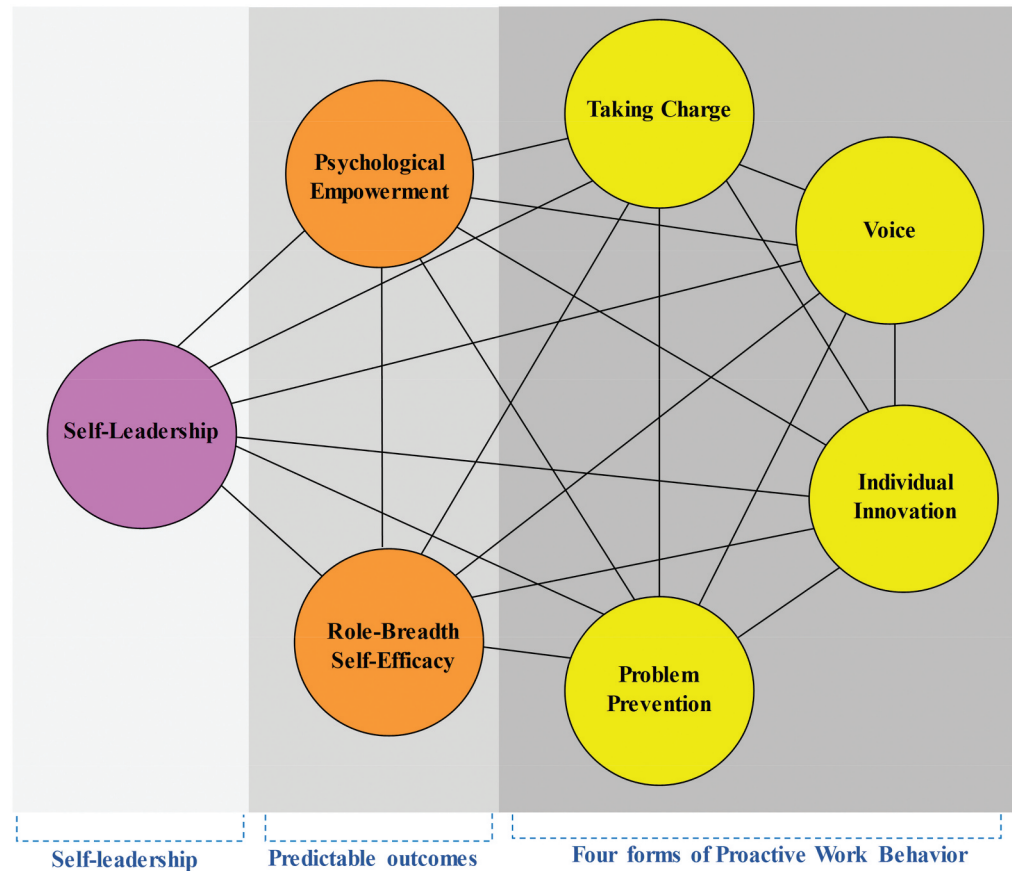
4. Method

4.1. Participants

A total of 256 power plant operational employees participated in this study. They were recruited through the convenience sampling method from several units of an electric state enterprise, i.e. production, maintenance, and general management, located in North Thailand. The participants consisted of 141 females and 115 males, and at the time of data collection, the mean age of all participants was 38.60 years ($SD = 12.06$). Their education levels included vocational certificate ($n = 76$), high vocational certificate ($n = 12$), bachelor ($n = 132$), and 36 (master degree). The mean job tenure of participants was 13.97 ($SD = 12.54$).

Before completing the questionnaire, the participants were informed about the objectives and implications of the current study, and all signed the consent forms. The data’s confidentiality was protected. All procedures involving human subjects were carried out following research ethical

Figure 1. Application of the Performance Mechanism Model (Neck & Houghton, 2006) to the current network model linking self-leadership to PWB.



guidelines and were approved by the University Research Ethics Committee (CMUREC No.63/101).

4.2. Measures

The participants completed an online questionnaire including four measures as follows:

The Abbreviated Self-Leadership Questionnaire (ASLQ) was developed by Houghton et al. (2012). It consists of nine items that were taken from the Revised Self-Leadership Questionnaire (Houghton & Neck, 2002) aiming to provide a general assessment of an individual's self-leadership. The scale was translated/back-translated to Thai by two qualified translators. The ASLQ was rated on a 5-point rating scale from 1 (*not at all accurate*) to 5 (*completely accurate*). Cronbach's α of the scale was .76 and McDonald's ω was .79, showing that the scale was satisfactorily reliable.

The Empowering at Work Scale (Spreitzer, 1995) was included to assess an individual's experience of intrinsic motivation at work manifested in four psychological states: meaning, competence, self-determination, and impact. The scale was translated/back-translated to Thai by Sriakaranont (2015). It consists of 12 items, and participants responded on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's α and McDonald's ω were .89 and .85, respectively.

The Role Breadth Self-Efficacy Scale was developed by Parker (1998). The scale consisted of ten items assessing an individual's belief in his/her capability to perform a variety of tasks. The Thai version of the scale derives from Sinthumongkhonchai (2019). Items were rated on a 5-point scale

from 1(not at all confident) to 5(very confident). Cronbach's α and McDonald's ω were .87 and .87, respectively.

The Proactive Work Behavior Scale developed by Parker and Collins (2010) consists of 13 items measuring four forms of proactive behavior at work: taking charge (3 items), voice (4 items), individual innovation (3 items), and problem prevention (3 items). The scale was translated/back-translated in the current study. Participants responded on a 5-point scale from 1 (*never*) to 5 (*always*). Reliability of overall scale was high (Cronbach's α = .88; McDonald's ω = .89).

4.3. Data analysis

Psychological network analysis was conducted based on the procedures suggested by Epskamp et al. (2018) and Epskamp and Fried (2018). The network model was composed of nodes (representing variables from the proposed model in the current study) and edges (associations between two variables after controlling other nodes in the network). For our analysis, seven variables (i. e. self-leadership, psychological empowerment, role-breadth self-efficacy, and four forms of proactive work behavior) were included in the network estimation. Data were analyzed with R software (version 4.04, open-source, available at <https://www.r-project.org>) and RStudio software (version 1.3.959).

First, non-normal continuous data of the nodes included in the network model were inspected (Epskamp & Fried, 2018). For this purpose, two multivariate normality tests were applied: (a) Henze-Zirkler's test (Henze & Zirkler, 1990) and (b) Chi-Square Q-Q plot. The analyses were implemented via *MVN* package (Korkmaz et al., 2014). If data are not normally distributed, a non-paranormal transformation can be applied (H. Liu et al., 2009) using a command from *huge* package (Zhao et al., 2012) in order to relax the normality assumption prior to the network analysis (Epskamp & Fried, 2018).

Second, Gaussian Graphical Model (GGM), or called partial correlation network, for cross-sectional continuous data was estimated, in line with guidelines from Epskamp and Fried (2018). By estimation of the covariance matrix as input, the network model was calculated via *qgraph* package (version 1.6.9; Epskamp et al., 2012) and *bootnet* package (version 1.4.3; Epskamp et al., 2018). In detail, edges are undirected and weighted, and they can be interpreted as partial correlation coefficients representing the unique association between two nodes, after controlling for all the other variables in the dataset (Epskamp & Fried, 2018). The GGM also uses regularization to attain a sparse network in which the small correlations to exact zero were shrink and spurious edges are removed. For this purpose, the Graphical Least Absolute Shrinkage and Selection Operator (gLASSO) with the Extended Bayesian Information Criterion Model Selection (EBIC; hypertuning parameter γ = 0.5) was implemented to the network estimation. This led the partial correlation network to be sparser and easier to interpret. After applying an EBIC gLASSO, blue edges represent the positive association between two nodes after controlling others in the network model, while thicker edges indicate stronger associations. Network visualization was derived from the Fruchterman-Reingold algorithm (Fruchterman & Reingold, 1991) which the nodes can be positioned in an informative way by placing a stronger association between two nodes close to each other, allowing more readability. Goodness-of-fit indices of the network model can be obtained from *qgraph* package (version 1.6.9; Epskamp et al., 2012).

Third, following the recent literature on psychological network analysis (Epskamp et al., 2018; Haslbeck & Waldorp, 2018; Jones et al., 2019), local network properties were investigated with three different centrality indices: *node strength*, *bridge strength*, and *predictability*. Findings from this analysis can be used to identify the relative importance of each node in the proactive work behavior network. Node strength represents how well a node is directly associated with other nodes and is calculated by the sum of the absolute weights of the edge linking the node to all other nodes (Epskamp et al., 2018). This can be done by *bootnet* package (Version 1.4.3; Epskamp et al., 2018). Bridge strength refers to a node's total connectivity with other clusters/communities

and is calculated by the sum of the absolute edge weights that exist between a certain node and all nodes that are not in the same community (Jones et al., 2019). For example, bridge strength of RBSE node is derived from the sum of the absolute edge weights of RBSE with other communities (i.e. self-leadership and the four forms of PWB, excluding psychological empowerment), using *networktools* (version 1.2.3; Jones, 2017). Predictability refers to the degree to which a certain node is predicted by all its neighboring nodes. This measure ranges from 0 to 1 indicating the amount of variance of a certain node accounted for by all the related nodes and provides an estimate of how much association we can have on a certain variable (e.g. taking charge) via all other variables in the model (Haslbeck & Waldorp, 2018). Predictability can be obtained by *mgm* package (Version 1.2–11; Haslbeck & Waldorp, 2018).

Forth, the accuracy and stability of the network model were evaluated to ensure the robustness of the network model (Epskamp et al., 2018). This step is necessary to carefully interpret network estimation and inference from network analysis. Two techniques suggested by Epskamp et al. (2018) were implemented using *bootnet* package (version 1.4.3; Epskamp et al., 2018): *edges accuracy* and *centrality stability*. Edge accuracy was examined by calculating a 95% confidence interval (CI) for each edge via nonparametric bootstrapping with 1,000 bootstrap samples. Also, stability of the centrality (i.e. node strength and bridge strength) was examined by computing the correlation stability (CS) coefficient derived from a case-dropping subset bootstrap method. This coefficient reflects how much of the original sample may be dropped while still keeping centralities that are highly correlated ($r = .70$) with the original sample. The value of CS-coefficient should not be below .25, adequate stability ranges between .25–.49, and preferred stability should be more than .50 (Epskamp et al., 2018).

5. Results

5.1. Preliminary analysis

Descriptive statistics can be obtained from Table 1. For the four forms of PWB, the mean scores ranged from 3.46 (voice; $SD = .59$) to 3.78 (problem prevention; $SD = .52$). The mean score of self-leadership was 3.60 ($SD = .52$). For the predictable outcomes, the mean scores of psychological empowerment and RBSE were 5.21 ($SD = .89$) and 3.29 ($SD = .66$), respectively. Zero-order correlation matrix is shown in supplemental table 1.

Before submitting the dataset to the network analysis, the multivariate normality assumption was checked (Epskamp et al., 2018). Finding from Henze-Zirkler's test (Henze & Zirkler, 1990) showed that the multivariate dataset deviated slightly from multivariate normality ($HZ = 1.53$, $p < .001$). Moreover, the result from the multivariate graphical approach using Chi-square Q-Q plot (see supplemental figure 1) found that there were some deviations from the straight line demonstrating the possible departures from a multivariate normal distribution. Epskamp and Fried (2018) suggested that non-normal data is often found in psychological data, and it can be relaxed by data transformation. To modify the distribution of the observed variables to that of the latent normally distributed variables, a nonparanormal transformation (H. Liu et al., 2009) was performed before the GGM analysis.

5.2. Network estimation

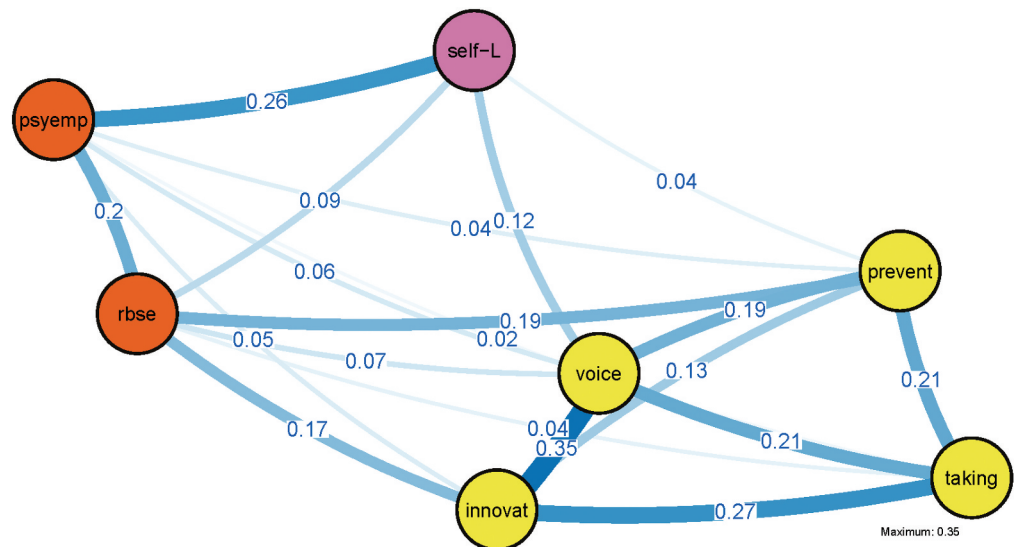
The proposed network linking self-leadership and PWB was estimated through GGM using the gLASSO in combination with EBIC model selection ($\gamma = 0.5$). This generated the network of regularized partial correlation coefficients that are shown in Table 1 and Figure 2. By using *qgraph* package, findings showed that the estimated network model fits with the data well (*Chi-square* = 1.45, $p = .48$; *CFI* = 1.00; *TLI* = 1.00; *RMSEA* = .00; *AIC* = 4605.98; *BIC* = 4698.15). Findings regarding the global network properties, out of 21 possible edges, 19 edges were non-zero indicating the network density of 90.48%. The mean weight (averaged partial correlation coefficients) was .13.

Table 1. Descriptive statistics, centrality indices, and regularized partial correlation coefficient matrix of the estimated network model of PWB												
	M	SD	Node strength	Bridge strength	Predictability	Regularized partial correlation coefficient						
						1	2	3	4	5	6	7
1. self-L	3.60	.52	-1.52	.51	.18	-	.26	.09	.00	.12	.00	.04
2. psyemp	5.21	.89	-.82	.44	.24		-	.20	.02	.06	.05	.04
3. rbse	3.29	.66	-.14	.55	.33			-	.04	.07	.17	.19
4. taking	3.69	.65	-.13	.06	.41				-	.21	.27	.21
5. voice	3.46	.59	1.30	.25	.49					-	.35	.19
6. innovat	3.57	.63	1.12	.22	.50						-	.13
7. prevent	3.78	.52	.18	.27	.39							-

Note. Node strength is standardized; two variables are independent after controlling all others variables in the network indicates by .00 in the regularized partial correlation matrix (EBIC gLASSO); self-L, self-leadership; psyemp, psychological empowerment; rbse, role-breadth self-efficacy; taking, taking-charge; innovat, individual innovation; voice, voice; prevent, problem prevention; variable 2 and 3 are the predictable outcomes; variable 4 to 7 are the four forms of PWB.

Figure 2. Regularized partial correlation network of self-leadership, predictable outcomes, and four forms of proactive work behavior.

Note. self-L, self-leadership; psyemp, psychological empowerment; rbse, role-breadth self-efficacy; taking, taking-charge; innovat, individual innovation; voice, voice; prevent, problem prevention; The regularized partial correlations or edge weights are all positive (colored blue), with thicker lines representing stronger correlations; To enable interpretability, the



For the estimated network in Figure 2, the network was overall positively associated. The strong associations in the network were found within the nodes of the PWB community. For instance, voice was positively associated with individual innovation (regularized partial correlation = .35), and taking charge had a positive association with individual innovation (regularized partial correlation = .27).

Furthermore, several points are worth revealing by zooming in on the links between self-leadership and the four forms of PWB as applied from the Performance Mechanism Model (Neck & Houghton, 2006). First, self-leadership had positive associations with two forms of PWB—voice and problem prevention (regularized partial correlation = .12 and regularized partial correlation = .04, respectively); however, no direct associations emerged between self-leadership and other's PWB (i.e. taking charge and individual innovation), these results partially supported H1. Second, associations were found between self-leadership and both predictable outcomes in the network model, for instance, self-leadership and psychological empowerment (regularized partial correlation = .26) and self-leadership and RBSE (regularized partial correlation = .09), thus supporting H2 and H3. Third, psychological empowerment had positive associations with all forms of PWB with the regularized partial correlation coefficients ranged from .02 (taking charge) to .06 (voice), thus supporting H4. Forth, RBSE also had positive associations with all forms of PWB with the regularized partial correlation coefficients ranged from .04 (taking charge) to .19 (problem prevention), these results supported H5.

5.3. Local network properties

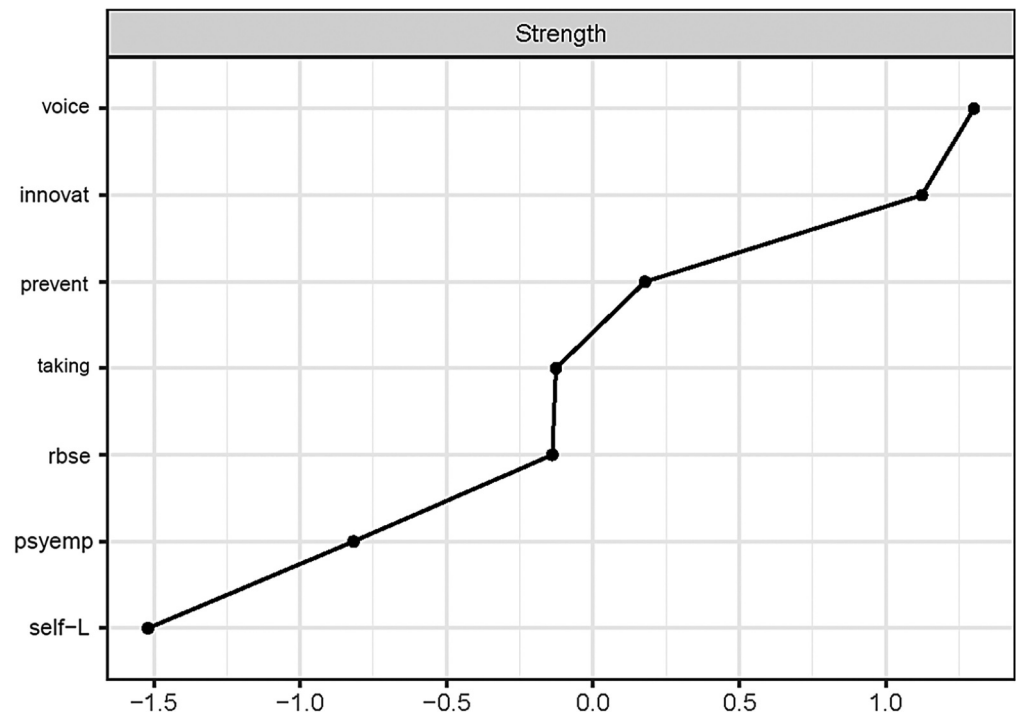
To examine the centrality of each node within the estimated network model, node strength, bridge strength, and predictability were estimated. These centrality estimates are shown in Table 1, Figures 3 and 4.

Regarding node strength, two forms of PWB (i.e. voice and individual innovation) exhibit the highest standardized node strength (please see Figure 3). This indicates that voice and individual innovation are the most central nodes and are likely to interact with other nodes in the current network. Self-leadership had the lowest standardized strength value.

Regarding the bridge strength, three communities within the estimated network model were specified by the Performance Mechanism Model (Neck & Houghton, 2006), as a guiding theory (Jones et al., 2019). This consisted of community 1 (four forms of PWB), community 2 (only self-

Figure 3. Node strength of the estimated network model.

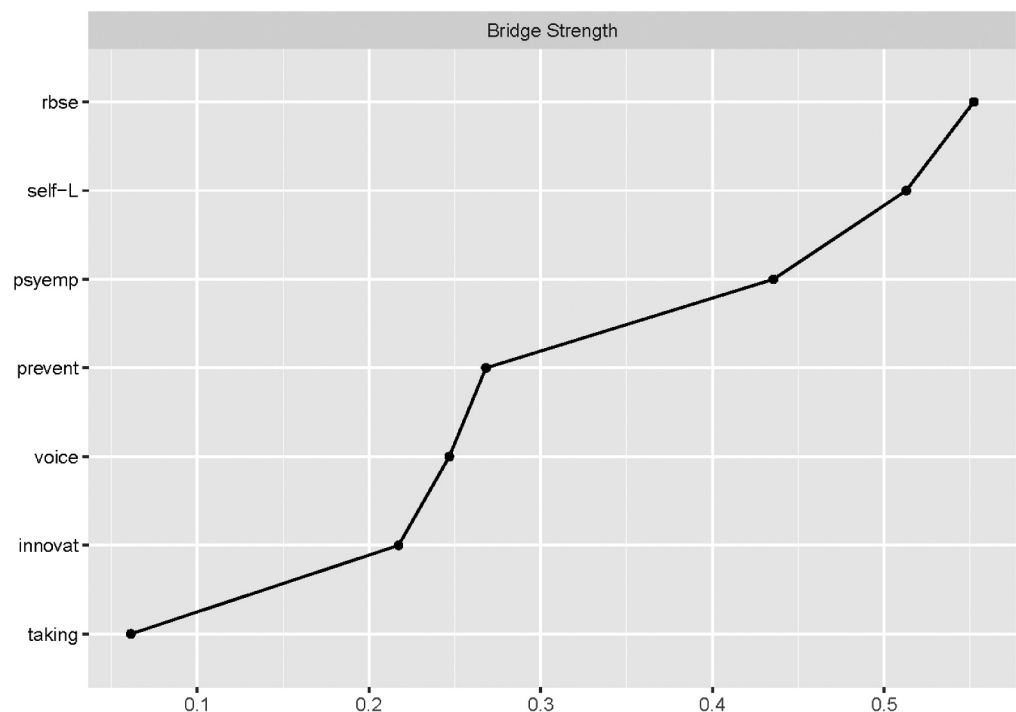
Note. Standardized values of the node strength were illustrated; a higher score indicates a more central node, reflecting that the nodes are stronger connections with others; self-L, self-leadership; psyemp, psychological empowerment; rbse, role-breadth self-efficacy; taking, taking-charge; innovat, individual innovation; voice, voice; prevent, problem prevention.



leadership), and community 3 (psychological empowerment and RBSE). The inspection of the bridge strength values is shown in Table 1 and is visualized in Figure 4. Across three communities, several nodes showed notable bridge strength values. Within the predictable outcomes (community 2), RBSE appeared to be a higher bridge node than psychological empowerment, meaning that RBSE showed to be of particular importance and may play the central pathway role linking with self-leadership and the four forms of PWB. Zooming in on the PWB community, problem prevention

Figure 4. Bridge strength of the estimated network model.

Note. Bridge centrality was estimated for each node in the network, ordered by highest raw value; Node with higher value represents stronger total connectivity with other communities; self-L, self-leadership; psyemp, psychological empowerment; rbse, role-breadth self-efficacy; taking, taking-charge; innovat, individual innovation; voice, voice; prevent, problem prevention; community 1 = taking, innovate, voice, and prevent; community 2 = self-leadership; community 2 = psychological empowerment and RBSE.



was the node with the highest bridge strength, representing its important role in the interplay between PWB and other communities (self-leadership and the two predictable outcomes).

Furthermore, node predictability ranged from .18 to .50, with an average of .363 which means that 36.3% of the variance of each node was explained by surrounding nodes. Interestingly, in Table 1, the forms of PWB illustrated the first four highest ranks in predictability values. Individual innovation had the highest predictability with 50% of its variance could be explained by other nodes. Voice had the second-highest predictability with 49% of its variance could be explained by its neighboring nodes. Self-leadership had the lowest predictability with 18% of its variance that could be explained by the neighboring nodes. Although on average 36.3% of each node's variance could potentially be explained by the other nodes within the current network, it is worth mentioning that the majority of variance (i.e. 63.7%) in the network was unexplained.

5.4. Accuracy and stability

Two techniques suggested by Epskamp et al. (2018) were used to examine the robustness of the estimated network model showing how probable it is to find a similar network when estimating the same network in another sample. First, the nonparametric bootstrap with 1,000 samples was used to identify the accuracy of edges. Figure 5 shows the resulting plots and 95% bootstrapped confidence intervals (CIs) around the estimated edge weights. The gray shade indicated that the CIs surrounding edge-weights (partial correlation coefficients) were of moderate size implying that interpreting the order of those edges should be done with some caution. Second, findings from the case-dropping subset bootstrap indicated that the stabilities of two centrality indices (i.e. node strength and bridge strength) were stable (please see Figure 6). The CS-coefficient for node strength was in a preferable range ($CS_{(cor=0.7)} = .516$), indicating that 51.6% of the data could be reasonably dropped to retain with 95% certainty a correlation of .70 with the original dataset. The CS-coefficient for bridge strength was also sufficient stable ($CS_{(cor=0.7)} = .594$).

6. Discussion

This study appears to be the first investigation of PWB from two angles that differ from past studies. It links self-leadership with PWB applying Neck and Houghton's Performance Mechanism Model. Meanwhile, these associations are investigated using network analysis, indicating that

Figure 5. Accuracy of the edge-weights for the estimated network model.

Note. The horizontal gray area within the plot shows that 95% bootstrapped CIs around the edge weights (1,000 bootstrapped samples); the red dots show the sample values, while the black dots show the bootstrap mean values.

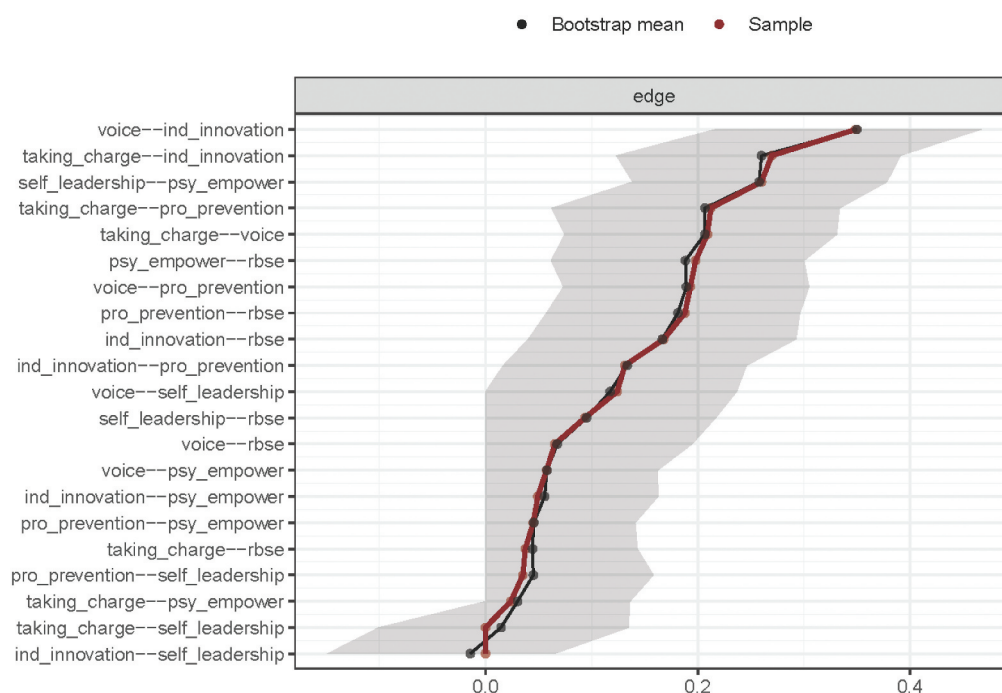
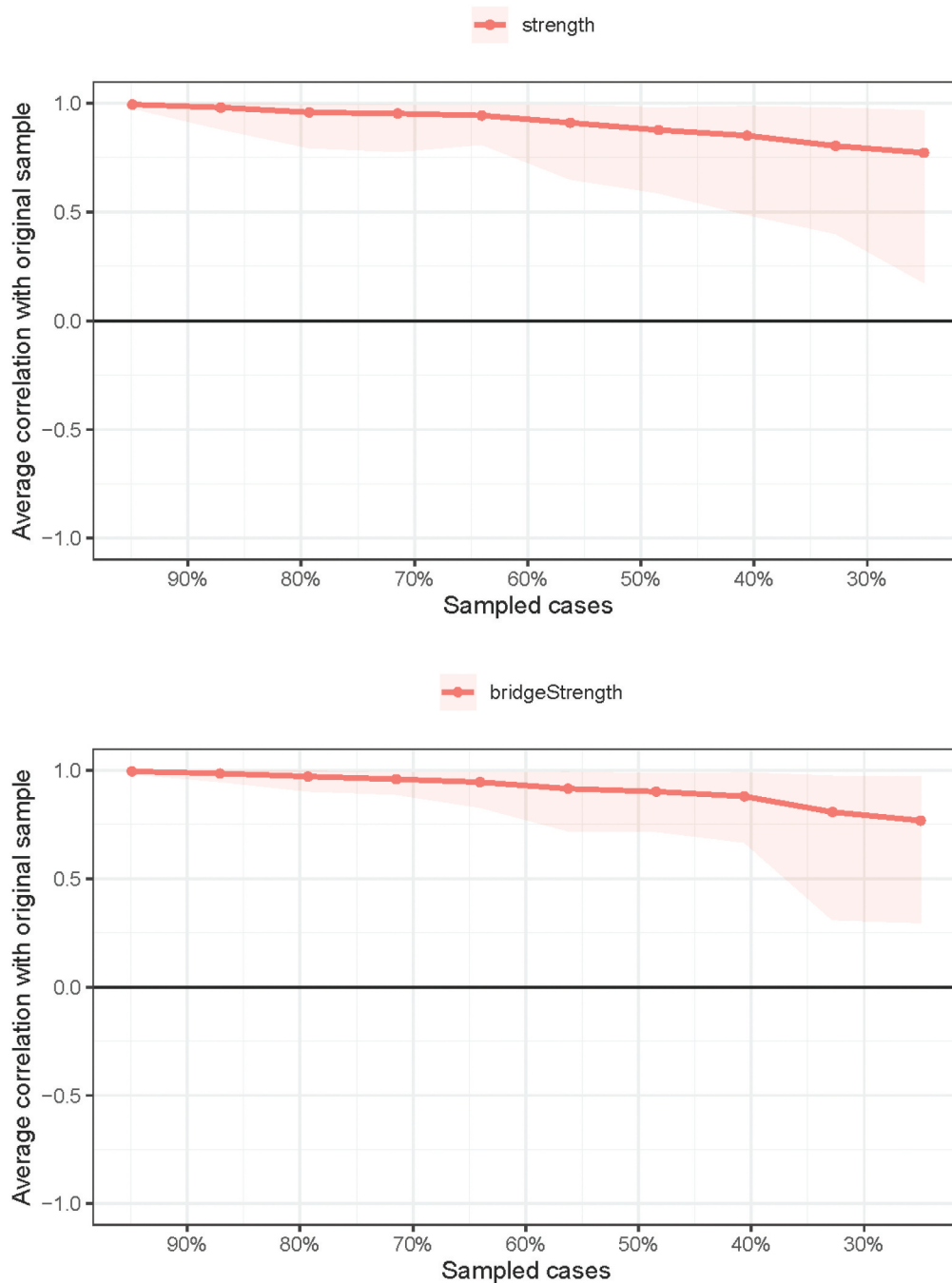


Figure 6. Stability of node strengths and bridge strengths.

Note. The red line represents the average correlation between centrality indices of the network sampled with participants dropped and the original sample. The areas represent the range from the 2.5th quantile to the 97.5th quantile.



those forms of PWB should not be studied independently, but the room should be allowed for research into the complexity and interplay between these behaviors. Several findings are worth discussing.

Results of centrality indices examination using bridge strength centrality and predictability show that two forms of PWB, voice and individual innovation, are the most central nodes in PWB network. It indicates that these two forms of behaviors have the strongest connections with other variables and mainly activate the exhibition of PWB among operational employees. It denotes that the key behaviors of PWB involve the situation in which individuals have chances to provide the suggestions

on innovative ways to change their work methods as well as can communicate such constructive ideas to their teams. This is consistent with Morrison (2011)'s suggestion, employee voice behavior is considered as the valuable form of PWB for an organization—individuals make attempts to challenge the status quo and provide anticipatory suggestions for positive changes. Thus, operational employees being able to proactively change their current tasks must have chances to voice their suggestions, concerns, or even opinions about work-related issues with the intention to improve work processes for teams and organization. Also, the employees are willing to take risks if such ideas could lead to future constructive outcomes (Morrison, 2011). Besides chances to voice opinions about work, to undergo experience of individual innovation is also important in the promotion of PWB. The essence of this behavior is to implement the shared ideas with others and to create novelty (Parker & Collins, 2010). Examples of individual innovation behaviors, the key indicators of PWB, include seeking new technology, procedure, and work techniques as well as creating constructive ideas and selling such ideas to co-workers (Scott & Bruce, 1994). In brief, voice and individual innovation are the key to the cultivation of employees' proactivity that management should pay attention to.

Results of partial correlation analyses showing relationships between variables in the network based on the literature review linking self-leadership with the forms of PWB reveal that self-leadership has positive direct associations with psychological empowerment and RBSE, implying that individuals using self-leadership strategies could effectively control themselves and their work environments. The experience of being successful in self-management leads to increased perceived self-efficacy on work performance (Prussia et al., 1998). Specifically, when job descriptions require individuals to perform a variety of tasks and demonstrate broader skills and abilities. Their beliefs in the ability to execute tasks would arise out of successful self-directed experience (Parker, 1998). Findings based on network analysis are also consistent with Neck and Houghton's Performance Mechanism Model, suggesting that using self-leadership strategies results in one predictable outcome—perceived self-efficacy. This study provides the first empirical evidence of the link between self-leadership and RBSE. Moreover, the result shows that self-leadership has a direct association with psychological empowerment. It indicates that the operational employees who effectively use self-management and self-motivation skills would have psychological experiences involving perceived self-worth as well as feel that they can control and make decisions on their own (Amundsen & Martinsen, 2015). That is consistent with Neck and Houghton (2006), the ability to regulate one's own behaviors and thoughts enables individual to realize their inner strength and motivate themselves to execute work effectively. Accordingly, the results of this study are consistent with previous international studies (Amundsen & Martinsen, 2015; Lee & Kim, 2013; C. S. Lee et al., 2007).

The results of PWB network analysis also discover a positive direct association between self-leadership and voice, indicating that the operational employees being able to regulate and monitor themselves to carry out the given tasks are likely to exhibit voice behaviors, communicate their opinions on work-related issues, and provide suggestions that would benefit team performance (Parker & Collins, 2010). This is consistent with Neck et al. (2020), and self-leadership strategies would enable individuals to focus on the tasks at hand and circumstances such as considering and monitoring work standards or goals. Furthermore, self-reliant individuals would be goal-oriented and engaged with the ideas about improving their performance. These individuals tend to voice their opinions and suggestions to colleagues and management about possible future events (LePine & Van Dyne, 1998). Furthermore, the network shows that self-leadership has a positive direct association with problem prevention. Self-regulatory theory, one of the theories that lay the foundation for self-leadership (Neck et al., 2020), can be used to explain this association. Individuals who are competent in regulating their behaviors would make attempts to monitor the behaviors, to what extent they are aligned with standards or desired states and have them improved when determining that the behaviors are failed to meet the standards. Such viewpoint is consistent with the context of the participants in the study conducted by Parker and Collins (2010), problem prevention is crucially important for operational employees in charge of planning and managing the operation of the workplace. If individuals could effectively regulate and monitor themselves, they would be able to monitor their performance, which might involve work circumstances as well. As a result, it is possible to anticipate future issues and figure out the solutions beforehand.

Moreover, the findings show that both predictable outcomes, RBSE and psychological empowerment, have positive direct associations with self-leadership and with all four forms of work behaviors. These are consistent with Neck and Houghton's Performance Mechanism Model and previous studies in other countries (Kotzé, 2017; Searle, 2011). Moreover, the analysis of bridge strength among nodes in the network indicates that RBSE may play as the most important pathway role between self-leadership and a cluster of PWB forms. Such a result implies that RBSE might play the mediator role linking the associations between self-leadership and the forms of PWB. Although direct relationships between self-leadership and two forms of PWB, taking charge and individual innovation, are not found; the bridge strength centrality reveals that self-leadership might have indirect relationships with these forms of PWB, through RBSE, which mediates these relationships. This result is consistent with Neck and Houghton's Performance Mechanism Model, suggesting that those operational employees who are competent in leading and motivating themselves would be likely to complete multiple tasks at hand. Such successful experiences promote positive states and give employees a feeling of confidence to perform broader tasks than their specified job-role descriptions. These tasks may involve proactive work such as suggesting key information to improve the unit by concentrating on the big picture, design and improve work methods, and solve long-term issues (Parker, 1998). Having confidence to practice proactivity at work in which more diverse operations are required would subsequently enable individuals to take actions and exhibit more proactive behaviors (Axtell & Parker, 2003).

7. Practical implications

To promote PWB among operational employees, the following practical implications are presented for the management practitioners.

First, findings indicated that RBSE plays the most important pathway from self-leadership to the forms of PWB. Thus, encouraging operational employees to become confident of performing broader tasks and initiating work methods that required additional interactions with colleagues might continue to have effects on PWB cultivation. Managements can create opportunities for experiences of achievement through forming operation improvement teams that require all operational employees to take on roles and are in charge of solving work issues related to their jobs' positions at team level or even organizational level. Managements may raise work issues and facilitate employees to engage in designing the methods that might involve extra-role workload. The improvement team must use individual creativity and interpersonal skills; also, the team members might use motivational and persuasive communications to promote self-confidence to improve work methods. Such aforementioned activities would be a part of establishing successful experiences and enable individuals to be confident in performing proactive roles that are diverse and exceed their typical work routines.

Second, organizational policymakers should formulate the policies supporting culture that facilitate working in a broader scope. In particular, organizational communication is an important process for exchanging information and motivating operational employees to become aware of the benefits and learn from their co-workers, which increases RBSE.

Lastly, findings also showed that self-leadership has direct associations with two forms of PWB: voice and problem prevention. Therefore, managements should initiate the change of work environment and procedures from the traditional management to self-managed work team (Manz & Sims, 1991). Such approach requires transitions in roles and functions of a team leader from controlling and command to providing suggestion, sharing information, giving feedback, and encouraging operational employees to influence themselves (e.g. setting challenging personal goal, self-monitoring, and self-evaluating; Stewart et al., 2019). The self-managed work team would make operational employees feel that they take on responsibility and have experiences of self-rewarding, including feel proud of their proactive tasks that effect change or feel that they are valuable team members. Experiences of being in such team allow individuals to feel confident and subsequently gain more faith in exhibiting proactive behaviors.

8. Research implications

Although the findings in this paper are compelling, there are a few limitations worth mentioning, as they suggest areas for future investigation.

First, the emphasis of future investigations could be broadened by including interesting variables into the PWB network. For example, those who are interested might incorporate other psychological attributes and job resource factors related to PWB such as employee intrapreneurship (Gawke et al., 2017), strength use (Bakker, 2017), human resource practices (H. W. Lee et al., 2019), and organizational support (Caesens et al., 2016).

Second, self-leadership is the aspect of individuals who can lead and influence themselves. In practice, individuals must carry out their jobs following the chain of command, referring that management or supervisor determine directions and support employees' operations. Therefore, it is interesting to explore leadership characteristics relating to employees' self-leadership and PWB such as leader support (Wu & Parker, 2017) and empowering leadership (Martin et al., 2013).

Finally, self-leadership in the current study was measured as the overall self-directed and self-influenced attribute. However, it can be divided into various strategies that individuals use to manage themselves. Thus, a further study could use the Revised Self-Leadership Questionnaire (RSLQ; Houghton & Neck, 2002) measuring and analyzing the following leadership strategies separately: (1) Behavior-focused strategies; (2) Natural reward strategies; and (3) Constructive thought pattern strategies. Linking between self-leadership strategies and forms of PWB would provide a practical advantage to personnel effectiveness development. It would help in reflecting on key leadership strategies that are closely related to PWB promotion.

9. Conclusion

This is the first study to provide empirical evidence for the link between self-leadership and PWB. A strength of this study includes applying a new statistical analysis approach, the psychological network analysis to investigate such associations. This research shows that voice and individual innovation are the most important aspects of PWB among operational employees. By giving the employees opportunities to share their suggestions and opinion about work-related issues as well as the responsibility to introduce new technology and work procedures to the team, PWB can be cultivated. The findings also indicate that self-leadership had positive associations with voice and problem prevention and RBSE may play the most important pathway role between self-leadership and PWB forms. The Performance Mechanism Model plays an important perspective in establishing these aforementioned associations. This study suggests that organizational policymakers pay greater attention to promoting the operational employees' confidence to conduct proactivity at work in which more diverse operations are required about improving proactive behaviors.

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