**ORIGINAL ARTICLE**

# A network approach to the relationship between career adaptability and starting salary among graduates

Yutong Liu[1,2] · Bin Ling[1] · Dusheng Chen[3]

## Abstract

Career adaptability is a psychological resource for individuals to deal with career events, and it is a system of human-environment interaction. The components of the career adaptability concept are not independent of each other but rather an interactive network. The present study aims to shed light on the nomological network of career adaptability and the starting salary by investigating their indicators using network analysis to reveal their structural networks and interrelationships. In addition, we compared the similarities and differences between the networks of different gender groups. Results indicate that career adaptability directly connects to starting salary for graduates, and some indicators are the core factors that influence starting salary. Besides, the global structure of gender-specific networks is very similar. However, some differences have been detected, such as becoming curious about new opportunities is the male network's core, while the core of the female network is doing the right thing.

## Introduction

Career adaptability, defined as "a psychosocial construct that denotes an individual's readiness and resources for coping with current and imminent vocational development tasks, occupational transitions, and personal traumas" (Savickas, 2005, p. 51), has increasingly caught scholars' attention in the field of vocational behavior. Career adaptability matters because it is a core self-regulation capacity and psychological resource for managing career change, occupational transitions, and career development. Previous studies have shown that career adaptability is beneficial to successful school-to-work transition(Fang & Saks, 2022), job search self-efficacy and employment status (Guan et al., 2013), subjective career success (Zacher, 2014), and reducing job content plateaus (Jiang, 2016).

Career adaptability is considered a complex construct consisting of four dimensions: concern, control, curiosity, and confidence (Savickas & Porfeli, 2012). As Savickas (2013) suggested, disequilibrium among four dimensions will produce problems in constructing careers. Therefore, it is important to identify the interesting relationship patterns between the four components of career adaptability to accurately estimate its internal structure, which could be overlooked if one focuses exclusively on potential variables. Traditionally, most studies adopt the latent factor approach (Costantini & Perugini, 2016) to conceptualize career adaptability. However, this focus overlooked the internal combination of the unique characteristics of career adaptability. In other words, they fail to capture how the specific resources of career adaptability fit together, including the patterns and interactions they combine (Parmentier et al., 2021). As a result, the structural pathways among the components of career adaptability, which cut across the boundaries of the different dimensions, are not reflected in traditional latent

✉ Bin Ling
ling.bin@hotmail.com

Yutong Liu
liuyutong1214@163.com

Dusheng Chen
risemail@163.com

[1] Business School, Hohai University, 8 Focheng West Road, Nanjing, Jiangsu 211100, China

[2] Department of Psychology, Harbin Normal University, 1 Shida Road, Limin Economic Development Zone, Harbin, Heilongjiang 150025, China

[3] Hangzhou Hikvision Digital Technology Co., Ltd., 518 Wuliangwang Road, Hangzhou, Zhejiang 310051, China

variable models. For example, it is important to consider whether the behavioral characteristics of career adaptability, such as chronically elevated global career adaptability, are likely to arise from the structural pathways among the observed variables. Therefore, there is a need for a more nuanced approach that goes beyond the traditional latent factor model to better capture the complex structural pathways of career adaptability.

To address these issues, we use the network approach (Borsboom, 2017; Isvoranu et al., 2022; Schmittmann et al., 2013) in this study to improve our understanding of the structure of career adaptability, which may lead to better forecast and management. The network approach views a phenomenon of interest as an emergent property, where the components of a network "work together" to produce the emergent phenomenon (Isvoranu et al., 2022). In this view, the network model acts like a "mediator" between the theoretical framework and the empirical data, providing a structure that optimally organizes the links between multiple variables (Isvoranu et al., 2022). Typically, links between variables are not directly observable, and existing studies are insufficient to assess the presence or absence of links. In such cases, network models can evaluate how relevant components are co-varied, making them highly helpful.

Compared to the traditional measurement model, the network approach has unique advantages when dealing with the complexity of conceptual systems. First, the network approach can identify both shared and unique attributes of a structural model of a construct (Costantini & Perugini, 2016), which can highlight the specific features of each dimension and reveal the mechanisms responsible for the structural model of career adaptability. Second, the network approach is more advantageous in exploring the relationships among observable indicators of a multidimensional construct. It can visually show the cluster of the indicators and encourage the analysis of the interrelations among all indicators (Borsboom, 2017; Schmittmann et al., 2013). Moreover, the network approach does not assume a latent factor underlying the indicators and dimensions. Instead, it examines the relations between indicators and constructs by exploring the interrelations among indicators (Epskamp & Fried, 2018; Schmittmann et al., 2013). Given the strengths of the network approach, we believe the network approach may provide a new perspective that reveals how components of adaptability, such as attitudes, beliefs, and abilities, interact mutually to activate career adaptability. Therefore, the network approach is good at exploring the structural pathways model of career adaptability we articulated above.

In the current study, we make several theoretical contributions. First, we break new ground in the career adaptability literature by adopting a network approach and focusing on network psychometrics. By analyzing the structural

pathways between career adaptability and starting salary, we identify key indicators that can better predict starting salary, such as *realizing that today's choices shape the future* and *learning new skills*, which goes beyond previous studies that focused only on the construct level relationship between career adaptability and salary (e.g., Guan et al., 2013; Zacher, 2014). Second, we identify gender differences concerning the network psychometrics of career adaptability. As previous work has shown that males and females use adaptabilities differently when constructing their careers (Zhang et al., 2021), we expected the interaction structure of career adaptability indicators to vary with different genders and were supported by the results. For example, we found that male adaptability factors such as future choices and learning new skills had the strongest correlation with salary, while for females it was thinking about the future and learning new skills. Learning new skills was important for both, but had a stronger correlation for males. Third, our study highlights the importance of the network approach in evaluating the relationship between career adaptability and starting salary, which provides new insights into the complex structural pathways of this relationship, offering exciting avenues for future research in this area.

## Theoretical background

### Career adaptability and its dimensions

Career adaptability is a psychosocial construct for individuals to cope with critical changes in job hunting and career construction. Prior work has suggested that career adaptability is a crucial self-regulation ability and psychological resource for individuals to cope with career transition (Savickas & Porfeli, 2012). According to career construction theory, the concept of career adaptability is performed by multiple subsystems of four adapt-abilities: (a) becoming concerned about career development in the future (concern), (b) taking responsibility for one's career through self-discipline (control), (c) being curiosity about possible future selves (curiosity), and (d) developing confidence in future career planning and implementation (confidence) (Savickas, 2005). Career construction theory organizes four dimensions of career adaptability into a structural model with three levels (Savickas, 2013).

At the highest or abstract level, career adaptability is the high-order commonality among four dimensions, and these dimensions are the general resources and self-regulation strategies that individuals use to adapt to vocational environments and transitions. Career adaptability and its dimensions are considered a latent model (Savickas & Porfeli, 2012). The commonality manifested by career adaptability

reflects the shared psychological attributes underlying the four adapt-abilities. The shared attributes refer to the common variances shared by concern, control, curiosity, and confidence (Savickas & Porfeli, 2012). Most studies on career adaptability have been conducted at the abstract level, mainly through the four adapt-abilities to construct career adaptability (Jiang, 2016; Savickas & Porfeli, 2012; Zacher, 2014). However, these existing studies have neglected the unique psychological features of the four career adaptabilities when constructing career adaptability and examining its mechanism.

At the intermediate level, each dimension includes a unique set of attitudes, beliefs, and competencies that shape people's career self-concept and lead to different problem-solving strategies and adaptive behaviors (Savickas, 2005, 2013). The four dimensions are related but different in defining career adaptability since each is also characterized by unique attributes that are not shared with other dimensions. For example, control disposes individuals to hold a decisive attitude and belief toward tasks and problems of career adaptability and to be armed with a competency of decision making; by comparison, confidence makes individuals have an efficacious attitude and belief and be armed with a competency of problem-solving (Savickas, 2013). Identifying the unique attributes of each dimension is very important to explore the different roles played by different dimensions (Costantini & Perugini, 2016). However, studies highlighting each dimension's uniqueness and its interrelation are limited.

The third level in the structural model concerns specific adaptive functions (Savickas, 2013). These functions are composed of different adaptive strategies and behaviors for each dimension, thus forming the corresponding adaptive functions of orientation, exploration, establishment, maintenance, and disengagement that allow people to cope with occupational tasks, transitions, and trauma. These adaptive strategies, behaviors, and functions are unique characteristics that belong to a dimension, are not shared with other dimensions, and are usually measured by specific, observable indicators. Eventually, this unique attribute is reflected at the individual level, in the form of different rates and profiles of development among four dimensions of career adaptability (Savickas, 2005, 2013).

However, based on the latent variable model, extant research generally has used the highest level of the conceptual hierarchy—the abstract level—to define career adaptability, considering global career adaptability as a potential common cause of its four dimensions. However, the traditional latent variable model only emphasizes the covariation between the indicators but ignores the unique attributes between the indicators and classifies this specificity as measurement error (Costantini & Perugini, 2016).

In addition, this traditional definition of career adaptability at the abstract level leads us to ignore other levels of the concept and fail to see the interaction patterns of the internal structure (Haenggli & Hirschi, 2020). For instance, is there an interaction between the adaptability resources of individuals? Whether and how does this interaction affect the global concept of career adaptability? In this case, the explanation of the latent variable model is limited. This limitation makes it challenging to explain the causality of the career adaptability measurement model and hinders the study of causality in practical problems. Similarly to the Causal Attitude Network (CAN) model (Dalege et al., 2016), we argue that, in the network model of career adaptability, it appears that individuals' adaptability resources are growing through their interactions until they develop a certain level of adaptability.

## Network analysis for the effect of career adaptability on starting salary

Prior work has shown that job search is the most important part of the career transition (Fang & Saks, 2022; Hlaďo et al., 2019; Steiner et al., 2022). College graduates' job search success (e.g., finding a job with a desired starting salary) is important for a smooth transition from school to work and for long-term career success (Steiner et al., 2022; Kanfer et al., 2001) conceptualized job search as a self-regulatory process reflecting goal orientation because job search is largely self-managed and characterized by uncertainty, competition, and multiple frustrations (Fang & Saks, 2022). As an important self-regulatory psychological resource, career adaptability will promote college students' self-regulatory ability in the job search process and increase individual employability (Guan et al., 2013). For instance, career adaptability positively correlated with salary (Coetzee & Stoltz, 2015), job-search self-efficacy (Matijaš & Seršić, 2021), and proactive career behaviors(Spurk et al., 2020), employment status (Guan et al., 2013), employment quality (Koen et al., 2012), and employability (Praskova & Johnston, 2021).

Although it has been found that career adaptability is related to starting salary (Pan et al., 2018). However, when considering the multiple psychological resources measured by career adaptability, these psychological resources do not appear to play an equal role. For example, when all four components of career adaptability are considered simultaneously, career concern is likely to be the most influential in employment status compared to the other dimensions (Guan et al., 2013). In particular, knowledge and skills are more strongly connected to salary than other career resources when considering broader career-adaptive resources(Haenggli & Hirschi, 2020). These results suggest

that the effect on starting salary might depend on the interaction of specific career adaptability indicators. However, past research has typically focused on global career adaptability (Parmentier et al., 2021), or used the four career adaptability resources to explain a range of outcomes (e.g., Rudolph et al., 2017), with few studies examining the structural pathways between the specific core resources of career adaptability (e.g., Haenggli & Hirschi 2020). As a result, the structural pathways between different career adaptability resources and their unique impact on starting salary remain unclear.

To address these issues, this current study depicts the structural pathways between career adaptability and starting salary using the network approach. As we elaborated above, the network analysis approach highlights the structural pathways of interaction between various nodes in the network(Isvoranu et al., 2022). By constructing a network model that includes indicators of career adaptability and starting salary, we aim to clarify how the indicators of career adaptability interact with each other, and which indicators have the strongest and most central impact on starting salary. In addition, we wanted to explore the relative importance of the observed indicators of career adaptability in the pathways to starting salary. Thus, we propose the first research question.

*Research Question 1: What are the network structural pathways by which career adaptability affects starting salary?*

### Network-based gender differences between career adaptability and starting salary

The second goal of this study is to compare the network structural pathways by which career adaptability affects starting salary across genders. Gender differences should be considered when investigating the relationship between career adaptability and starting salary. Because prior work has pointed out the disparities in career success and remuneration between males and females (Woehler et al., 2021). In practice, the gender pay gap comes out as early as the beginning of graduation. There is much empirical evidence that female graduates have significantly lower average salaries than male ones (Säve-Söderbergh, 2019). Previous research has found that men and women also show different strategies for career adaptability (Hlaďo et al., 2019). When discussing the gender-related findings, however, the results are ambiguous. Research has shown that males were significantly higher than females in overall career adaptability and showed higher control, curiosity, and confidence levels (Hlaďo et al., 2019). Males seem to have more severe career concerns than females (Coetzee & Harry, 2015), and the lower the professional self-doubt for males, the more career

concern and in-depth exploration (Zhang et al., 2021). In contrast, some research concludes that females have higher career adaptability than males and exhibit more career focus and career confidence (Duarte et al., 2012). However, current research explains little about how the association between career adaptability and starting salary changes across genders. Therefore, we propose the second research question:

*Research Question 2: Do networks of career adaptability and starting salary express internal structural differences across genders?*

## Methods

### Network analysis of career adaptability

In the last decade, network analysis has gained much attention in psychometrics (Robinaugh et al., 2020). Exploratory research using network models is already widely used and has produced a wealth of research outputs in clinical psychology (Lunansky et al., 2021), personality (Papageorgiou et al., 2019), emotions (Deckard et al., 2022), and attitude (Dalege et al., 2016). A network is an abstract model consisting of nodes and edges. Nodes represent observed variables, usually abstract entities (such as items), whereas edges represent potential connections and relationships among these nodes. For psychometric purposes, scholars can explore the conceptual structure of a variable by visualizing network patterns of multiple items (Robinaugh et al., 2020).

Network models are helpful because they contain rich information, such as spatial characteristics of the variable network structure (e.g., is the network dense or sparse?), the hierarchy of particular nodes in that structure (e.g., central versus peripheral nodes), and the possible ways in which variables are affected by particular external factors (e.g., which nodes in the network are connected to external factors?) (Isvoranu et al., 2022). Network analysis can infer which nodes are more important based on network characteristic indexes, such as the centrality index. There are three kinds of centrality indices, namely strength centrality, closeness centrality, and betweenness centrality (Costantini et al., 2015). Strength centrality refers to the intensity of the connections between notes; closeness centrality quantifies the distance between a node and other nodes within a network; and betweenness centrality quantifies the distance of the shortest path between a node and other nodes (Costantini et al., 2015).

In this current study, we believe network analysis provides a novel approach to the psychometric structure of career adaptability and increases the precision of conditional associations between items of career adaptability

(Isvoranu et al., 2022). Generally, most scholars have used latent variable analysis (e.g., confirmatory factor analysis, structural equation modeling) to construct the multidimensional structure of career adaptability by exploring the common variances or factors between a set of items (Rudolph et al., 2017). Latent models are used to model potential common causes and verify the causality through the non-cyclic directional model (a variable does not directly or indirectly cause itself) (Foygel & Drton, 2010). This latent variable approach involves strong assumptions about the estimated model, such as local item independence, and multivariate normality (Bollen, 2002). However, these statistical assumptions are often violated because of measurement errors, temporal dependence on data collection, and observational dependence (Borsboom et al., 2021). Network analysis is suitable to estimate the psychometrics attributes that concern the relationship between constructs and manifest indicators and the conditional associations among indicators without strong a priori statistical assumptions (Borsboom et al., 2021). Compared with latent variable models, networks have more advantages in exploring indicators' relationships. Network analysis allows for the dependence of variables and the control of each variable, focusing more on the unique variance between variables rather than the shared variance across variables (Costantini et al., 2015). As stated by Savickas (2005), the psychometric structures of career adaptability are extraordinarily complex and heterogeneous. Within the conceptual hierarchy of career adaptability, its manifest variables may represent different patterns of conditional associations and they are interconnected with different weights. Hence, network models are explorative tools that can be used to assess the structure of adaptability networks based on empirical data(Costantini et al., 2015; Schmittmann et al., 2013).

## Participants

This study recruited graduating students from a university in southeastern China as participants. The data was collected in March, which is graduation and job search season in China. During this period, companies launch recruitment campaigns, and graduates, as job seekers, actively seek employment and start their careers. Collecting data during the recruitment season is ideal for studying career adaptability among college students (Guan et al., 2015), as it captures the critical period of school-to-work transition and the need to improve career adaptability (van der Horst et al., 2021). With the assistance of the staff from the Student Career Guidance Center, we distributed questionnaires (about 5,000 people) to graduates, and they should sign informed consent before filling out the questionnaires (e.g., career adaptability, starting salary, and other job search

information). In the end, we obtained 1021 valid questionnaires. Of these, twenty-eight students did not report gender (2.7%). To maintain the integrity of the sample data, we responded to the first research question with a full sample (N = 1021) to analyze the network structure of career adaptability, and to the second research question with a sample (N = 993) excluding the 28 participants to compare the gender differences in the network structure. Of these 1021 subjects, 55.9% were male, 41.3% were female, and 2.7% had missing gender values. They have diverse professional backgrounds, including Engineering (20.9%), Science (4.6%), Agricultural and Biological Sciences (14.5%), Humanities (5.1%), Social Sciences (18.1%), Informatics (25.9%), and Medicine (11.0%). Participants applied for jobs with different levels of effort and results, leading to an average of 18.99 resumes (± 31.13), 5.85 interviews (± 6.31), and 2.15 offers (± 2.05).

## Measures

***Career adapt-abilities.*** Career adaptability was measured with the Career Adapt-Abilities Scale (CAAS) (Porfeli & Savickas, 2012), which consisted of 24 items ranging from 1 (strongly disagree) to 5 (strongly agree). This scale includes 4 sub-scales: concern ($\alpha = 0.83$; e.g., 'Thinking about what my future will be like'), control ($\alpha = 0.74$; e.g., 'Keeping upbeat'), curiosity ($\alpha = 0.79$; e.g., 'Exploring my surroundings'), and confidence ($\alpha = 0.85$; e.g., 'Performing tasks efficiently'). We performed a confirmatory factor analysis (CFA) to test the fit of the career adaptability. The result of the CFA indicated a good construct validity ($\chi^2 = 1767.19$, $df = 238, \chi^2_{/df} = 7.43, CFI = 0.95, TLI = 0.94, RMSEA = 0.08$, $SRMR = 0.03$).

***Starting salary.*** We use starting salary as a standard indicator of outcome (Haenggli & Hirschi, 2020; Pan et al., 2018), with initial annual gross earnings ranging from (1) RMB 30,000 to (8) > RMB 310,000; and the average annual salary of the participants was RMB 85,700(± 52,600). The participants also reported on their job search outcomes, including how much they had applied for a job, participated in interviews, received offers, and earned annual salaries.

## Analytical strategy

The open-source statistical software "R" (R Core Team, 2022) was used in this study to construct, visualize, and analyze psychological network models. The network model is represented by the Gaussian Graphical Model (Costantini et al., 2015). First, to avoid false correlation, such as the situation where two variables are statistically correlated but not correlated, we use the regularization method to dilute the network model to obtain a clearer and more

readable network model. Specifically, we used the "Graphical LASSO" algorithm in R-package "Glasso" (Friedman et al., 2015). In this algorithm, the sparse inverse covariance matrix is used to estimate the partial correlation through the inverse matrix of the covariance matrix (accuracy matrix) and the positive proportion of the partial correlation matrix to obtain the sparse inverse covariance matrix model, which can restore the diagonal structure and avoid overfitting (Foygel & Drton, 2010). Second, we use the Extended Bayesian Information Criterion (EBIC) to control the sparsity of the network, and all the normalized edges are displayed in the network model, explaining the data as fully as possible while following the principle of Minimalism (Chen & Chen, 2008).

In addition, this study compares male and female networks using the Network Comparison Test (NCT; Van Borkulo et al., 2022). NCT is a sort-permutation method to directly compare the network structure of two cross-sectional datasets, which mainly includes three aspects: (1) network structure invariance; (2) global strength invariance; (3) edge weight invariance (Van Borkulo et al., 2022). The concrete steps are: (1) The original data of different groups are used to estimate network structure through correlation, and the network models of the two groups of samples are obtained; (2) The distribution interval of the network model is re-estimated by rearranging the members of the group repeatedly and randomly; (3) Whether there are significant differences in the original network model in step (1) is evaluated based on the distribution interval (Van Borkulo et al., 2022).

Following the recommendation by Epskamp and Fried (2018), this study adopts polynomial correlation to construct the network model and realizes automatic operation processing through the R-package "qgraph" (Epskamp & Fried, 2018), "NetworkComparisonTest" (Van Borkulo et al., 2019), and "ggplot2" (Wickham et al., 2016). In the first step, we try to build a network model of career adaptability, then include starting salary to analyze the overall network model. In the second step, we analyze the network differences between career adaptability and starting salary from the perspective of gender. To explore the performance and differences of different genders in career adaptability and starting salary, we divide the investigation samples into the male group (n=571) and female group (n=422) and analyze and compare the constructed network of the two samples. Finally, we explore the shortest paths between career adaptability and starting salary in the two network models. The effective paths between career adaptability and starting salary can be observed through the visual network structure figure, thus revealing how career adaptability is activated to starting salary. In addition, each network was tested for accuracy in this study.

## Results

### Network analysis

Figure 1a-b describe the networks of (a) career adaptability and (b) career adaptability and starting salary. The different colors of the nodes represent the dimensions to which the project belongs, generally with the green edge and red edge representing a positive correlation and a negative correlation, respectively. Figure 1c reports the shortest path network model of career adaptability and starting salary, where edges that belong to the shortest path are represented by solid lines, while dashed lines represent background edges. Figure 2a-b shows the centrality of each network, and based on the evaluations of accuracy and stability, such as confidence interval of edge weight accuracy and difference test for center stability and centrality, the centrality indicators are deemed interpretable (see Supplementary Materials).

In Fig. 1a, the network model of career adaptability shows a clustering of the four dimensions, with the structure of concern dimensions being relatively close while the control, curiosity, and confidence structure is relatively distant and mixed with other dimensions. Centrality, an essential indicator of the network model, is determined by measuring the importance of certain nodes in the network. Nodes with high centrality have larger weights, more connections to other nodes, and are considered important nodes in the network. Proceeding to Fig. 2a, the nodes with the highest centrality in the career adaptability network are *being aware that having to make educational and career choices* (CN4), *probing deeply into questions* (CY5), and *learning new skills* (CE3). These nodes have many connections to other nodes, indicating that they are the most influential nodes in the career adaptability network. Furthermore, Fig. 2b shows that the core structure of the network containing starting salary is similar to the career adaptability network in Fig. 2a. The centrality results reveal a growing increase in the importance of *realizing that today's choices shape the future* (CN2), which is as important as *being aware that having to make educational and career choices* (CN4), *probing deeply into questions* (CY5), and *learning new skills* (CE3). However, there is a slight decline in the importance of *probing deeply into questions* (CY5). These networks have been tested for accuracy and stability and the results support the interpretation of centrality.

Figure 1c shows the shortest path between graduates' career adaptability and starting salary. This shortest path analysis is a useful tool for identifying potential pathways of influence between nodes and any intermediate nodes, as it shows the most efficient connections between two nodes. With this information, specific career adaptability indicators that influence starting salary can be identified, as well as the
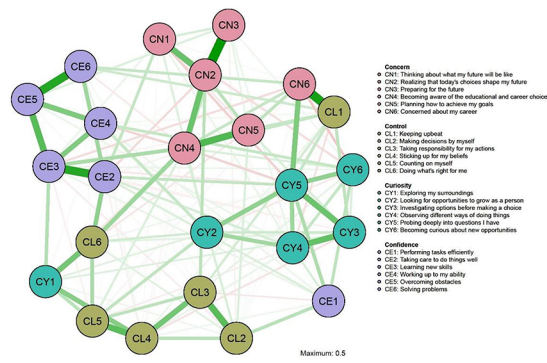
a. Network of career adaptability facets.
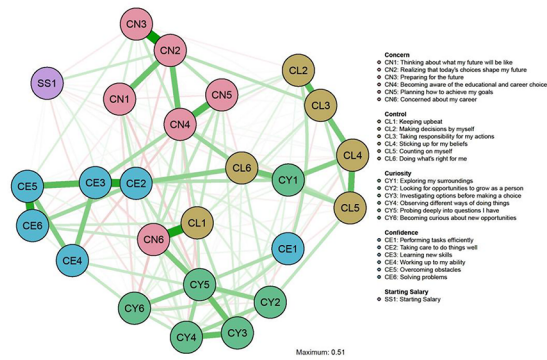


b. Network of career adaptability and starting salary facets.
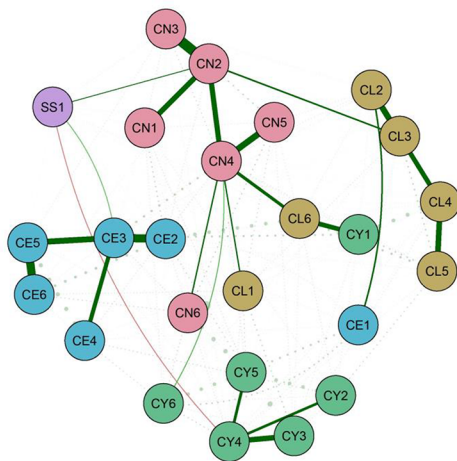


c. Shortest pathways from career adaptability factors to starting salary.

**Fig. 1** Network of (**a**) career adaptability, (**b**) career adaptability and starting salary facets, and (**c**) shortest pathways
Note: Item groups are color-coded, and thicker, darker edges indicate stronger connections. Green and red edges represent positive and negative connections, respectively. See the online article for the color version of this figure.

most effective pathway from career adaptability to starting salary.

According to the network model graph in Fig. 1b, graduates' career adaptability is related to their starting salary, either directly or indirectly. The shortest path model in Fig. 1c reveals that salary is primarily linked to other career concern items through *realizing that today's choices shape the future* (CN2), and CN2 is connected to other career
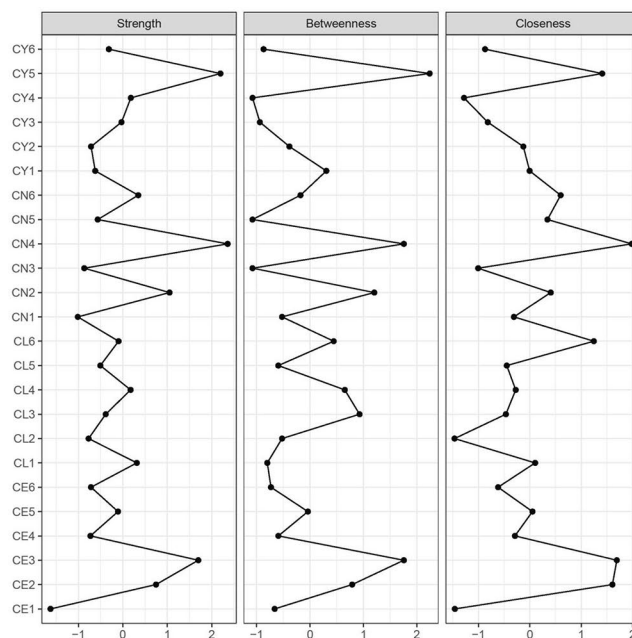
a. Standardized centrality indices for the network of career adaptability facets.
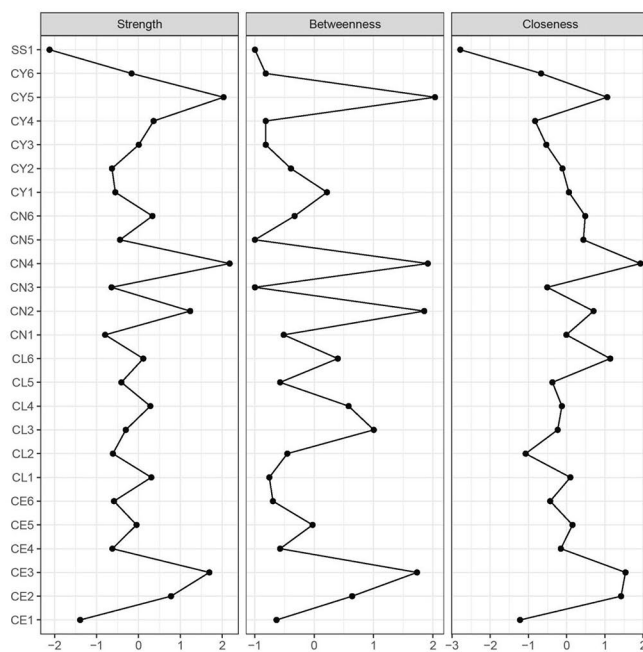


b. Standardized centrality indices for the network of the career adaptability and starting salary facets.

**Fig. 2** Centrality plot for the (**a**) career adaptability and (**b**) contains career adaptability and starting salary facets

Note: Centrality indexes in network analysis determine node importance. There are 3 types: strength, betweenness, and closeness centrality. Strength is the intensity of connections, betweenness is number of shortest paths that pass through a node, and closeness is the distance to other nodes. The centrality measures are displayed in standardized z-scores and the relevant original centrality indices can be found in Supplementary Tables S1 and S2

control items through *taking responsibility for one's actions* (CL3). Additionally, salary is connected to items of career confidence through *learning new skills* (CE3). Furthermore, salary has a strong positive correlation with *realizing that today's choices shape the future* (SS1-CN2), a weaker positive correlation with *learning new skills* (SS1-CE3), and a clear negative correlation with *observing different ways of doing things* (SS1-CY4). Overall, the network and shortest

path model in Fig. 1b suggests that graduates' career adaptability is linked to their starting salary through key indicators, with *realizing that today's choices shape the future* being the most important adaptability resource affecting salary, followed by *learning new skills*, and *observing different ways of doing things* negatively impacting salary. These results respond to Research Question 1.

## Network comparison

This study aims to expand our understanding of career adaptability through the application of network analysis, with the objective of generating new theoretical insights. To achieve this objective, the study compared the network structure's invariance, connection density, and edge weight among male and female groups. Through repeat 1000-time sampling estimation for the network, the results show a significant difference in the global strength between the two groups, where the global strength of the male network is higher than that of females (Strength$_{male}$ = 12.30, Strength$_{female}$ = 11.83, $p < .05$), signifying that the male group exhibits stronger connections (edges) and a higher aggregate weight of connections, on average. In other words, compared to females, the connections between nodes in the career adaptability network of the male group are relatively more stable or significant, and thus have greater influence and strength in the overall function of career adaptability. However, the network structure of male and female groups, which refers to the way nodes or career adaptability indicators in a network are connected, is similar. Moreover, there are no significant differences in the structural invariance ($p = .85$) and edges ($p = .85$) between the two groups of network models. These results suggest that, despite similar structures, the male group may have an advantage in terms of global career adaptability compared to females. We discuss our findings in the following by comparing the two group networks in structure and centrality.

We compared the starting salaries of males and females in the survey sample and found that males had significantly higher starting salaries than females ($M_{male}$ = 9.19, $SD_{male}$ = 5.85; $M_{female}$ = 7.73, $SD_{female}$ = 4.20; $t = 4.58$, $p < .001$) as indicated by the independent samples t-test. First, the NCT test results also revealed significant differences between the male and female groups in terms of the internal relationship of career adaptability. As shown in Fig. 3, the results indicated that males are significantly greater than females in terms of *planning positive correlation that how to achieve goals* and *keep upbeat* (CN5-CL1, $p < .05$). Second, some links are stronger in the male network. For example, a direct positive correlation exists between *adhering to beliefs* and *observing different ways of doing things* (CL4-CY4, $p < .05$). Meanwhile, there is a strong negative correlation

between *thinking about what the future will be like* and *being curious about new opportunities* (CN1-CY6, $p < .05$), and there is a direct positive correlation between *preparing for the future* and *being curious about new opportunities*, while a direct negative correlation with *solving problems* (CN3-CY6, $p < .05$; CN3 - CE6, $p < .01$). Third, there are interesting and unique connections in the female network. For instance, there is a direct positive correlation between *preparing for the future*, *adhering to beliefs*, and *researching various options before making a decision* (CN3-CL4, $p < .05$; CN3 - CY3, $p < .01$), and there is a strong positive correlation between *observing different ways of doing things* and *overcoming obstacles* (CY4-CE5, $p < .001$), and the more they *think about what their future will be like*, the more females will *make decisions by themselves* and *work up to their ability* (CN1-CL2, $p < .05$; CN1-CE4, $p < .05$), which the connections are not any in the male network.

Furthermore, the relationship between career adaptability and starting salary differs between gender groups (as shown in Fig. 4). Specifically, a significant negative correlation exists between *adhering to beliefs* and salary in males, but not in females (CL4-SS1, $p < .05$). Combining the shortest path model in Fig. 4, we observe that the two groups have different influence pathways on the relationship between career adaptability and salary. In the male group, *realizing that today's choices for the future* and *learning new skills* are the most critical adaptability factors influencing salary while *adhering to beliefs* negatively influences salary (CN2-SS1, CE3-SS1, CL4-SS1). In contrast, for the female group, *thinking about the future* and *learning new skills* were the most critical factors affecting the adaptability of salary (CN1-SS1, CE3-SS1). Furthermore, although *learning new skills* was vital in affecting salary in both groups, males were found to have a stronger correlation than females.

To sum up, these results reflect the importance of Research Question 2, indicating that the network structure of career adaptability and starting salary differs by gender.

## Centrality analysis

Figure 5 provides an overview of the centrality comparison results of the network models between male and female samples. The results suggest that the global strength of the two groups shows a relatively consistent trend, which is reasonable given that there is little difference between the two groups. When combined with other centrality indicators, the results show that the item with the highest centrality in the male group is *becoming curious about new opportunities* (CY6), while in females, it is *doing what is right for me* (CL6). This means that the career adaptability resource of *being curious about new opportunities* significantly impacts the male group networks and reinforces the positive results,
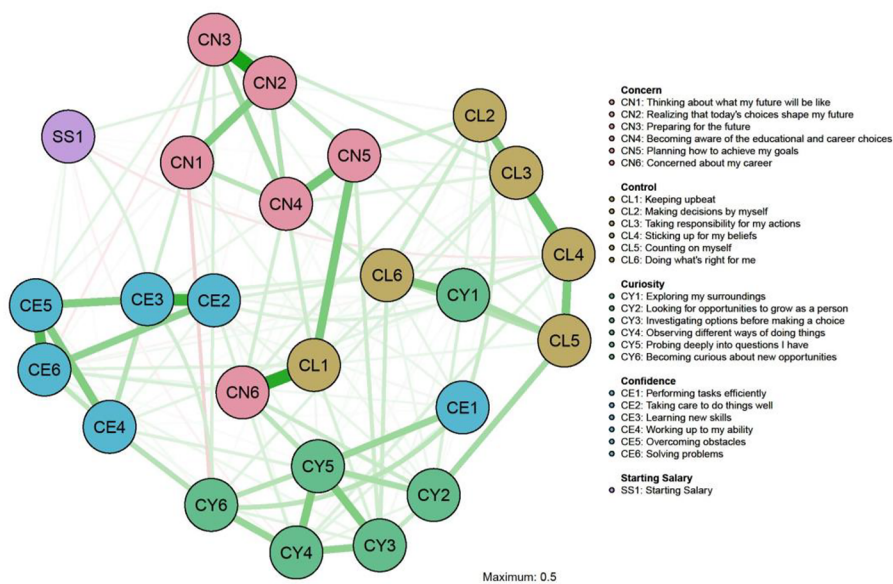
a. male group
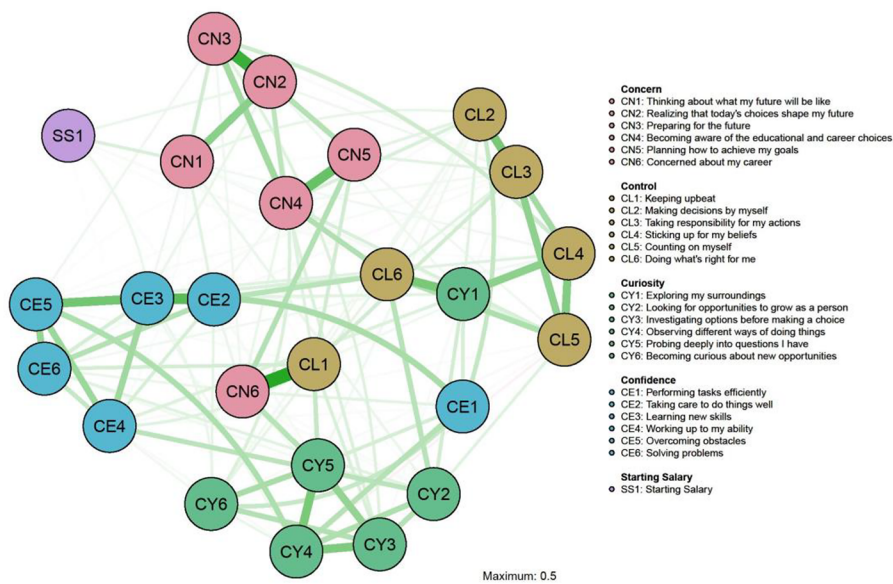


b. female group

**Fig. 3** Networks plot for the (**a**) male and (**b**) female groups respectively

while *doing what is right for me* has a significant impact on the female network. This finding supports the notion that career adaptability resources may be gendered, as it suggests that men and women may have different tendencies when mobilizing these resources. This gender difference in career adaptability resources could potentially exacerbate the gender gap in starting salaries and job search outcomes.

## Discussion

The findings contribute to the literature on career adaptability and network models. The study presented here is the first to facilitate the network research of career adaptability through mapping the network structure, including starting salary across gender groups. Specifically, our findings highlight the importance of dynamic networks of career
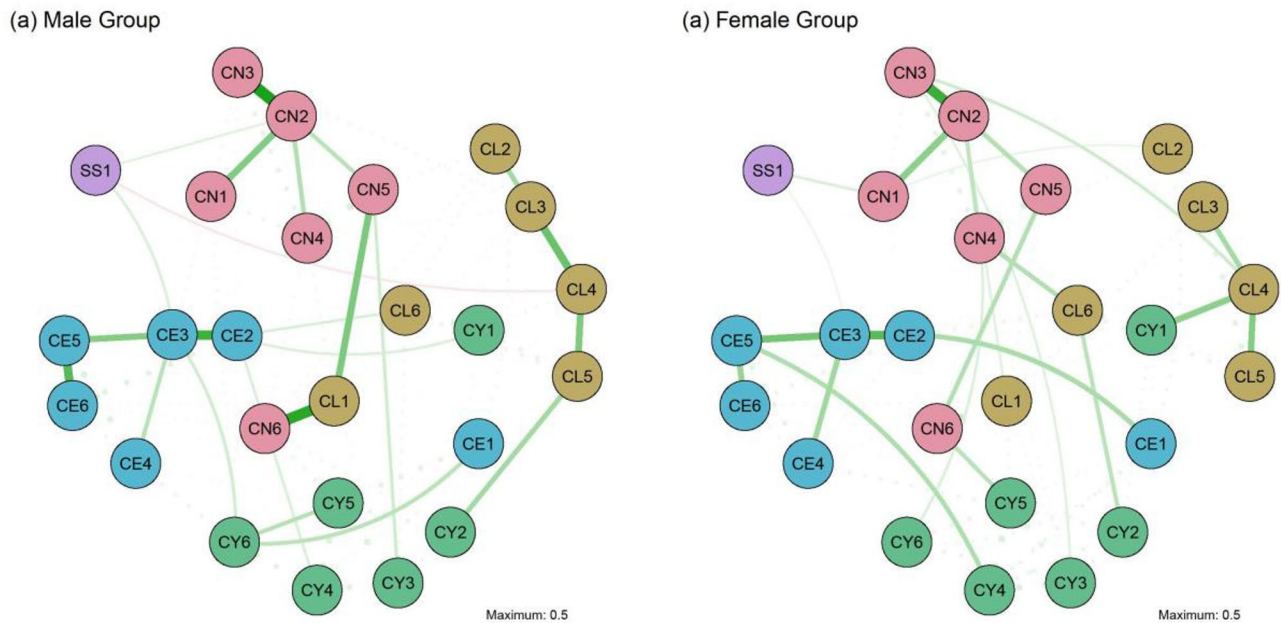
**Fig. 4** Shortest pathways from career adaptability indicators to starting salary (**a**) for male and (**b**) for female samples
Note: Solid lines are used to represent the edges belonging to the shortest pathways, while the background edges are shown with dashed lines

adaptability in connecting starting salary and describe how different genders' pathways change in corresponding networks. Our findings make the following theoretical contributions.

First, our findings contribute to the career construction theory and career adaptability literature by examining the network psychometrics of career adaptability. Previous career construct theory research has focused on career adaptability as a crucial component(Haenggli & Hirschi, 2020; Rudolph et al., 2017), and had not adequately investigated career adaptability in a complex dynamic network. Our study demonstrates the utility of the network approach in advancing our understanding of career adaptability constructs. Specifically, the indicators of concern, control, curiosity, and confidence show a high degree of clustering in the network, consistent with its traditional factor analysis structure. From a broader perspective, recent explorations of career adaptability development in college students suggest reconsidering how career resources interrelate and influence job search outcomes. Our study significantly extends this finding by showing the important central nodes in the network. Our centrality analysis shows that some central nodes, for example, *being aware that having to make educational and career choices* (CN4), *probing deeply into questions* (CY5), and *learning new skills* (CE3), had the most direct and strongest links to other nodes. When considering starting salary, *realizing that today's choices will shape the future* (CN2) also fulfills this important function.

Consequently, these core nodes have the most influence on activating the career adaptability dynamic network.

Second, our work challenges the conventional approach to the relationship between career adaptability and starting salary by exploring network models. The nature of career adaption development is uneven, thus the current research on career adaptability calls for clarification of the incremental utility of different facets of career resources. Our research responds to this call and by computing shortest pathway networks, our findings revealed how career adaptability effectively activates starting salary. More precisely, we demonstrate that *learning new skills* (CE3) and *recognizing that today's choices will shape the future* (CN2) seem to have incremental utility within career adaptability resources and are the most effective ways to influence starting salary. As we could show, each of the career adaptability resources represented by the indicators contributes differently to starting salary. This reaffirms our assertion that career adaptability needs to be considered in a systematic network framework to better understand its resource function and unique value. For example, based on the results of this study, it seems possible to improve concern adaptability by raising awareness that current choices will shape the future and control adaptability by taking responsibility for their actions, thereby increasing starting salary. Similarly, individuals can learn new skills to improve their confidence and adaptability, which can also help improve their starting salary, as employees who exhibit higher adaptability are
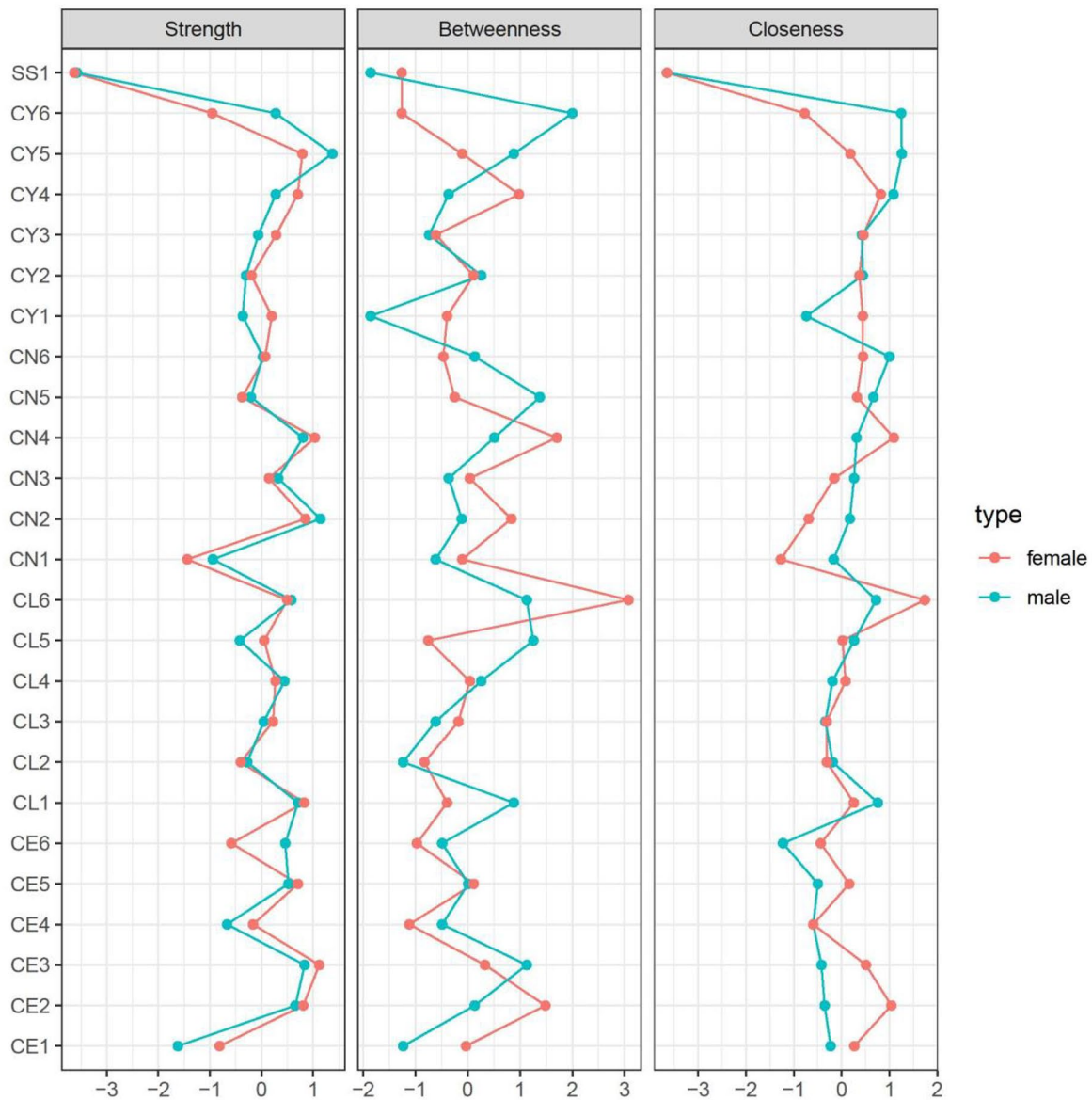
**Fig. 5** Centrality plot for male (in blue) and female (in orange) group networks, contains career adaptability and starting salary facets
Note: The centrality measures are displayed in standardized z-scores, and the relevant original centrality indices can be found in Supplementary Tables S3 and S4

more likely to achieve career success, which is consistent with previous research findings (Haenggli & Hirschi, 2020).

In addition, there were also unintended results in our study. *Observing different ways of doing things* (CY4) is negatively associated with starting salary. This result could be explained by the higher importance of other core career resources for starting salary, which has also been confirmed in many other studies (e.g., Haenggli & Hirschi, 2020). In other words, the negative effect in the global network model might be a suppressor effect. Suppressor effects occur when a predictor amplifies the predictive power of another indicator. The suppression effect in this study suggests that many

homogeneous indicators contain distinguishable components of different characteristics (Watson et al., 2013). Our results contribute to a clearer view of the inherent, but largely hidden, distinguishable career resources in occupational adaptability.

Finally, we shed light on the important role that gender plays in evaluating the network structure of combing career adaptability and starting salary. The results of the network comparison in this study show that males are more curious about new opportunities from the perspective of preparing for the future, rather than thinking about what their future will be like, and are better at planning how to achieve goals

and keep upbeat. While females are more focused on doing what is right for them, are more committed to preparing for the future and thoroughly researching options before making decisions, are more aware of different ways of doing things, and are better at overcoming obstacles. This finding is consistent with previous findings (Zhang et al., 2021) that males are associated with higher levels of career concern (i.e., males can better understand that one must choose carefully and be prepared for work). However, this finding is not evident in females (Zhang et al., 2021). These gender differences in career adaptability and starting salary may be attributed to societal pressures and expectations. For example, males are often portrayed as more ambitious and goal-oriented in their career pursuits (Brownell, 1994). Such stereotypes may encourage males to prioritize career planning and preparation, leading them to seize opportunities (Wong & Rasdi, 2019). Conversely, women generally face explicit barriers and limitations in their career development due to career-restrictive cultural norms and traditions (Dutta, 2017; Jogulu & Franken, 2023). This may result in women having a cautious attitude toward career planning and salary (Combet & Oesch, 2019). As a result, they may prioritize finding a "good fit" job and thoroughly researching their options before making decisions. In summary, the finding provides valuable insights for a better understanding of gender differences in career adaptability and salary.

## Implications for practice

This research has important implications for career education and counseling practices. Our results show how core resources activate and interact with career adaptation networks, which means that specific career adaptive resources make it easier to build more resources. Therefore, educators and vocational counselors should pay attention to more than the overall level of career adaptability. Instead, they should appreciate career adaptability at a more concrete indicator level and focus on developing specific adaptive resources to trigger the growth of other resources to promote career success. Our findings suggest, for example, that awareness of today's choices shaping the future, awareness of the need to make educational and career choices, probing deeply into questions, and learning new skills are considered the strongest predictors of current research. When designing career interventions in the Chinese context, career counselors should pay more attention to these indicators and help their students improve them.

## Limitations and future directions

This study also has some limitations that could be addressed in the future. First, due to the cross-sectional nature of the

data in this study, we could not examine changes in career adaptability networks over time and their lagged effects. Haenggli and Hirschi (2020) also noted that career adaptability resources are not static either. This issue deserves further exploration in future research to measure the cross-lagged association of career adaptability resources over time, especially to test the positive spiral of resources (Hakanen et al., 2008).

Second, although this study describes the influence path between specific career adaptability and salary, salary as an important incentive factor may affect some career adaptability of individuals in long-term career development. For example, research shows that employees receiving more support from their leaders (e.g., salary or promotion) often develop higher levels of career adaptability (Sibunruang et al., 2016). In the future, longitudinal network analysis or experimental methods can be used to reveal the causal cycle, including possible interactions.

Moreover, we investigate the network patterns underlying the links between career adaptability and starting salary. However, we cannot introduce some contextual variables (e.g., pandemic, culture) that may influence our results. For example, the advent of the COVID-19 pandemic has changed the career development of many people around the world (Autin et al., 2020). We believe that the pandemic may be taken into account when people construct their careers. The pandemic may influence the pattern and process of individuals' adaptability to their career environment. Hence, future network research should consider contextual factors like the pandemic when exploring the structure of career adaptability.

## Declarations

**Competing interest** The authors declare that there are no competing financial interests or personal relationships that could have influenced the research in this paper.

**Ethics approval and consent to participate** This paper has been reviewed and approved by the ethics committee of the corresponding author's university. The authors have no conflicts of interest, and the participants have all signed informed consent forms.

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