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Research Article

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Development and Psychometric Validation of a Psychological Capital Scale for Jordanian University Students Using the Rasch Rating Scale Model

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Abstract

This study aimed to develop and validate a Psychological Capital (PsyCap) scale for Jordanian university students using the Rasch-based Andrich Rating Scale Model (RSM). The study was conducted on a sample of 1,240 university students drawn from a non-Western educational context. An initial pool of 62 items was developed based on the four dimensions of psychological capital: self-efficacy, hope, optimism, and resilience. After conducting Rasch Rating Scale analysis, 20 misfitting items and 186 non-fitting respondents were excluded, resulting in a final scale consisting of 42 items. The findings demonstrated that the final scale showed acceptable fit statistics, with Infit and Outfit Mean Square values approximating the ideal Rasch model expectations. Reliability indicators revealed high internal consistency (Cronbach's alpha = 0.96), as well as strong person reliability (0.98) and item reliability (0.99). In addition, the scale demonstrated satisfactory evidence of unidimensionality and local independence. The results support the psychometric soundness of the developed scale and confirm its suitability for assessing psychological capital among Jordanian university students. This study contributes to the literature by developing a culturally appropriate PsyCap scale using modern Rasch measurement theory in an Arab educational context.

Keywords: *Psychological Capital, RaschModel, Rating Scale Model, Psychometrics, Scale Development, Jordanian University Students.*

1. Introduction

In the late 1990s, a significant shift occurred in the field of psychology with the emergence of positive psychology, led by Martin Seligman. This movement redirected the focus of psychological research toward human strengths and the positive aspects of behavior, emphasizing well-being, happiness, and optimal functioning (Seligman & Csikszentmihalyi, 2000). Positive psychology seeks to understand how persons can realize their full potential, thereby laying the foundation for the development of new constructs that highlight human capabilities, including psychological capital (PsyCap) (Cavus & Kapusuz, 2015).

Psychological capital represents a modern extension of traditional forms of capital. Unlike economic capital, which is associated with material resources, human capital, which relates to knowledge and skills, and social capital, which is based on relationships and networks, psychological capital focuses on persons' internal positive psychological states (Luthans et al., 2007; Yildiz, 2018). It encompasses a set of positive psychological attributes that contribute to personal and professional development, enabling persons to cope effectively with challenges and to perform successfully in demanding environments (Sehhat et al., 2015).

The concept of psychological capital has attracted considerable attention in recent years due to its strong association with a variety of desirable outcomes at the person, group, and organizational levels. Scholars have provided multiple definitions of PsyCap, reflecting its multidimensional nature. For instance, Caza et al. (2010) describe it as a system composed of four key components—self-efficacy, optimism, hope, and resilience—that motivate persons to pursue goals and overcome obstacles. Similarly, Peterson et al. (2011) define PsyCap as a positive psychological state characterized by confidence in decision-making, persistence in achieving goals, and a positive attribution style. Gupta and Singh (2014) view it as a contemporary approach to human resource development, while Corner (2015) emphasizes its role as a sustainable competitive advantage. These perspectives collectively highlight the importance of psychological capital in fostering positive attitudes, motivation, and adaptability.

The four core dimensions of psychological capital—self-efficacy, optimism, hope, and resilience—have been widely recognized in the literature. Self-efficacy refers to persons' confidence in their abilities to perform tasks successfully and to face challenges with determination (Hacioglu & Erkus, 2019; Malone, 2011). Optimism reflects a stable tendency to expect positive outcomes and to maintain a favorable outlook toward the future (Bockorny, 2015). Hope involves goal-directed thinking, including both the motivation to pursue goals and the ability to identify pathways to achieve them (Harvey et al., 2009). Resilience represents the capacity to recover from adversity and to adapt effectively to changing circumstances (Rego et al., 2012; Hayek, 2012). Together, these dimensions form a comprehensive framework that supports persons in dealing with life challenges and achieving success.

Psychological capital has been extensively studied in organizational contexts, where it has been linked to important outcomes such as job performance, engagement, creativity, job

satisfaction, and organizational commitment (Gupta & Singh, 2014; Rehman et al., 2017; Rafaq et al., 2020; Abu Jarad & Abu Hujair, 2018; Kurt & Demirbolat, 2018; Abu Saif, 2018). These findings underscore the practical importance of PsyCap as a key resource for enhancing productivity and well-being in the workplace. However, despite the growing body of research in this area, relatively limited attention has been given to psychological capital in educational contexts, particularly among university students.

University students constitute a vital segment of human capital, as they represent the future workforce and play a crucial role in societal development. During their academic journey, students encounter a wide range of challenges, including academic pressures, social demands, and uncertainty about their future careers. Successfully navigating these challenges requires not only cognitive abilities but also strong psychological resources, such as confidence, optimism, perseverance, and adaptability. Therefore, understanding and measuring psychological capital among university students is essential for supporting their academic success and psychological well-being.

Several instruments have been developed to measure psychological capital, most notably the Psychological Capital Questionnaire (PCQ) developed by Luthans et al. (2007), as well as its shortened versions (Avey et al., 2010). Additionally, alternative measurement approaches, such as implicit measures, have been proposed (Harms & Luthans, 2012). While these instruments have demonstrated acceptable psychometric properties, they were primarily developed as research tools within Western contexts and organizational settings. This raises concerns regarding their suitability for use in different cultural contexts, including the Jordanian educational environment.

Furthermore, most existing measures of psychological capital rely on Classical Test Theory (CTT), which has been criticized for several limitations, particularly its dependence on sample characteristics and its limited ability to address certain measurement issues (Hambleton & Swaminathan, 1985). In contrast, Item Response Theory (IRT) provides a more advanced framework for psychological measurement, allowing for the estimation of item parameters that are independent of the sample and offering greater precision in assessing latent traits (Crocker & Algina, 1986; Lord, 1980).

Among IRT models, the Rasch-based Rating Scale Model (RSM), developed by Andrich, is particularly suitable for analyzing polytomous data derived from Likert-type scales. This model enables the estimation of both item difficulty and person ability on a common scale, while also providing tools for evaluating important measurement assumptions, such as unidimensionality and local independence (Wright & Masters, 1982). As such, it offers a rigorous and objective approach to scale development, making it highly appropriate for constructing a psychological capital measure.

Despite the methodological advantages of Rasch models, their application in developing psychological capital scales remains limited, particularly in Arab educational contexts. Moreover, there is a lack of standardized and culturally appropriate instruments designed to assess psychological capital among Jordanian university students. This gap highlights the need for developing a reliable and valid measurement tool that reflects the cultural and educational characteristics of this population.

Accordingly, the present study aims to develop and validate a Psychological Capital scale for Jordanian university students using the Rasch Andrich's Rating Scale Model. By adopting this approach, the study seeks to provide a psychometrically sound and culturally relevant instrument that can be used in both research and practical applications, contributing to a deeper understanding of psychological capital in the Arab educational context.

Despite the widespread use of the Psychological Capital construct, most validation studies have relied on classical test theory and have been conducted within Western contexts. There is a clear lack of studies applying modern measurement models, such as the Rasch model, to examine the scale's psychometric properties in non-Western populations. This study aims to address this gap by developing and validating a Psychological Capital scale specifically designed for Jordanian university students using the Rasch-based Rating Scale Model within an Arab educational context.

This study contributes to the literature in three ways:

1) it develops a culturally appropriate Psychological Capital scale for Jordanian university students,
2) it applies the Rasch-based Rating Scale Model as a modern psychometric approach in scale development and validation,
3) it provides evidence supporting the reliability and validity of the developed scale across different levels of respondents.

Study Problem

The problem of the present study stems from the lack of a precise and culturally appropriate instrument for measuring psychological capital among Jordanian university students. Despite the growing importance of psychological capital in understanding persons' positive psychological resources, existing measures have been primarily developed in organizational contexts and within Western cultures, which may limit their applicability in educational settings and nonWestern environments.

Moreover, most available instruments rely on Classical Test Theory (CTT), which has several limitations, particularly in providing sample-dependent estimates and in addressing complex measurement issues. This highlights the need for more robust measurement approaches that ensure greater accuracy and objectivity. In this context, Item Response Theory (IRT), particularly the Andrich's Rating Scale Model, provides a more advanced framework for scale development. However, the use of such models remains limited in Arab research, especially in the development of psychological measures tailored to university students.

Accordingly, the present study addresses this gap by developing and validating a psychological capital scale for Jordanian university students using the Andrich's Rating Scale Model, with the aim of providing a reliable and psychometrically sound measurement tool.

Study Significance

The significance of the present study can be understood at three interrelated levels: theoretical, methodological, and practical. From a theoretical perspective, this study contributes to the literature on psychological capital by extending its application to university students within an Arab educational context. While previous research has primarily focused on organizational settings, this study highlights the relevance of PsyCap in higher education and provides a deeper understanding of its dimensions among students. Methodologically, the study offers an important contribution by employing the Andrich's Rating Scale Model in the development and validation of the scale. Unlike traditional approaches based on Classical Test Theory, the Rasch model provides more precise and objective measurement by ensuring sample-independent item estimates and allowing for a rigorous evaluation of item and scale properties. This strengthens the psychometric quality of the developed instrument and supports its use in future research. From a practical perspective, the developed scale provides educators, counselors, and researchers with a reliable and valid tool for assessing psychological capital among university students. The availability of such a tool can support the design of targeted interventions aimed at enhancing students' self-efficacy, hope, optimism, and resilience, thereby improving their academic performance and psychological well-being. In addition, the scale can be used in educational planning and policy development to promote positive psychological resources among students.

Study Objectives

The present study aims to develop and validate a Psychological Capital (PsyCap) scale for Jordanian university students using the Andrich's Rating Scale Model. To achieve this aim, the study seeks to:

1. Examine the extent to which the responses to the scale items fit the assumptions of the Andrich's Rating Scale Model.
2. Estimate the item difficulty parameters and person ability levels based on the Rasch model.
3. Evaluate the psychometric properties of the scale, including reliability and validity indicators.
4. Assess the overall functioning of the scale in measuring psychological capital among university students.

Conceptual and Operational Definitions

- **Psychological Capital (PsyCap):** Psychological capital refers to a positive psychological state characterized by growth and development, encompassing self-efficacy (exerting effort to succeed in challenging tasks), optimism (maintaining a positive outlook toward present and future success), hope (persevering toward goals and redirecting paths when necessary), and resilience (adapting and recovering from challenges) (Luthans, Youssef, & Avolio, 2007). In this study, it is operationally defined as the total score obtained by a student on the Psychological Capital scale developed by the researchers.
- **Rating Scale Model (RSM):** The Rating Scale Model is a polytomous latent trait model derived from the Rasch model, designed for responses with ordered and equally spaced categories. In the present study, it is used to analyze students' responses to the Psychological Capital scale and to estimate both item and person parameters.
- **Item Psychometric Properties**: Item psychometric properties refer to the characteristics of test items, including difficulty (item location), discrimination (slope of the item characteristic curve), and guessing (lower asymptote of the curve), which determine the quality and effectiveness of the measurement process. In this study, these properties are evaluated based on the fit of items to the Rating Scale Model.
- Ite**m Difficulty Parameter (b):** The item difficulty parameter represents the point on the latent trait continuum at which there is a 50% probability of endorsing the item, assuming no guessing effect. Operationally, it refers to the estimated difficulty value for each item of the Psychological Capital scale as obtained through Rating Scale analysis.
- **Item Discrimination Parameter (a**): The item discrimination parameter reflects the ability of an item to differentiate between persons with different levels of the latent trait, represented by the slope of the item characteristic curve at its inflection point. In this study, it is reflected in the consistency of item performance and their alignment with the model assumptions.
- **Item Guessing Parameter (c):** The guessing parameter represents the probability that persons with low levels of the latent trait respond correctly to an item by chance, corresponding to the lower asymptote of the item characteristic curve. In this study, it is inferred from the behavior of item characteristic curves and their conformity to model expectations.
- **Scale Psychometric Properties**: Scale psychometric properties refer to the indicators of validity and reliability that reflect the overall quality and accuracy of the measurement tool. In this study, these properties are determined through statistical analyses based on the Rating Scale Model.
- **Item Information Function**: The item information function represents the contribution of each item to the precision of measurement across different levels of the latent trait. In this study, it is used to determine how well each item contributes to measuring psychological capital independently of other items.
- **Test Information Function:** The test information function represents the total amount of information provided by all items in the scale at a given level of the latent trait. In this study, it is used to evaluate the overall precision of the Psychological Capital scale.
- **Person Parameters:** Person parameters refer to the ability estimates that indicate the level of the latent trait possessed by each person according to latent trait theory. In this study, they represent students' levels of psychological capital as estimated through Rating Scale analysis.
- **Parameter Estimation**: Parameter estimation refers to the process of obtaining numerical values that represent item characteristics and person abilities within the measurement model. In this study, it is conducted using the Rating Scale Model to derive accurate estimates for both items and persons.

Study Limitations

The findings of this study should be interpreted in light of several limitations. **First**, the study was conducted on a sample of students from Yarmouk University, which may limit the generalizability of the results to students in other universities or different cultural and educational contexts. Although the sample included students from various academic disciplines, it may not

fully represent the diversity of all Jordanian university students. **Second**, the study relied on self-reported data collected through a questionnaire, which may be subject to response biases such as social desirability or inaccurate self-assessment. This could influence the accuracy of the measured levels of psychological capital. Additionally, the results are constrained by the operational definitions of the study variables, as psychological capital was measured using the specific scale developed in this study. Therefore, interpretations of the findings are limited to the scope of these definitions and the measurement approach employed.

2. Methodology

This section describes the study population, sampling procedures, and the procedures followed for developing and validating a Psychological Capital scale for Jordanian university students using the Rasch-based Andrich Rating Scale Model. The use of the RSM in the present study provides several advantages over traditional approaches. Unlike classical test theory, the RSM allows for the examination of item-level functioning, ensuring that the scale measures the construct consistently across different levels of respondents. It also enables the assessment of item difficulty, person ability, and scale invariance, which enhances the precision and generalizability of the measurement.

Ethical Considerations

The study adhered to the ethical principles governing scientific research involving human participants. Participation in the study was entirely voluntary, and informed consent was obtained electronically from all participants before they completed the questionnaire. Participants were informed about the purpose of the study and assured that their responses would remain confidential and would be used only for research purposes. No identifying information was collected, and all data were analyzed anonymously to ensure participants' privacy and confidentiality.

Study Population and Sample

The target population of this study consisted of students enrolled in Jordanian public universities. Yarmouk University was selected as the study setting because it is one of the largest public universities in Jordan and includes students from diverse geographical, social, and academic backgrounds. Therefore, it was considered reasonably representative of the broader population of Jordanian university students. A cluster random sampling technique was employed to select participants. The cluster units consisted of academic classes and sections from different faculties within the university. Initially, faculties were categorized into three major academic fields: scientific, humanities, and medical faculties. Several academic sections from each category were then randomly selected, and all students enrolled in the selected sections were invited to participate in the study.

Data were collected electronically during the academic year 2025 through an online questionnaire distributed to approximately 2,600 students across the selected academic sections. A total of 1,240 students completed the questionnaire and were included in the final analysis, yielding a response rate of approximately 47.7%. The final sample included 540 male students and 700 female students. In terms of academic specialization, 542 students were from scientific faculties, 492 from humanities faculties, and 206 from medical faculties. This distribution was intended to ensure adequate representation of the major academic disciplines within the university.

To examine the possibility of nonresponse bias, early and late respondents were compared on the total Psychological Capital scores and selected demographic variables. No substantial differences were observed between the two groups, suggesting that nonresponse bias was unlikely to have significantly affected the results. The sample size was considered appropriate for Rasch Rating Scale analysis and factor analysis. Previous studies have recommended large sample sizes for obtaining stable parameter estimates in Item Response Theory models, typically ranging between 250 and 500 participants (Reeve, 2004; Embretson & Reise, 2004). Therefore, the sample size in the present study (N = 1,240) was deemed sufficient for the analyses conducted.

Conceptual Framework of the Study

The conceptual framework of this study is centered on the construct of **Psychological Capital (PsyCap)** as a latent variable that reflects a positive psychological state among university students. PsyCap is conceptualized as a multidimensional construct composed of four core components: self-efficacy, hope, optimism, and resilience, which together represent students' internal psychological resources. The study focuses on developing and validating a measurement scale for this construct rather than examining causal relationships between variables. To achieve this, the framework integrates the **Andrich's Rating Scale Model (RSM)** as a methodological and analytical approach that links students' responses (persons) to the scale items (indicators), enabling the estimation of both person ability (level of psychological capital) and item difficulty on a common continuum. The target population of the framework is Jordanian university students, whose responses are used to evaluate the functioning of the scale. Through this framework, the study aims to ensure that the developed instrument demonstrates strong psychometric properties, including validity, reliability, unidimensionality, and measurement precision, ultimately providing a scientifically sound and culturally appropriate tool for assessing psychological capital in the

Procedures for Developing the Scale Using the Rasch-based Rating Scale Model

Step 1: Defining Scale Dimensions

The first step in developing the Psychological Capital scale involved identifying the theoretical dimensions underlying the construct. This was done through a review of the relevant educational and psychological literature, as well as previously developed Psychological Capital measures, including the 24-item PCQ (Luthans, Youssef, & Avolio, 2007), the 12-item PCQ (Luthans, Avolio, Avey, & Norman, 2007), and the three-factor Psychological Capital scale developed by Grobler and Joubert (2018). Based on this review, four core dimensions were identified as the foundation of the scale: self-efficacy, hope, optimism, and resilience. These dimensions were adopted because they represent the most widely accepted conceptual structure of psychological capital in the literature and served as the basis for generating the scale items in the subsequent stage.

Step 2: Writing the Scale Items

In the second step, an initial pool of items was developed to represent the four dimensions of psychological capital identified in the previous stage. A total of 110 items were generated and

distributed across the four dimensions as follows: self-efficacy (24 items), hope (25 items), resilience (30 items), and optimism (31 items). A five-point Likert scale was used for responses (Always, Often, Sometimes, Rarely, and Never). The items were constructed to reflect the theoretical dimensions of psychological capital and were arranged in an alternating sequence across the four dimensions. The initial set of items was then submitted to a panel of 12 experts in educational psychology and measurement to evaluate their face validity in terms of clarity, linguistic accuracy, and relevance to the intended dimensions. Based on the experts' feedback, several modifications were made, including rewording unclear items, correcting linguistic issues, and removing redundant or irrelevant items. Items that received less than 10% agreement among experts were excluded, resulting in a reduced pool of 70 items. Subsequently, the revised scale was administered to a pilot sample of 130 students from Yarmouk University who were not included in the main study sample. The purpose of this pilot study was to assess the clarity of the items and identify any potential ambiguities. Participants were asked to provide feedback on unclear or difficult items. Based on their responses, further refinements were made, including rephrasing items that showed extreme response patterns (i.e., when 90% or more of participants selected the same response category) and eliminating additional redundant items.

As a result of these procedures, the preliminary version of the scale was reduced to 62 items distributed across the four dimensions as follows: self-efficacy (16 items), hope (14 items), optimism (17 items), and resilience (15 items). The internal consistency of this version was assessed using Cronbach's alpha, yielding a coefficient of 0.89, which was considered acceptable for proceeding with the subsequent stages of scale

Step 3: Testing the Unidimensionality Assumption

In this step, the unidimensionality assumption, which is a fundamental requirement for the application of Item Response Theory (IRT) models, was examined. The preliminary version of the scale, consisting of 62 items, was administered to the main sample of 1,240 students selected through cluster random sampling. To assess unidimensionality, several complementary indicators were employed, as recommended in the literature (Hattie, 1985). **First**, internal consistency was evaluated using Cronbach's alpha coefficient, which yielded a value of 0.92 for the total scale. This high coefficient indicates a strong level of internal consistency and provides initial support for the assumption of unidimensionality. **Second,** corrected item-total correlations were calculated between each item and the total score of the scale (excluding the item itself). These correlations ranged from 0.456 to 0.725, with a mean of 0.501, and all were statistically significant at the 0.05 level. In addition, Cronbach's alpha values after deleting each item ranged from 0.892 to 0.918, indicating that all items contributed positively to the overall consistency of the scale. **Third**, factor analysis was conducted using Principal Component Analysis (PCA) with Varimax rotation. The results revealed four factors with eigenvalues greater than 1, explaining a total of 68.469% of the variance. Notably, the first factor had an eigenvalue of 13.332 and accounted for 21.503% of the variance. According to Reckase's criterion, the presence of a dominant first factor that explains at least 20% of the variance provides evidence supporting unidimensionality (Hambleton & Swaminathan, 1985; Hattie, 1985). Taken together, these findings provide converging evidence that supports the unidimensionality assumption of the scale, thereby justifying the use of the Andrich's Rating Scale Model in the subsequent analysis.

Construct Structure and Interpretation of the Scale

Although exploratory factor analysis supported the presence of four theoretically meaningful dimensions of Psychological Capital (self-efficacy, hope, resilience, and optimism), the present study conceptualizes Psychological Capital as a higher-order global construct composed of interrelated dimensions. The dominance of the first factor, which explained the largest proportion of variance and exceeded the commonly accepted criterion for unidimensionality, provided sufficient justification for applying the unidimensional Rasch Rating Scale Model (RSM). Within the Rasch framework, unidimensionality does not require the complete absence of subdimensions; rather, it requires the existence of a dominant latent trait underlying item responses. In the present study, the four dimensions were highly related and collectively reflected a broader Psychological Capital construct. Therefore, the RSM was applied to estimate respondents' overall Psychological Capital levels while still acknowledging the multidimensional theoretical structure of the construct.

Accordingly, the developed scale may be interpreted at two complementary levels. First, a total score may be used as an indicator of overall Psychological Capital among university students. Second, subscale scores may also be interpreted separately to assess the specific dimensions of self-efficacy, hope, resilience, and optimism. However, the primary interpretation emphasized in the present Rasch analysis concerns the overall Psychological Capital construct.

Step 4: Model Selection

Selecting an appropriate measurement model represents a critical step in the process of scale development, particularly after establishing the assumption of unidimensionality (Hulin, Drasgow, & Parsons, 1983). In the present study, the Andrich's Rating Scale Model (RSM) was selected as the most suitable model for analyzing the data. The selection of the RSM was based on several considerations**. First**, the data collected in this study were based on a five-point Likert scale, which produces polytomous responses. The RSM is specifically designed to handle such ordered categorical data and is therefore appropriate for this type of measurement. **Second**, the RSM is a Rasch-based model that assumes equal discrimination across items and focuses primarily on estimating item difficulty. This characteristic makes it suitable for scale development, as it provides a simple and robust framework for measurement. **Third**, logistic models, such as the RSM, are widely preferred due to their mathematical simplicity and practical applicability, as well as their availability in commonly used software programs. These features make the model more accessible and easier to interpret in applied research contexts. Based on these considerations, the Andrich's Rating Scale Model was deemed the most appropriate model for analyzing the responses to the Psychological Capital scale in this study.

Rating Scale Functioning and Model Justification

The functioning of the five response categories of the Psychological Capital scale was examined prior to conducting the final Rasch analysis. The response categories ("Never," "Rarely," "Sometimes," "Often," and "Always") demonstrated adequate category frequencies across all items, indicating that all response options were meaningfully utilized by participants.

Examination of the category structure further revealed that the average measures advanced monotonically across categories, suggesting that higher response categories corresponded to higher levels of the latent trait. In addition, the category threshold estimates were ordered progressively, supporting the proper functioning of the rating scale categories and indicating that respondents were able to distinguish appropriately between adjacent response options. The ordered thresholds provided evidence that the five-point Likert scale functioned consistently with the assumptions of the Rasch Rating Scale Model (Linacre, 2002). The Rasch Rating Scale Model (RSM) was preferred over the Partial Credit Model (PCM) because all items in the Psychological Capital scale shared the same response format and identical category structure. The RSM assumes common threshold distances across items, making it more parsimonious and appropriate when response categories function similarly across the scale. In contrast, the PCM is more suitable when items have different category structures or when category thresholds vary substantially across items. Since the response categories in the present study demonstrated consistent functioning, the RSM was considered the most appropriate model for the analysis.

Step 5: Data Analysis

To examine the extent to which individual response patterns fit the Rating Scale model, person ability estimates and associated fit statistics (Infit and Outfit) were calculated. This step is essential to ensure that the data conform to the assumptions of the model. Table 4 presents the summary statistics of person measures and fit indices. After selecting the RSM, 12 questionnaires were excluded due to response patterns or incomplete data. Student responses were scored as follows: for positive items, always = 4, Often = 3, Sometimes = 2, rarely = 1, Never = 0; for negative items, scores were reversed (Always = 0, Never = 4). Data were entered into a computer and analyzed using BIGSTEPS to assess item fit to the RSM. The analysis involved:

Data Screening and Fit Exclusion Criteria

Before conducting the final Rasch Rating Scale analysis, the data were screened in a sequential manner. The initial dataset consisted of 1,240 respondents and 62 items. **First**, person fit was examined using Infit and Outfit mean-square statistics and their standardized values. Respondents were considered misfitting and excluded if their Outfit ZSTD values exceeded ±2.00 and/or their Outfit MNSQ values fell outside the acceptable fit range of 0.70–1.30. Based on these criteria, 186 respondents were excluded, leaving 1,054 respondents for item calibration.

Second, item fit was evaluated using the same fit criteria. Items were considered misfitting if their Infit or Outfit MNSQ values fell outside the acceptable range of 0.70–1.30 or if their standardized fit values indicated substantial deviation from model expectations. Based on these criteria, 20 misfitting items were removed from the initial 62-item scale. The final scale therefore consisted of 42 items.

After excluding the 186 misfitting respondents and 20 misfitting items, the final Rasch Rating Scale analysis was conducted on 1,054 respondents and 42 items. Of these, 1,053 were nonextreme respondents and one respondent showed an extreme score pattern. Therefore, the reporting of person estimates distinguishes between the total analyzed sample (N = 1,054) and the non-extreme sample used for certain Rasch estimates (N = 1,053). Because the final scale contained 42 items, the number of possible item pairs for local independence analysis was 861, calculated as 42 × 41 / 2.

Table 3 presents the fit statistics for person responses to the Psychological Capital (PsyCap) scale. The mean Infit Mean Square (MNSQ INFIT) was 1.04, and the mean Outfit Mean Square (MNSQ OUTFIT) was 1.08, both closely approximating the ideal value of 1, as expected by the Andrich Rating Scale Model (RSM). The mean standardized Infit statistic (ZSTD INFIT) was 0.38, and the mean standardized Outfit statistic (ZSTD OUTFIT) was 0.68, slightly deviating from the ideal value of 0. These values align closely with the model's expected range (0, 1), indicating general conformity of responses to the RSM (Wright & Stone, 1979). To assess person fit, the researchers examined the standardized Outfit statistic (ZSTD OUTFIT). Persons with ZSTD OUTFIT values exceeding +2 or falling below -2, or with corresponding MNSQ values greater than 1, were considered non-fitting, as their responses deviated significantly from the model's expectations (Wright & Stone, 1979; Alastair & Hutchinson, 1987; Julian, 1988). Based on this criterion, 186 persons were identified as non-fitting, as their observed responses did not align with the expected responses based on their estimated abilities. These persons were excluded from further analysis to ensure model conformity. After removing non-fitting persons, the data were reanalyzed to evaluate item fit to the RSM. Item difficulty parameters were estimated for each of the 62 items, along with their standard errors and fit statistics (Infit and Outfit). Table 5 summarizes the mean and standard deviation of the item difficulty estimates, their standard errors, and the Infit and Outfit statistics for these parameters.

Table 4 illustrates that the mean Infit and Outfit Mean Square (MNSQ) values for the Psychological Capital (PsyCap) scale items closely align with the ideal value of 1, as expected by the Andrich Rating Scale Model (RSM). Specifically, the mean Infit MNSQ was 1.02 (SD = 0.24), and the mean Outfit MNSQ was 1.01 (SD = 0.07). Similarly, the mean standardized Infit (ZSTD INFIT) and Outfit (ZSTD OUTFIT) statistics were 0.2 (SD = 1.2) and 0.1 (SD = 1.1), respectively, approaching the ideal value of 0. The standard deviations also approximated the model's expected value of 1, indicating that the items generally fit the RSM well. To further evaluate item fit, the researchers examined the Infit and Outfit statistics, which reflect the stability of an item's relative difficulty across different ability levels. Analysis revealed that 20 items were non-fitting, deviating significantly from the model's expectations and introducing noise into the data (Linacre & Wright, 1993). Despite these items showing good discrimination based on their point-biserial correlation coefficients (rpbis), non-fitting items typically exhibit negative rpbis values, indicating poor fit. However, all items in this study had positive rpbis values, suggesting adequate discrimination despite the fit issues for these 20 items. Items marked with alphabetic indicators in the analysis were deemed well-fitting based on discrimination metrics, and there was notable consistency in the rpbis values across items.

Table 5 provides detailed information on the 20 non-fitting items, including their Infit and Outfit statistics, weighted mean square values, and discrimination coefficients (rpbis).

Maximum Extreme Score: 1 Persons

It is noted from Table5 that the final free estimates of persons' abilities ranged between a minimum total score of (5) and a maximum total score of (167). The mean of the ability distribution was (0.38) logit units, with a standard deviation of (1.81) logit units, within a range from (-4.89) logits to (6.75) logits. The standard error of the mean ability estimates was (0.06), which is close to the ideal condition assumed by the model. This indicates the accuracy of locating persons on the trait continuum. Table 5 summarizes the results of the analysis of the free estimates of the item difficulty scale values.

From Table 6, it is evident that the values of the liberated estimates for item difficulty ranged between (-1.73) and (2.33) logits, distributed around an average ability of (0.0) logits, with a standard deviation of (0.89) logits. The standard deviation of the model errors for the difficulty estimates was (0.00), which is the ideal value, indicating the accuracy of the item difficulty estimates. Additionally, the difficulty parameter for each item of the Psychological Capital Scale in its final form (42 items) was estimated using the Unconditional Maximum Likelihood Estimation (UCON) method to obtain the most precise estimates of item difficulty and minimize estimation error to the lowest possible level. Table 7 presents the difficulty values of the items along with the standard error of these estimates. All these items conformed to the model and fell within the internal and external fit limits suggested by the rating scale model (0.7–1.3).

To fulfill the requirements of objectivity in measurement concerning the Psychological Capital Scale, it is essential to provide evidence supporting the fulfillment of the rating scale model's assumptions. Previous discussions have confirmed one of the model's fundamental assumptions—unidimensionality—supported by a set of relevant indicators. Regarding the assumption of local independence, the Local Dependence Indices for Polytomous Items (LDIP) program, developed in Fortran 95, was employed to verify this assumption. This program calculates three key indices: Q_3, Z_{Q_3}, and G_2. The Z_{Q_3} index serves as the critical threshold for identifying item pairs that violate the local independence assumption. If the arithmetic mean of the observed Z_{Q_3} values for item pairs falls between the lower and upper bounds of the expected Z_{Q_3} range, this indicates that the local independence assumption holds (Kim, Cohen, & Lin, 2005). The analysis revealed that the mean Z_{Q_3} value for all 861 item pairs fell within the acceptable range between the lower and upper bounds of the Z_{Q_3} indices. Table8 presents the local independence indices based on latent trait theory, further validating the model's assumptions.

Table 8 demonstrates that the mean Z_{Q3} value (0.325460) lies within the minimum and maximum Z_{Q3} values, providing evidence of local independence (Kim, Cohen, & Lin, 2005). Further analysis examined the proportion of item pairs meeting local independence within a confidence interval. Table 9 presents the results.

Table 9 reveals that the number of item pairs demonstrating local independence reached 842 cases, accounting for 97.79% of the total. In contrast, only 19 item pairs (2.21%) showed local dependence. This indicates that the number of locally independent item pairs exceeds six times those exhibiting local dependence, strongly supporting the fulfillment of the local independence assumption (Kim, Cohen, & Lin, 2005). Furthermore, Hambleton and Swaminathan (1985) noted that the local independence assumption is equivalent to unidimensionality, implying that establishing unidimensionality in the scale simultaneously verifies local independence. Additional evidence supporting model assumptions includes the items' equivalent discriminative ability. This is confirmed by the close clustering of point-biserial correlation coefficients (rpbis), reflecting similar discrimination indices across items. Hambleton and Swaminathan (1985) specified that for discrimination indices to be considered equivalent and model-compliant, their values should fall within the range of (mean discrimination index ±0.15). With the mean discrimination index at 0.76 (as shown in Table 7), the acceptable range becomes 0.61 to 0.91. All calculated point-biserial correlations fell within this range, and their small standard deviation further confirms this assumption. This conclusion is reinforced by the parallel item characteristic curves, as illustrated in Figure 1, which presents sample item characteristic curves for the Psychological Capital Scale.

Regarding the assumption of a low guessing parameter (c), there is no direct method to determine whether a person answered an item through guessing (random selection) or not. However, when examining the item characteristic curves (nonlinear regression lines of scores on the scale) as shown in Figure (1), it was observed that the lower asymptote approaches zero for all items.

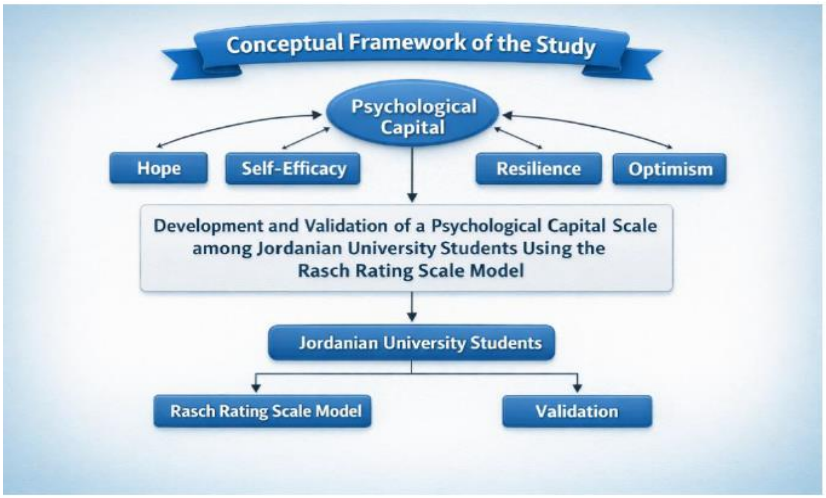


Figure 1: Conceptual Framework of the Study for Developing and Validating the Psychological Capital Scale among Jordanian University Students Using the Andrich's Rating Scale Model

This occurs when persons do not resort to random answering, indicating good item fit to the model. Furthermore, it cannot be claimed that speed played a role in answering the items, as no respondent left any item unanswered. After presenting these indicators that demonstrate the fulfillment of the model's assumptions and the good fit of items to the the Rasch-based Rating Scale Model, it is necessary to present indicators related to the psychometric properties of the scale's final version (42 items).

Step 6: Psychometric Properties of the Psychological Capital Scale (Validity and Reliability)

Validity Evidence

The validity of the Psychological Capital Scale was verified through multiple methods. **Logical validity** was established through theoretical analysis by examining the concept of psychological capital, formulating items representing its dimensions, and having them reviewed by a panel of experts. Based on their feedback, the scale items were modified. Logical analysis is one of the procedures used to verify the **construct validity** of measurement tools (Cronbach, 1971). Correlational techniques were also employed to validate the measurement tool, representing one of the most widely used approaches (Shavelson, 1991). These methods included factor analysis, trait correlation matrices, the multitrait-multimethod matrix (MTMM), and regression analysis (Byrne, 1984). To establish the instrument's validity, corrected item-total correlations were computed between each item's score and its respective subscale score on one hand, and between the item score and the total scale score (with the item removed) on the other. This analysis was conducted for all 42 items in the final version of the scale, following the exclusion of respondents who did not fit the Rasch-based Rating Scale Model. The purpose was to evaluate each item's contribution to both its specific subscale (dimension) and the overall scale. Table 10 presents these correlation coefficients between item scores and both subscale scores and total scores (after item removal), serving as indicators of the scales construct validity.

The analysis demonstrated strong relationships between items and their theoretical dimensions, with all corrected item-total correlations exceeding acceptable thresholds. This pattern of results supports the scale's internal consistency and confirms that each item appropriately measures its intended construct. The multitrait-multimethod analysis further verified the discriminant validity of the subscales, showing higher correlations within dimensions than across dimensions. These comprehensive validation procedures provide robust evidence for the scale's construct validity and its ability to reliably measure psychological capital across its proposed dimensions.

Item-dimension correlations were consistently high and exceeded item-total correlations, indicating that each item effectively measures its respective dimension and contributes to the overall scale. This coherence between item, dimension, and scale measurements provides strong evidence of construct validity. To further validate the 42-item scale, exploratory factor analysis (EFA) was conducted using the promax method with oblique rotation, accounting for correlations between dimensions. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.964, exceeding the threshold of 0.5, confirming the sample's suitability for EFA. The analysis identified four factors, as shown in Table 11.

Table 11 reveals that four factors collectively account for approximately 81.85% of the variance in persons' scores on the scale. The first factor explains 34.68% of the variance, followed by the second factor (21.72%), and the third factor (14.58%). Examination of the factor analysis results in Table 11 shows that the eigenvalue for the first factor was notably high (14.57) compared to the eigenvalues of the remaining factors. This finding strongly supports the scale's unidimensionality (Hattie, 1985), confirming that the instrument measures a single construct psychological capital. For interpreting item factor loadings, the researcher followed the classification system recommended by Comrey (as cited in Abd-el-Gaid, Trueblood & Shrigley, 1986), which categorizes loadings as follows: excellent (≥0.71), very good (0.63-0.70), good (0.55-0.62), acceptable (0.45-0.54), and weak (0.32-0.44). To determine factor membership, the researcher applied the highest loading criterion (Abd-el-Gaid, Trueblood & Shrigley, 1986), assigning each item to the factor where it showed the strongest loading (≥0.45). All 42 items demonstrated loadings across all four factors, with their distribution among factors detailed in Table 11.

The analysis revealed that the majority of items showed excellent to good loadings on their primary factors, with minimal cross-loadings on secondary factors. This clear factor structure provides strong evidence for the scale's construct validity and supports the theoretical framework of psychological capital as a unified yet multidimensional construct. The substantial variance explained by the first factor, coupled with its dominant eigenvalue, particularly reinforces the scale's measurement of psychological capital as a higher-order construct while still acknowledging its distinct components.

Reliability Indicators

The reliability of the Psychological Capital (PsyCap) scale was assessed using two approaches: traditional measurement methods and Item Response Theory (IRT).

Traditional Measurement Methods

Internal consistency reliability was calculated using Cronbach's alpha. The resulting value was 0.96, indicating high reliability. This robust coefficient suggests that the scale is highly consistent and suitable for assessing PsyCap levels among Jordanian university students, demonstrating strong internal coherence as a reliability indicator.

Item Response Theory (IRT)

The present findings provide strong support for the psychometric soundness of the Psychological Capital Scale based on RSM. The acceptable fit statistics indicate that the items function consistently in measuring a unidimensional construct. The application of the RSM offers a more rigorous validation compared to traditional methods, highlighting the robustness of the scale across different levels of respondents.

Using IRT, reliability was evaluated by estimating item difficulty and person ability parameters, yielding two reliability coefficients: Person Reliability and Item Reliability. In IRT, reliability reflects the precision of estimating the positions of persons and items on the latent trait continuum. The accuracy of items in defining this continuum was assessed using the Item Separation Index (Gi), defined as the ratio of the standard deviation of the estimated item difficulty parameters to the mean

standard error of these estimates. For the final 42-item scale, the Item Separation Index was 20.31, exceeding the threshold of 2, indicating that the items are sufficient to define the latent trait continuum—namely, the level of PsyCap among university students.

Similarly, the Person Separation Index (Gp) was calculated to assess the adequacy of the sample in distinguishing between items, yielding a value of 7.56, also exceeding 2. This confirms that the sample is sufficient for item separation. Using these separation indices (Gi and Gp), reliability coefficients for items and persons were computed with the formula :($R= G^2 / 1+ G^2$) where (G) is the separation index and (R) is the reliability coefficient (Wright & Masters, 1982). The resulting reliability coefficients were 0.98 for items and 0.99 for persons, both exceptionally high. The item reliability coefficient indicates that the sample size is adequate for distinguishing between items, thereby defining the latent trait continuum. The person reliability coefficient suggests high precision in estimating person abilities.

These IRT-based reliability coefficients are analogous to the Kuder-Richardson Formula 20 (KR-20) in Classical Test Theory (CTT), which represents the lower bound of reliability (Julian,1988). Additionally, the number of statistically distinct strata for items and persons was calculated using the formula: H= (4G)/3, where (H) is the number of strata and (G) is the separation index. The results yielded 27.08 strata for items and 10.08 strata for persons, indicating that the items effectively capture person differences in PsyCap and that the sample exhibits approximately 10 distinct ability levels. Another indicator of the scale's reliability in IRT is the Test Information Function (TIF), derived by summing the Item Information Functions (IIFs).

across all items, as expressed by: $I(\theta) = \sum_g Ig(\theta)$ where $I(\theta)$ is the total test information at ability is $\text{level}\,\theta$, and $\sum_g Ig(\theta)$ the information provided by item (i) at the same ability level. The TIF assesses the precision of item and ability parameter estimates, with each item's contribution to the test's information being independent of other items—unlike in CTT, where an item's contribution to reliability and validity depends on other items. The Item Information Function (IIF) for the RSM is given by:

$I(\theta) = [P'i(\theta)]2 / [Pi(\theta)(1 - Pi(\theta)]$. where $[Pi(\theta)]$ is the probability of selecting category (k) for item (i) at ability level (θ)

The TIF is inversely proportional to the standard error of estimation, making it a key reliability indicator. A lower standard error corresponds to higher reliability, as expressed by: $SE(\theta) = \frac{1}{\sqrt{I(\theta)}}$ where $SE(\theta)$: is the standard error at ability level (θ), and $I(\theta)$

Am the test information (Hambleton & Swaminathan, 1985). This relationship mirrors CTT, where reduced estimation error increases reliability. IRT's advantage lies in its ability to estimate standard errors at each ability level, allowing precise assessment of each item's contribution to measurement accuracy. The TIF for the final 42-item scale was estimated using the WINSTEPS software. Figure 2 illustrates the Test Information Function curve for the scale.

Figure 2 illustrates the Test Information Function (TIF) for the final 42-item Psychological Capital (PsyCap) scale. The maximum value of the TIF occurs near the midpoint of the latent trait continuum, gradually decreasing as it moves away from this point. This pattern aligns with the expectations of the Andrich Rating Scale Model (RSM), where the scale provides the greatest amount of information when the ability level ((\theta)) equals the item difficulty ((b)), applicable to both one- and two-parameter models. This indicates high precision in estimating ability at the midpoint of the trait continuum. At the extremes, the amount of information decreases, reflecting lower precision.

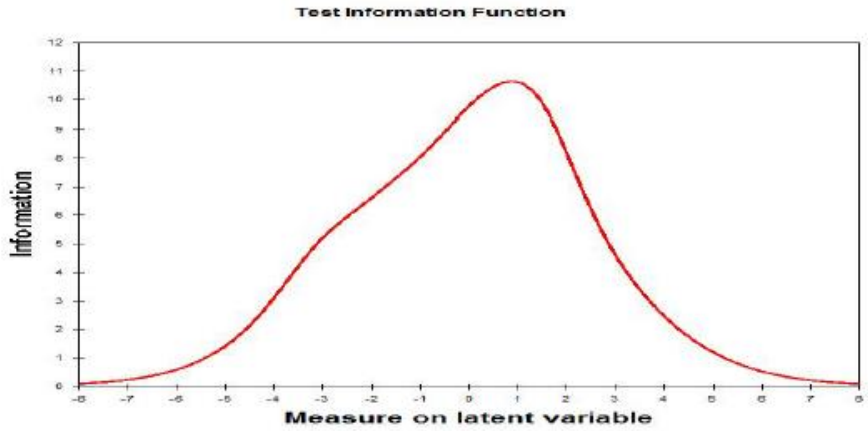


Figure 2: Test Information Function Curve for the PsyCap Scale.

The standard error corresponding to the TIF's maximum value was minimal, approaching zero, which serves as a strong indicator of estimation accuracy and, consequently, the scale's robust reliability. Reeve (2004) highlights that the TIF is directly linked to reliability: as the TIF increases, the standard error of estimation decreases, leading to higher reliability. This relationship underscores the scale's ability to provide precise and consistent measurements of PsyCap among Jordanian university students.

Final Form of the Scale

The final version of the PsyCap scale consists of 42 items designed to measure Psychological Capital among university students. When administered, the scale requires approximately 60 minutes completing. Students are instructed to respond to each item freely, as there are no correct or incorrect answers. Responses are recorded on a five-point Likert scale: "Always," "Often," "Sometimes," "Rarely," or "Never."

Scoring

Responses to the Psychological Capital scale are scored using a five-point Likert format. For positively worded items, responses are assigned scores as follows: "Always" = 4, "Often" = 3, "Sometimes" = 2, "Rarely" = 1, and "Never" = 0. For negatively worded items, the scoring is reversed, such that "Always" = 0 and "Never" = 4. The total raw score on the scale ranges from 0 to 168, with higher scores indicating higher levels of psychological capital. In terms of the latent trait continuum within Item Response Theory (IRT), individuals' ability estimates extend approximately from -5.15 to 6.47 logits, reflecting variation in levels of psychological capital among respondents.

Interpretation of Scores

To interpret the scores, the researchers propose classifying students into five categories based on their total raw scores, with corresponding ability levels on the latent trait continuum:

1. Very Low PsyCap (Raw Score < 42): Equivalent to an ability level of -2.826 logits or lower. These students exhibit critically low PsyCap, warranting significant concern and requiring appropriate psychological intervention.

2. Low PsyCap (Raw Score 42 to <84): Equivalent to ability levels between -2.826 and 0.502 logits. These students have low PsyCap, indicating concern and the need for psychological support to improve their psychological strengths.

3. Moderate PsyCap (Raw Score 84 to <126): Equivalent to ability levels between -0.502 and 1.822 logits. These students possess moderate PsyCap, which should be enhanced through targeted interventions.

4. High PsyCap (Raw Score 126 to <168): Equivalent to ability levels between 1.822 and 4.146 logits. These students demonstrate high PsyCap, reflecting strong psychological resilience and positive traits.

5. Very High PsyCap (Raw Score ≥168): Equivalent to ability levels above 4.146 logits. These students exhibit exceptionally high PsyCap, indicating outstanding psychological capital.

This classification system enables educators and counselors to identify students' PsyCap levels and tailor interventions to foster self-efficacy, optimism, hope, and resilience, aligning with the study's goal of supporting student development in Jordanian universities.

3. Conclusion

This study successfully developed a psychometrically sound Psychological Capital (PsyCap) scale tailored for Jordanian university students, utilizing the Andrich Rating Scale Model (RSM), a polytomous extension of the Rating Scale model grounded in Latent Trait Theory. The scale, finalized at 42 items after rigorous item analysis and removal of 20 non-fitting items, demonstrated strong alignment with the RSM, as evidenced by Infit and Outfit statistics approximating the ideal values (MNSQ ≈ 1, ZSTD ≈ 0). The scale measures four core dimensions of PsyCap—self-efficacy, optimism, hope, and resilience—offering a reliable and objective tool for assessing students' positive psychological traits. The findings confirm that the scale possesses robust psychometric properties, including high internal consistency (Cronbach's alpha = 0.89–0.92) and unidimensionality, with the first factor explaining 21.503% of variance. The removal of 186 non-fitting respondents and 20 non-fitting items ensured the scale's precision, with item difficulty and person ability parameters accurately estimated. This culturally tailored instrument fills a critical gap in the educational literature, where no standardized PsyCap scale previously existed for Jordanian university students, despite their role as vital human capital for societal development. The scale's practical utility lies in its ability to diagnose students' psychological strengths and inform targeted interventions. By identifying levels of selfefficacy, optimism, hope, and resilience, educators and counselors can design guidance programs to foster these traits, enhancing students' academic performance, well-being, and readiness to contribute to society. The study underscores the importance of positive psychology in higher education, particularly in fostering resilient, motivated persons capable of navigating challenges in a rapidly changing world.

Recommendations

Based on the findings of the present study, several recommendations can be proposed. **First**, the Psychological Capital scale developed in this study can be utilized by educators and counselors to assess students' levels of psychological capital and to identify individuals who may require targeted support. **Second**, educational institutions are encouraged to design and implement structured intervention programs aimed at enhancing students' self-efficacy, hope, optimism, and resilience, given their importance in improving academic performance and psychological wellbeing. **Third**, researchers are advised to apply the developed scale in different educational contexts and populations to further examine its validity and generalizability. **Fourth**, future studies are recommended to employ advanced Rating Scale-based analyses, such as Differential Item Functioning (DIF), to investigate potential differences across demographic variables such as gender and academic specialization. **Finally**, longitudinal research designs are suggested to examine the development of psychological capital over time and its impact on students' academic and personal outcomes.

Compliance with Ethical Standards

The authors declare that the study complied with ethical standards for research involving human participants.

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Conflict of interest

The authors declare no conflict of interest behind the work on this manuscript

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