

Progressing Cross-Lagged Structural Equation Modeling Analysis in a Quasi-Experimental Study to Examine the Effectiveness of Career Intervention

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ABSTRACT

Expanding on the frequent use of a pretest-posttest design to examine differences, this study aimed to explore the effective use of cross-lagged structural equation modeling using pretest-posttest designs to examine the effectiveness of career intervention. By retrospectively clarifying the rationale underlying the variables of a quasi-experimental study (Yang et al., 2024), this study integrates self-determination theory (SDT) into the career literature, establishing a more robust theoretical framework for exploring causality. Analysis of pretest-posttest data indicated that cross-lagged structural equation modeling revealed a significance of pretest variables in predicting them at the posttest. While partially supporting the hypothesized SDT rationale, this study recommends an increased measurement frequency, suggesting at least three assessment points for future studies. Owing to the difficulty in making causal inferences, it is necessary to include a control group(s) in the design of a quasi-experimental study. These findings have implications for advancing career interventions and evaluating their effectiveness.

Keywords: career intervention, cross-lagged structural equation modeling, pretests-posttests, self-determination theory, theory-driven intervention

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Introduction

Review of the literature on career intervention

1. Advancement in the examination of intervention effectiveness

In recent decades, most career counseling studies have used pretest-posttest designs to demonstrate the degree to which participants' outcome variables change after participating in interventions (Fouad et al., 2009; Osborn et al., 2007, 2020). However, the weaknesses of this quasi-experimental design have been widely discussed owing to its lack of internal and external validity (Gopalan et al., 2020). The absence of a control group(s) and random assignment in pretest-posttest designs makes it difficult to establish a clear causal relationship between changes in the observed variables, thereby compromising internal validity. Additionally, the external validity may be limited because the unique study setting may not apply to different contexts. As Gopalan et al. (2020) highlighted, accurately representing larger populations without random assignment or control groups is difficult, thus restricting the broader applicability of the study's findings beyond its specific context.

Despite these recognized weaknesses, pretest-posttest designs are still frequently used in career counseling owing to their practicality. They offered a baseline through pretest measurements to compare changes in post-intervention results, thus evaluating the effectiveness of the intervention. In fact, using this approach does not imply disregarding the fundamental requirements of rigorous experimental research that should be emphasized to obtain strong evidence (Slavin, 2020) but rather indicates a response to the constraints posed by the practical circumstances of the research setting. This is frequently a pragmatic choice when extended observations or repeated measurements are not feasible, requiring an alternative approach (Miller et al., 2020). The prevalence of pretest-posttest designs in career counseling (Maree et al., 2019; Masdonati et al., 2009) highlights the importance of quantifying progress and results in interventions to present scientific evidence for evaluating and supporting the effectiveness of career intervention. However, as research on the effectiveness of career intervention is still in its initial phases, it is necessary to investigate how reliable data can be obtained and analyzed using additional approaches to evaluate

the effectiveness of the intervention.

Regardless of the lack of three or more time measurements, pretest-posttest designs facilitate longitudinal analysis, shed light on the process of change and durability of intervention effects over time, and aid in establishing cause-and-effect relationships. Focusing on the process variables complements the existing explanation of the change between the pretest and posttest. By examining the process variables that explain how outcome variables change, insights and knowledge can be gained regarding the mechanisms driving the change from the initial pretest to the subsequent posttest. Tesch (2016) argued that incorporating this process perspective into the current use of pretest-posttest designs helps uncover the underlying factors contributing to observed differences in outcomes. Delving deeper into the mechanisms driving this change is crucial when a substantial difference emerges between the pretest and posttest results. A thorough analysis of these results can enhance our understanding of the rationale behind the effectiveness of career intervention.

Among the various longitudinal research designs, cross-lagged analysis is a valuable approach for probing the intricate relationships between variables of interest over time. If the fundamental rationale investigated in this study can be theoretically grounded, the cross-lagged structural equation modeling (SEM) approach provides researchers with a means to explore the developmental trajectories of these variables using repeated measurements (Falkenström et al., 2022; Zyphur et al., 2023). Instead of merely investigating the correlation between variables obtained from a single measurement point, a cross-lagged analysis explores how changes in one variable relate to subsequent changes in another. As Zyphur et al. (2023) highlighted, using cross-lagged analysis, the temporal order and potential causal connections between variables can be addressed to explore the causality that may exist in the variables. For example, the Cross-Lagged Panel Model (CLPM) has demonstrated effectiveness when used in conjunction with dynamic SEM to analyze longitudinal data. This approach enables researchers to draw causal conclusions while simultaneously controlling for persistent confounding factors such as individual differences that remain consistent over time.

Notably, similar to the aims of cross-lagged analysis, that is, exploring the mutual influence between variables of interest, understanding the dynamics of

change is crucial for examining the effectiveness of an intervention. However, the dynamics of change that must be assessed are significantly more complicated than those of traditional paired-sample t-tests, which analyze the mean difference between the pretest-posttest measurements of the main variables. To address this challenge, adopting a cross-lagged analysis, which investigates developmental trajectories, offers an alternative approach that complements the traditional paired-sample t-tests frequently employed in pretest-posttest designs. Cross-lagged analysis provides insights to causal relationships and temporal patterns among variables by revealing how these variables mutually influence each other over time. Incorporating cross-lagged analysis into the examination of study variables in pretest-posttest designs can shed light on the underlying mechanisms that drive developmental changes.

For a more comprehensive understanding on the effectiveness of career intervention, this study aimed to increase the use of cross-lagged SEM in quasi-experimental studies. This SEM approach is used to analyze data derived from a pretest-posttest design (Yang et al., 2024), similar to most pretest-posttest designs in career counseling (Babarović et al., 2020; Cadaret & Hartung, 2021) that typically involve repeated measurements as the primary means for assessing the effectiveness of career interventions.

2. Theory-driven career interventions that highlight process variables

When using repeated measurements to examine the effectiveness of career interventions, rigorous findings cannot be obtained from cross-lagged analyses without discussing their relevance to theory-driven interventions (Osborn et al., 2020). Specifically, focusing on how to advance quasi-experimental designs for examining the effectiveness of career intervention, another fundamental concern that should be addressed is the advancement of theory-driven interventions while aiming to establish the effective use of cross-lagged SEM in pretest-posttest designs.

Enhancing theory-driven knowledge to assess the effectiveness of an intervention is significant in career counseling, as it offers insights into the reasons and mechanisms behind changes during intervention implementation. In conjunction with advocating for evidence-based career practices (Brown, 2017; Haug & Plant, 2016; Robertson, 2021), theory-driven intervention development and evaluation

establish a robust foundation for accumulating evidence on the processes involved in the implementation of career intervention (Osborn et al., 2020).

The emphasis on theory-driven interventions aids in the evaluation of the theoretical foundation of current career interventions, allowing for the specification of the underlying reasons (“why”) that explain their efficacy. This knowledge contributes to the theoretical robustness of career intervention. Prioritizing theory-driven approaches aligned with evidence-based practices facilitates theory-based feedback, thereby advancing the accumulation of the “know-how” for implementing change. Understanding how to articulate the rationale for change supports the long-term advancement of the effectiveness of career intervention.

When introducing theory-driven interventions, existing career interventions can be enhanced by thoroughly discussing the process variables that determine the intervention outcomes. In addition to examining the outcome variables, the primary task of advancing the effectiveness of career intervention involves incorporating process variables into the study of the effectiveness of the intervention (Hirschi & Froidevaux, 2020; Spokane & Nguyen, 2016). This approach is recommended in program evaluation studies, as it aids in gathering evidence and cultivates a more comprehensive understanding of how changes unfold during intervention implementation. The emphasis on process evaluation in program evaluation is aligned with the focus of career studies, ensuring effective intervention implementation and stakeholder engagement. This approach contributes to a more comprehensive evaluation of career interventions, encompassing their impact on diverse aspects of career development. Beyond the primary outcomes typically assessed in pretest-posttest designs of the effectiveness of intervention, it is crucial to consider the process variables that explain the factors resulting in these outcomes to establish a solid rationale that can be explored in these studies. Identifying these process variables, which shed light on the underlying mechanisms of change, contributes to our practical understanding of how to assess the degree to which the expected effects can be observed and assessed during intervention implementation.

However, it is essential to emphasize that the examination of developmental trajectories involving process variables must be firmly rooted in a well-established theoretical framework. This emphasis on a theoretical grounding ensures that we

gain theory-driven insights into how to conduct career interventions effectively. Although several meta-analyses (Wang et al., 2023; Whiston et al., 2017) highlight the growing maturity of contemporary career interventions, understanding on the effective implementation of theory-driven career interventions and the most appropriate methods for evaluating their processes is still lacking. Until recently, our understanding of theory-driven practices in career counseling and their practical implementation was limited. Consequently, the advancement of a robust rationale for the effectiveness of career intervention has been hindered, leaving a significant gap in our understanding of the most effective strategies and practices for career counseling.

3. Beyond existing theory-driven interventions for career decision-making

Among the existing theoretical perspectives used in career counseling, the Career Information Processing (CIP) model is the most frequently examined to evaluate the effectiveness of intervention. Sampson et al. (2004) established CIP's theoretical foundation and provided a comprehensive framework for understanding how individuals make career-related decisions. By outlining the cognitive processes involved in making effective career decisions (i.e., gathering information for self- and option knowledge, making choices through communication, analysis, synthesis, valuing, execution, and metacognitive processes), Sampson et al.'s (2004) model not only provides well-structured components for implementing a career intervention but also explains how it can be used to assess changes in career decision-making processes, highlighting the aspects that should be addressed when evaluating the effectiveness of an intervention (Osborn et al., 2020). However, CIP's simplification of career decision-making, which focuses on a linear and sequential process, neglects the non-cognitive factors that underlie motivational complexities. This omission hinders the ability to emphasize adequately the motivational mechanisms essential for effective career interventions. Additionally, it has been discussed that the CIP's heavy emphasis on rational decision-making and information gathering limits the ability to account for contextual variations in decision-making (Constantine et al., 2005; Xu, 2023).

Specifically, because motivational mechanisms are neglected, the CIP model

explains what occurs during the implementation of career interventions. While efforts have been made to elucidate how changes in career decision-making processes occur, particularly in terms of skill enhancement such as career problem-solving, decision-making skills, and metacognitive skills (Osborn et al., 2020), the emphasis on these skills does not directly address the agency that determines motivation and activates career-related behaviors. Even after describing the desired outcomes of effective career interventions such as self-knowledge, option knowledge, decision-making skills, and executive processing (Osborn et al., 2020), CIP does not clearly explain how participants can be motivated by specific rationales or how the mechanisms facilitating these changes are activated and strengthened. After reviewing the theoretical foundation of CIP, researchers have reported a notable gap: the absence of a human agency model that can be integrated into career interventions to promote autonomous motivation. Nevertheless, as previously indicated (Chen, 2017; Hirschi & Koen, 2021; Quigley & Tymon, 2006), understanding the essential skills required for career decision-making should be coupled with a comprehensive understanding of the motivational mechanisms that significantly contribute to driving career-related actions. The limitations inherent in current CIP interventions impede the advancement of theory-driven interventions, particularly those geared toward enhancing career decisions and fostering career action (Haenggli et al., 2021; Hirschi, 2020; Young & Valach, 2019). Merely arriving at a decision does not inherently lead to subsequent action. Consequently, underscoring the cultivation of effective career actions through strategically implemented career interventions is imperative and the paramount focus of career counseling.

Solution that highlights motivational mechanisms toward career action

When striving to employ cross-lagged SEM effectively in pretest-posttest designs, process and outcome variables should be considered for a well-established approach to conducting theory-driven interventions. Beyond focusing solely on career-related outcome variables, integrating the human agency model (Chen, 2006, 2017) into career interventions to understand the implementation of autonomous motivation offers a crucial avenue for exploring the underlying rationale behind intervention implementation.

Therefore, the self-determination theory (SDT; Ryan & Deci, 2019, 2020) provides a robust theoretical framework for exploring causality. As it emphasizes the importance of basic psychological needs in optimal functioning at work (Autin et al., 2022), SDT can be integrated into career literature to reveal the motivational mechanisms underlying career decision-making and action. According to Ryan and Deci (2019, 2020), fulfilling basic psychological needs for autonomy, competence, and relatedness can be recognized as the fundamental agency determining human behavior in various settings. Need frustration, rather than need satisfaction, provides another dimension that explains occurrences in need-thwarting environments (Vansteenkiste & Ryan, 2013; Vansteenkiste et al., 2020) and how it is negatively associated with human agency and optimal behavior. Considering both dimensions, namely need satisfaction and frustration, and their roles in explaining career agency (Chen, 2006, 2017), SDT offers a concise yet comprehensive understanding of the motivations that guide career actions.

By applying this perspective to elucidate career decisions, Yang et al. (2024) proposed two main mechanisms to explain the potential connections between undergraduate students' basic psychological needs and career variables. The first elucidates how career indecisiveness contributes to the overall sense of frustration frequently experienced in higher education. While this aspect has been predominantly addressed in university counseling interventions that promote mental health and well-being (Baik et al., 2019), it can be integrated with the second mechanism, which explains how need satisfaction fosters autonomous motivation that determines career behavior. This mechanism underlying career growth suggests that satisfaction and autonomous motivation collectively contribute to career decision-making. In a study with 130 undergraduate students who participated in career interventions, changes in SDT-based constructs (satisfaction and frustration of basic psychological needs and autonomous motivation) and two statuses of career decision-making (i.e., career decidedness and career indecisiveness) between pretests and posttests were significant (Yang et al., 2024); however, the SDT rationale underlying the relationship between these basic psychological needs and career variables has yet to be empirically examined.

The absence of empirical examination of the need-based dynamics of career

interventions highlights the pressing need for further research and exploration. Investigating and validating the SDT rationale can contribute to our understanding of the underlying mechanisms that activate career actions among undergraduate students. Moreover, it can have practical implications for career counseling and interventions aimed at enhancing undecided and unprepared students' decision-making processes as well as their career actions pertaining to higher education. By conducting empirical studies to examine the SDT rationale, the gap between career intervention theory and practice can be closed, ultimately providing evidence-based guidance to support undergraduate students in actualizing their career actions toward career self-management. Consequently, the establishment and continuous enhancement of theory-driven interventions to facilitate the need-based dynamics of career actions can be achieved.

Research purpose and hypotheses

Expanding on the reasoning derived from SDT, this study aimed to explore the motivational mechanisms embedded in effective career interventions to enhance our understanding of how need satisfaction and frustration are differently connected to career indecisiveness and action. Figure 1 demonstrates the SDT rationale underlying the significant changes between the pretests and posttests, based on data from Yang et al.'s (2024) study. This rationale requires further examination using a cross-lagged SEM analysis.

The first explains how career indecisiveness exacerbates frustration associated with basic psychological needs. Career indecisiveness significantly increases frustration and negatively influences undergraduate students' basic psychological needs. The inability to make career decisions intensifies anxiety and hinders the establishment of career identity, exploration of options, and professional development, ultimately precipitating persistent frustration (da Silva et al., 2020; Sampaio et al., 2021). This prolonged indecisiveness in career decision-making contributes to the far-reaching frustration experienced in contemporary higher education.

Conversely, the second mechanism, drawn from SDT, explains that the satisfaction of basic psychological needs experienced by participating in career interventions influences autonomous motivation (Chen, 2006; Ryan & Deci, 2020) and

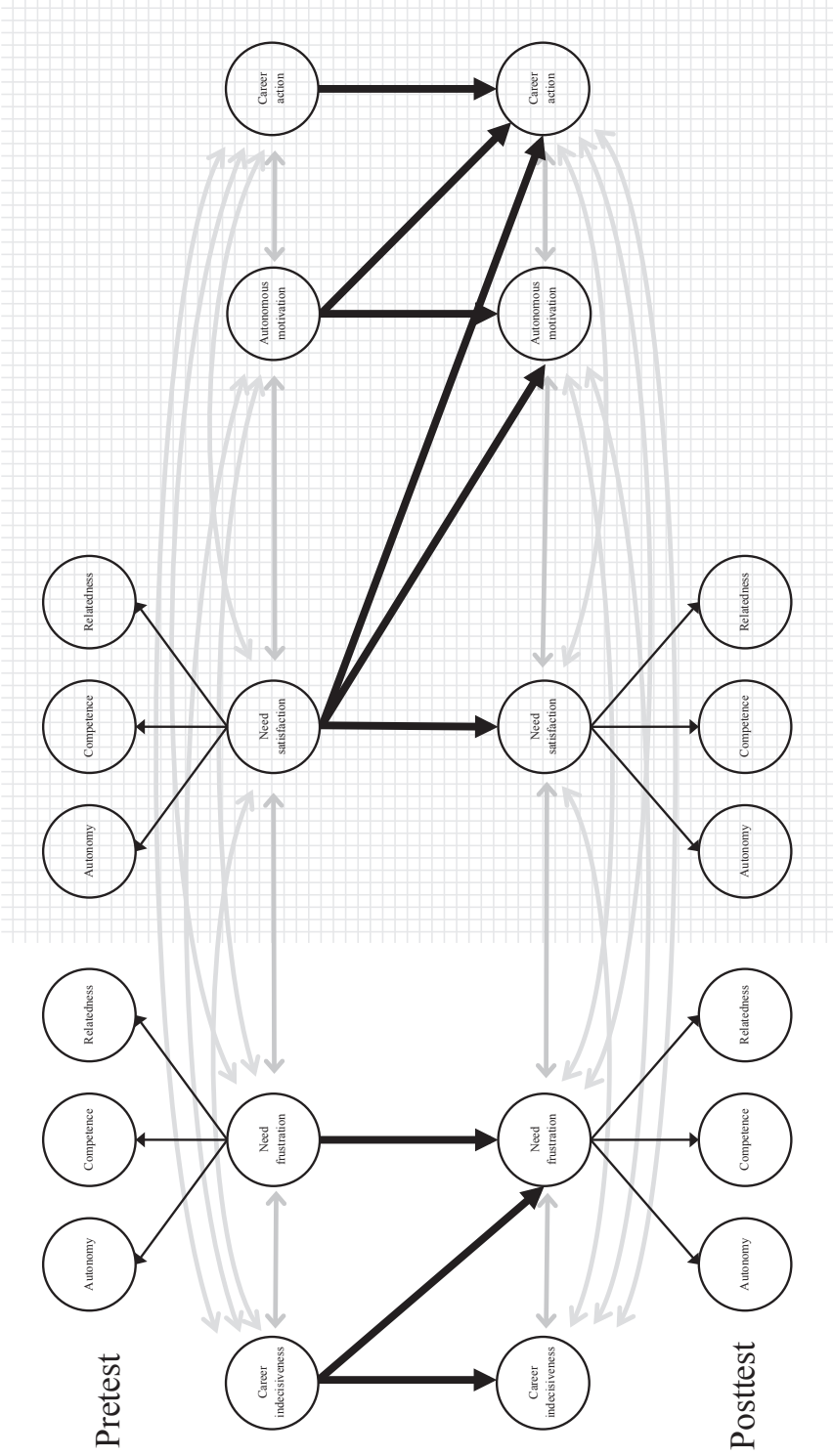


Figure 1 Adaptation of cross-lagged SEM to examine the SDT rationale

that these motivational processes collectively increase the level of career action (Chen, 2017). This hypothesis emphasizes the significance of need satisfaction in achieving optimal functioning, and in turn, its contribution to career growth. As Ryan and Deci (2019, 2020) discussed, when individuals experience satisfaction with their basic psychological needs of autonomy, competence, and relatedness, they are more likely to strive to fulfill these needs, even when facing difficulties. The fulfillment of these psychological needs serves as a catalyst for career growth and success (Autin et al., 2022; da Silva et al., 2020; Sampaio et al., 2021). Instead of examining career decidedness to explain the degree to which an informed career choice is made, an analysis centered on career action further illustrates the effects of career interventions on goal-directed career behavior, which is closely associated with the increasing emphasis on contemporary career self-management (Haenggli et al., 2021; Hirschi, 2020; Hirschi & Koen, 2021).

Accordingly, the three hypotheses presented in Figure 1 were established. Along with one hypothesis that explains all the study variables at Time 1 and predicts them at Time 2, two additional hypotheses were established to examine the rationale underlying the association between basic psychological needs, career indecisiveness, and career actions.

The hypotheses are specified as follows:

Hypothesis 1: Basic psychological needs (frustration and satisfaction), autonomous motivation, career indecisiveness, and career actions at Time 1 predict them at Time 2.

Hypothesis 2: Hesitation to make career decisions (i.e., career indecisiveness) at Time 1 positively predicts basic psychological need frustration at Time 2.

Hypothesis 3: Career actions at Time 2 are influenced by satisfaction with basic psychological needs (mediated by autonomous motivation) at Time 1.

These hypotheses were established using a cross-lagged SEM (Falkenström et al., 2022; Orth et al., 2022; Zyphur et al., 2023; Figure 1) to explore whether the hypothesized rationale drawn from SDT was supported and could be used to explain the causality focusing on how basic psychological needs are associated with career variables.

Methods

Data source

The data used in this study were derived from Yang et al. (2024) as part of the second author's research project, funded by the National Science and Technology Council, Taiwan. This two-year study explored how the Youth Capacity-Building Program (YCBP), which was launched by the Taiwan Fund for Children and Families, influenced the basic psychological needs and self-determination motivation of socioeconomically underprivileged undergraduate students, with implications for strengthening career choices in youth support and higher education. By analyzing the quantitative and qualitative results obtained from participants' experiences during a one-year career intervention period (i.e., the YCBP), this study explored the factors that determined undergraduate students' satisfaction and frustration with their basic psychological needs and career behaviors.

Two measurements were conducted in the original study: first, at the beginning of participation in the career intervention (pretest) and second, after participants had completed the career intervention (posttest). Although the original study used core SDT constructs to achieve its research goals, it did not analyze the specific relationship between satisfaction or frustration with basic psychological needs and career variables.

Building on the significant differences between the pretests and posttests conducted on data from the original study (Yang et al., 2024), this study further extended the SDT rationale and developed Hypotheses 2 and 3, addressing the two main psychological mechanisms. By testing these hypotheses and generating new findings, this study aimed to discuss how future research can improve its experimental design to enhance the exploration of causal relationships obtained from pretest and posttest measurements.

Variables and instruments

In career studies, selecting process variables involves aligning them within a theoretical framework and ensuring practical measurability, sensitivity to change,

and ethical considerations. Comprehensive selection is achieved through contextual relevance, interdisciplinary perspectives, and a review of the existing literature (Heppner & Heppner, 2003; Whiston & Rahardja, 2008). Five latent variables were formed using data obtained from Yang et al. (2024) to analyze the SDT rationale explaining the association between basic psychological needs and career variables.

In terms of basic psychological needs, this study considers satisfaction and frustration with autonomy, competence, and relatedness needs, offering a more comprehensive understanding of human agency. This study uses these motivational variables as second-order latent variables to align with their original structures, as described in previous studies (Chen et al., 2015; Sheldon & Deci, 1993). In addition to need satisfaction and frustration, autonomous motivation is another variable that explains motivational processes, indicating that motivation functions in a self-determined manner.

Career-related measures (career indecisiveness and action) were also used. Career indecisiveness refers to the extent to which a career decision has not been made, causing anxiety or confusion about the current career uncertainty, whereas career action refers to the steps taken to set and pursue career goals. These two career variables are first-order latent variables. The instruments used to measure these variables are briefly described below. Further details of the scales used in this study can be found in Yang et al.'s (2024) study.

The Basic Psychological Need Satisfaction and Frustration Scale, developed by Chen et al. (2015), was used to assess autonomy, competence, and relatedness as the three basic psychological needs addressed by the SDT. This 24-item scale has a Chinese version that has been validated using confirmatory factor analysis (Chen et al., 2015). Within the scale, each of the three basic psychological needs was assessed using eight items, split into four positive statements measuring need satisfaction. (e.g., "I feel a sense of choice and freedom in the things I undertake.") and four negative statements measuring need frustration (e.g., "Most of the things I do feel like I have to.").

The Chinese version of Sheldon and Deci's (1993) 10-item Self-Determination Scale was used to assess autonomous motivation. A bilingual PhD student fluent in Chinese and English translated the scale. A back-translation process was used

following the typical procedure suggested in cross-cultural studies to ensure accuracy and maintain the original meaning (Klotz et al., 2023). This scale has two subscales: self-awareness and choice perception. Participants rated each item on a scale ranging from 1 (“only A feels true”) to 9 (“only B feels true”). For example, an item for self-awareness: “My emotions sometimes seem alien to me” versus “My emotions always seem to belong to me”; and one for choice perception: “I always feel like I choose the things I do” versus “I sometimes feel that it is not really me choosing the things I do.” Items for choice perception were reverse-scored.

The Taiwanese Career Decision Scale (TCDS), developed by Yang et al. (2022), was used to assess students’ level of uncertainty and confusion about their careers (“career indecisiveness”; six items). Sample items include the following: “In the face of career issues, I am hesitant. Decision-making is difficult” and “I feel full of uncertainty and powerlessness concerning my future career.” A comprehensive measurement was developed by constructing the TCDS. The resulting Career Action Scale, comprising 10 items, assessed participants’ proactive efforts to set and pursue their career goals once they had reached a state of career decidedness. Sample items include the following: “I have already found my career goal at present, and I am working hard to achieve it” and “I have determined my future career plans and am currently actively preparing for and gradually making progress.”

Central tendency bias was addressed by converting all scales to a 6-point format (1 = “very strongly disagree”; 6 = “very strongly agree”). The methodology was assessed for robustness and reliability. The measurement scales were subjected to a comprehensive validation assessment, with measures to ensure accuracy.

Analytical strategy

To examine the rationale behind effective career interventions, a cross-lagged SEM analysis was conducted on the relationship between the central SDT constructs, career indecisiveness, and career action. Using Mplus for SEM, this primary analysis explored the hypothesized relationships between variables within the SDT framework and career variables rather than strictly employing them as a tool to confirm model fit.

Results

Descriptive statistics and correlations

Table 1 shows the descriptive statistics for the five variables and their correlations. As noted in the lower values corresponding to the pretest scores on the diagonal values at the pretest, the means of the positive variables (need satisfaction, autonomous motivation, and career action) exceeded 3.55, with need satisfaction being the highest (>4.51). In terms of the negative variables (need frustration and career indecisiveness), the pretest for need frustration was low (mean = 2.88), whereas career indecisiveness was relatively high (mean = 3.51). The standard deviations were predominantly less than one, except for career indecisiveness (1.03).

Table 1 Correlations of the variables measured at pretest and posttest

| | 1 | 2 | 3 | 4 | 5 |
|--------------------------|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Career indecisiveness | 3.09 (1.13) 3.51 (1.03) | .44*** | -.28** | -.44*** | -.61*** |
| 2. Need frustration | .47*** | 2.37 (.80) 2.88 (.69) | -.75*** | -.93*** | -.18 |
| 3. Need satisfaction | -.37*** | -.75*** | 4.74 (.70) 4.51 (.54) | .92*** | .32*** |
| 4. Autonomous motivation | -.36*** | -.83*** | .66*** | 3.96 (.87) 3.55 (.90) | .23* |
| 5. Career action | -.59*** | -.13 | .34*** | .24* | 3.91 (.88) 3.69 (.94) |

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. The diagonal values from top left to bottom right represent the means of the corresponding variables, and the numbers within parentheses are standard deviations. The upper and lower values correspond to the posttest and pretest scores, respectively. Values above the diagonal in the table are the correlations between the posttest variables, whereas those below the diagonal are the correlations between the pretest variables. The correlations between the pretest and posttest variables are $r = .50***$ for career indecisiveness, $r = .37***$ for need frustration, $r = .27**$ for need satisfaction, $r = .39***$ for autonomous motivation, and $r = .49***$ for career action.

The upper values corresponding to posttest scores on the diagonal values presented in Table 1 reveal that, at posttest, need satisfaction had a high mean (mean = 4.74, indicating more than “agree”). Furthermore, the means of career action (3.91) and autonomous motivation (3.96) were close and the lowest among the positive variables. Between the two negative variables, need frustration remained relatively low (mean = 2.37) compared to career indecisiveness, which remained relatively high (mean = 3.09, indicating “slightly disagree”); however, their scores were close and below “agree.” Moreover, the standard deviations were mostly less than 1, except for career indecisiveness (1.13).

Most pretest and posttest variables exhibited skewness and kurtosis values within an acceptable range (−1 to 1), indicating normal distributions. Only one posttest variable (autonomous motivation) had a kurtosis value exceeding an absolute value of 1 but was still within the acceptable range (1.10), suggesting a normal distribution for the study data. Further information on the variables’ descriptive statistics can be found in Yang et al.’s (2024) study.

In terms of the correlations between the variables, in Table 1, the values above the diagonal are the correlations between posttest variables, whereas those below the diagonal are the correlations between pretest variables. Correlations of the variables measuring the pretest and posttest demonstrated similar results, with only one nonsignificant correlation between need frustration and career action ($p > .05$). In addition, the correlations existing between pretest and posttest variables were $r = .50$ for career indecisiveness ($p < .001$), $r = .37$ for need frustration ($p < .001$), $r = .27$ for need satisfaction ($p < .01$), $r = .39$ for autonomous motivation ($p < .001$), and $r = .49$ for career action ($p < .001$).

Main analysis

Using cross-lagged SEM, a primary analysis was conducted to examine the hypotheses. The results provided statistical support for Hypotheses 1 and 2, whereas Hypothesis 3 was only partially supported.

Figure 2 shows that all study variables measured at Time 1 significantly predict their corresponding values measured at Time 2 (β values = .55, .32, .36, .41, .52 for career indecisiveness, need frustration, need satisfaction, autonomous motivation,

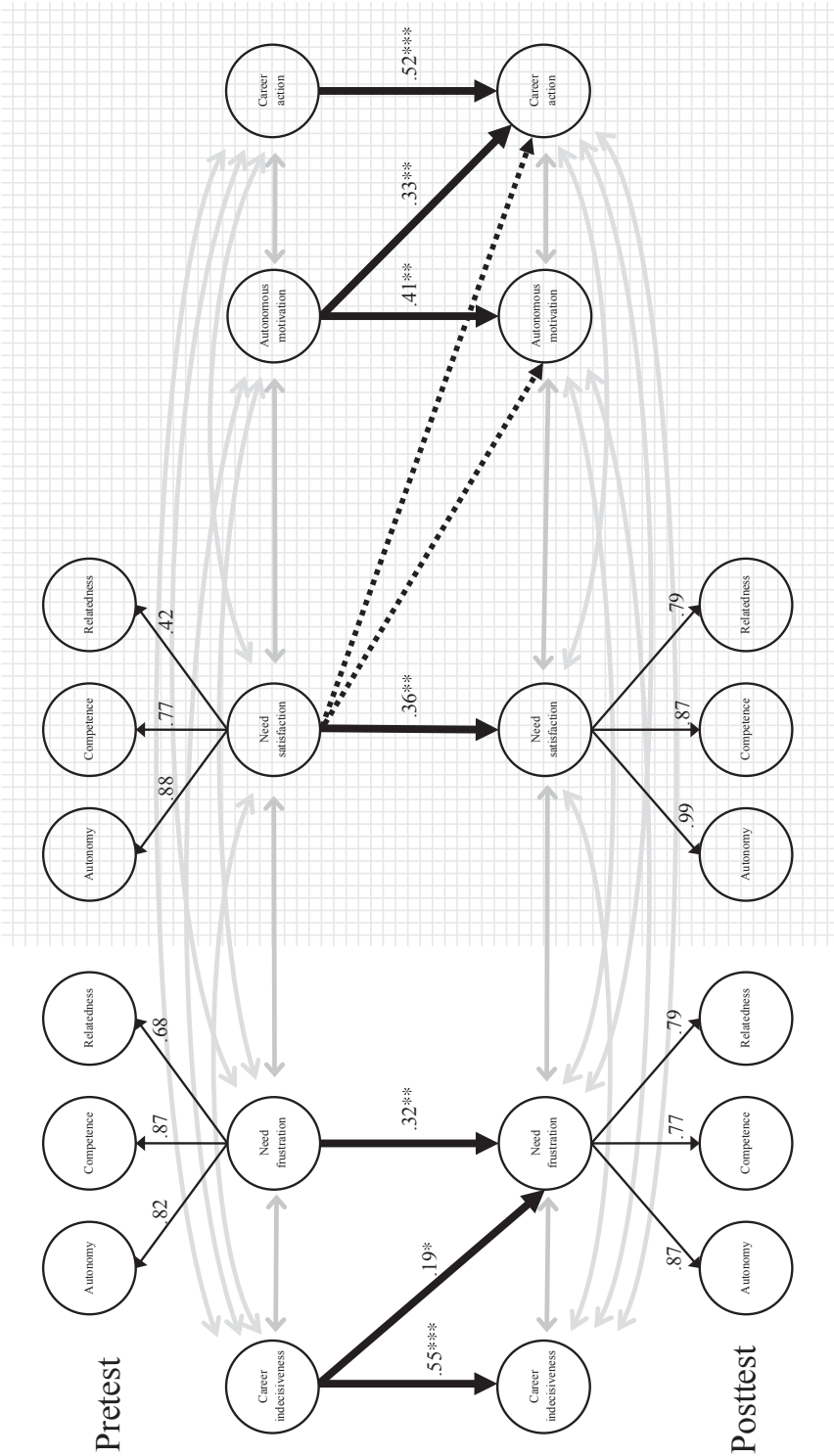


Figure 2 Cross-lagged SEM results

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Solid black lines indicate significant paths, and the coefficients are standardized. Dotted lines represent nonsignificant paths.

and career action, respectively; $p < .001$ or $p < .01$). Basic psychological needs, autonomous motivation, career indecisiveness, and career action at Time 1 were predicted at Time 2.

The autoregressions of the five variables, which were initially measured and subsequently re-evaluated at the same time point, offer insights into the inherent self-predictive tendencies of these constructs. These positive predictions align with theoretical expectations, suggesting that these variables tend to maintain a certain degree of stability over time. This result was consistent with the positive correlations that existed between the pretest and posttest variables explained in the note under Table 1, suggesting that the scores of career indecisiveness, need frustration, need satisfaction, autonomous motivation, and career action obtained at the beginning of participation in a career intervention positively predicted their scores after participating in a career intervention. Hence, Hypothesis 1 is statistically supported.

Regarding the first motivational mechanism that addresses the relationship between career indecisiveness and need frustration, the standardized regression coefficient (β value = .19, $p < .05$) supported the hypothesis that the status of hesitating to make a career decision at Time 1 positively predicts their basic psychological need frustration at Time 2. Even when controlling for need frustration measured at Time 1, career indecisiveness measured at Time 1 accounted for need frustration measured at Time 2. The prediction was positive with a significance level of .05. Hence, Hypothesis 2 is supported.

However, the final hypothesis, addressing the second motivational mechanism, lacked full support owing to the absence of statistical significance in predicting the influence of need satisfaction on both autonomous motivation and career action ($p > .05$). The hypothesis that satisfaction with basic psychological needs at Time 1 influenced career action at Time 2 (mediated by autonomous motivation) was not supported. Only the prediction of autonomous motivation on career action proved significant, with a positive effect (β value = .33, $p < .01$). When considering need satisfaction, autonomous motivation, and career action measured at Times 1 and 2 (i.e., autoregressive effects), only autonomous motivation measured at the first time point predicted the variation in career action measured at the second time point (i.e., cross-lagged effect). Consequently, Hypothesis 3, which explains the motiva-

tional mechanism underlying career growth, is only partially supported.

Discussion

Advancement of theory-driven career interventions

Developmental trajectories are crucial in career studies and provide dynamic insights into career evolution. They help identify critical stages, predict transitions, and consider contextual factors (Grosemans & De Cuyper, 2021; Hirschi, 2011; Negru-Subtirica et al., 2015; Ocampo et al., 2020). Insights from these trajectories can inform career development interventions and shape educational strategies and policies from a holistic perspective of career growth in education and the workplace.

Using a cross-lagged SEM analysis, this study partially supports the hypothesized model derived from SDT. In addition to the decrease in need frustration owing to a low level of career indecisiveness, the hypothesis that posits the emergence of autonomous motivation through need satisfaction and its subsequent influence on career actions received only partial support. Only the positive influence of autonomous motivation on career action was statistically significant. The two supported hypotheses (Hypotheses 1 and 2) align with the SDT's assertion that basic psychological needs remain stable and are closely associated with human behavior (Ryan & Deci, 2019, 2020). Furthermore, the developmental trajectory of basic psychological needs can be investigated by assessing the stability of need satisfaction and frustration over time and by examining whether these levels change (increase or decrease) throughout development.

Together with the effect of need satisfaction on optimal functioning (Ryan & Deci, 2019, 2020), difficulty in completing developmental tasks and threats to daily life can negatively affect basic psychological needs, potentially precipitating an overall sense of need frustration (Vansteenkiste & Ryan, 2013; Vansteenkiste et al., 2020). Moreover, this association is manifested in career issues, including career choices and actions. The results of this study provide a direction for exploring career behaviors from an SDT perspective.

Future studies should expand on the SDT framework developed in this study to investigate additional career variables associated with basic psychological needs.

Investigating career self-efficacy, identity, and orientations, which determine the agency underlying career self-management (i.e., self-directed and value-driven components of intrinsic motivation), would provide an alternative rationale for integrating SDT into the existing career literature (Chen, 2017; Hirschi & Koen, 2021; Lent et al., 2016; Quigley & Tymon, 2006). This discussion can help establish a more theoretically grounded bridge to facilitate dialogue between SDT and career literature and advance theory-driven career interventions.

By contrast, current CIP career interventions focus on cognitive skills that contribute to career decisions (McLennan & Arthur, 1999; Osborn et al., 2020). Emphasizing an interdisciplinary theoretical foundation for investigating the motivational mechanisms that determine career actions can help propose in-depth research perspectives and practical approaches to theory-driven career interventions, which promote career decision-making and actions from a need-based perspective that explains agents in complex and dynamic environments. Additionally, this emphasis on incorporating basic psychological needs into research on career actions would strengthen the emerging discussion among researchers (Hayden et al., 2021) regarding enhancing agency within the CIP framework.

Enhancing methodological rigor of pretest-posttest designs for conducting cross-lagged SEM: Minimum of three measurement time points

The analysis conducted in this study highlights the potential use of cross-lagged SEM in the context of pretest-posttest research designs. Conventionally, quasi-experimental designs tend to emphasize the effectiveness of intervention by comparing the difference between pretest and posttest scores while frequently neglecting the salience of multiple measurements, thus constraining the depth of data analysis within experimental frameworks. This study clearly demonstrates the difficulty in interpreting the results obtained from a pretest-posttest design that uses only two measurements, as discussed by Marsden and Torgerson (2012).

This study, circumscribed by the constraints of the existing two-time pretest-posttest data, merely explained the influence of pre-intervention psychological states and career conditions on post-intervention outcomes. Consequently, the analysis

offered limited insights into the dynamics that occurred during the intervention process. The acquisition of comprehensive process knowledge remains unattainable within this study, even when employing cross-lagged SEM.

Ensuring a minimum of three measurement time points is crucial for robust causal explanations in psychology, with previous researchers (e.g., Curran & Bauer, 2011; Maxwell & Cole, 2007) favoring longitudinal designs for the accurate identification of causal relationships. Emphasizing the psychotherapeutic mechanisms of change (Kazdin, 2007) also highlights the importance of tracking variables over time, facilitating a comprehensive understanding and effective control of confounding factors. These studies consistently advocate at least three time points aligned with contemporary perspectives on research design and causation in psychology.

The apparent implication of this analysis is that the simple inclusion of an additional measurement point obtained during the intervention process to provide a complete dataset of the same variables across the three time points was significantly better than the current use of cross-lagged SEM. Adding one measurement time point to the prevalent use of pretest-posttest designs for examining career interventions can facilitate a more intricate data analysis within the paradigm of cross-lagged SEM. This enhancement in the present quasi-experimental design in career counseling engenders the potential to yield valuable research outcomes that are conducive to a more profound comprehension of the dynamic processes underlying changes in the implementation of career intervention. Insights obtained from such a quasi-experimental design, with at least three measurements to determine the causality between the main study variables through cross-lagged SEM, would significantly contribute to the understanding about the effectiveness of an intervention.

Furthermore, as previously discussed, incorporating an additional measurement point during the intervention process can provide a more perspicuous and comprehensive explanation of how psychological pre-intervention and career-related states influence those presented during the intervention and how this intervention process shapes post-intervention outcomes. This accumulation of knowledge serves as a foundation for establishing process indicators to facilitate process-oriented evaluations of effectiveness, beyond merely enhancing the comprehension of dynamic processes to facilitate summative assessments (Flynn, 1994; McLennan & Arthur,

1999). Moreover, the benefit of using process-oriented effectiveness assessments complements our discussion on the importance of addressing the scholarly underpinnings of career interventions. Both individually and in conjunction, they contribute to the practical advancement and theoretical explanation of the effectiveness of career interventions. This quasi-experimental design approach, based on at least three measurements (i.e., pre-, process, and posttests), provides pragmatic guidance for practitioners involved in planning and evaluating career interventions. The accumulation of evidence-based intervention findings will promote the practical implementation of the theory-driven career interventions emphasized in this study.

Control groups' imperative role in elucidating cross-lagged SEM results

The absence of one or more control groups in the original study raised concerns about the validity and reliability of the findings. Miller et al. (2020) argued that control groups are essential in experimental designs, as they provide a baseline against which the effects of the intervention or variables of interest can be compared. Lack of control group(s) is a frequent concern in career counseling research, as observed in various studies (Osborn et al., 2007; Schams et al., 2022). Unfortunately, without establishing a control group in the original study, attributing the observed changes solely to the variables under investigation becomes challenging for the use of cross-lagged SEM because other confounding variables may exert an impact.

Establishing a control group in career studies is challenging, primarily because of the dynamic nature of career development. In addition, ethical concerns arise when considering random assignments to a control group, as this may limit participants' career development opportunities and necessitate a balance between research needs and ethical considerations. Furthermore, longitudinal studies face challenges in maintaining a stable control group over time, given that participants experience career changes and life events that introduce variability. Additionally, resource constraints, encompassing limited time and funding, compound the challenges by presenting obstacles to the recruitment and retention of participants in the experimental and control groups. These multifaceted challenges highlight the complexities researchers encounter when exploring the factors that shape their career trajectories.

However, as highlighted by Miller et al. (2020), incorporating one or more control groups would have allowed for a more robust analysis, thus enabling this study to account for external factors that could influence the results. For example, the significant changes observed after participating in the intervention could be attributable to natural maturation, considering the extensive duration of more than one year of the career intervention examined herein. Additionally, significant results might be found among undergraduate students who did not participate in the intervention. The intervention examined in this study was specifically designed for socioeconomically underprivileged undergraduate students. The absence of results comparing the differential effects of this career intervention on privileged and underprivileged students hindered the interpretation of the cross-lagged SEM results.

The absence of control groups makes it difficult to draw definitive conclusions and limits the generalizability of the findings to broader populations or contexts. Future studies using quasi-experimental designs should include one or more control groups to enhance the credibility and comprehensibility of the results.

Technical advancements: Alternatives in the paradigm of using cross-lagged SEM

This study adopted a theoretical framework in line with SDT instead of relying solely on a data-driven approach to derive its findings. Specifically, it employs a theory-driven paradigm to explore how basic psychological needs are associated with career variables and how effective career interventions can be implemented. Instead of thoroughly examining all the cross-lagged relationships hypothesized in the CLPM, this study examined the expected connections between the variables at Times 1 and 2 (Figure 1). This analytical strategy was selected to establish a theory-based intervention framework in career counseling rather than adhering to the stringent requirements associated with the use of the CLPM (Mund & Nestler, 2019).

In using cross-lagged SEM, there has been increasing criticism (Lucas, 2023; Mund & Nestler, 2019) that the assumptions of the standard CLPM are excessively restrictive, including assumptions of linearity and stationarity. Furthermore, standard CLPMs are frequently criticized for their limited ability to account for within—and between-person effects, which should be clarified to understand individual varia-

tions in longitudinal data. Additionally, they tend to overlook the complexities of real-world data, including nonlinear relationships, bidirectional causality, and the presence of unobserved variables, thus precipitating potentially biased parameter estimates (Lucas, 2023). False interpretations of results may also exist. To address these limitations and provide more comprehensive solutions, next-generation cross-lagged models, such as the random intercept CLPM (RI-CLPM), autoregressive latent trajectory model with structured residuals (ALT-SR), and dual change score model (DCSM), are emerging and are used more frequently (Mund & Nestler, 2019), as they offer greater flexibility and robustness in capturing the intricacies of longitudinal data.

While the complexity of these next-generation cross-lagged models increases, causing challenges in parameter estimation, it is essential to note that contemporary statistical software—particularly R package lavaan and Mplus—significantly streamlines the process of obtaining analytical results for these models (Mund & Nestler, 2019). Along with close learning from the ongoing development of these innovative modeling approaches and understanding the specific conditions under which they are most applicable, researchers who are concerned with how to employ a cross-lagged SEM analysis in quasi-experimental designs should exercise caution in model selection. Specifically, this selection also involves considering theoretical underpinnings that are essential to their research aims and practical factors in the research field wherein their quasi-experimental study is conducted, such as the frequency of measurements and sample size. In the context of employing cross-lagged SEM, various next-generation cross-lagged models require data from at least three measurement time points to ensure a robust analysis (e.g., RI-CLPM, ALT-SR, DCSM; Mund & Nestler, 2019). This careful methodological consideration ensures that researchers make wise choices when selecting models that optimally suit their research questions in quasi-experimental studies on the effectiveness of career interventions.

Along with the ongoing discussion on the issues of effect size for cross-lagged effects (Orth et al., 2022), the advancement of these robust cross-lagged models provides scientific evidence in various analytical frameworks. These models aim to balance rigorous statistical requirements with the practical requirements of quasi-

experimental studies. However, for career researchers and practitioners dedicated to enhancing the effectiveness of career interventions, the primary emphasis should remain on formulating precise research hypotheses firmly rooted in the theoretical rationale. Subsequently, appropriate statistical models can be selected to analyze and assess the effectiveness of these interventions. Therefore, it is important to understand the limitations of these statistical models. By doing so, theory-driven career interventions can be effectively implemented, fostering a continuous dialogue between theoretical deductions and empirical discoveries, thus advancing and enriching the theoretical foundations of career-counseling interventions.

Conclusion

This study demonstrates that rigorous quasi-experimental designs are necessary to explore the relationship between basic psychological needs, career actions, and observed changes in career interventions. As most existing studies on career decision-making and actions are cross-sectional, limiting our understanding of causal relationships and practical applications, future studies on career interventions should employ rigorous quasi-experimental designs (with one or more control groups) that contribute to establishing causality to explain the relationships between key variables drawn from the theoretical rationale. Under the condition wherein the change in intervention can be compared with that in the control group(s), using a cross-lagged SEM analysis with a rigorous quasi-experimental design to simultaneously analyze the longitudinal data collected from at least three measurements in this quasi-experimental design helps clarify complex results and produce specific knowledge regarding how causality makes changes throughout the implementation of career interventions.

As Lent et al. (2019) have highlighted, investigating the causal sequence of perceptions, traits, and contextual factors is crucial for advancing the theoretical understanding and practical applications of career interventions. As demonstrated in this study, the methodological limitations inherent in popular pretest-posttest designs hamper the generalizability of the findings to undergraduate students and impede the understanding of the complex relationships between key variables.

Despite advancements beyond the conventional pretest-posttest designs used to examine the effectiveness of career interventions, the outcomes of the cross-lagged SEM analysis continue to present difficulties in explaining how to integrate conditions that can effectively facilitate change in the intervention. Extending the example discussed here, the ongoing exploration of how to use the cross-lagged SEM analysis approach effectively to advance the theoretical underpinnings of current career interventions requires continuous scholarly effort.

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在準實驗研究中 推進交叉延宕結構方程模型分析 以檢視生涯介入之有效性[†]

楊育儀¹

摘要

延伸自目前採用於檢驗前後測差異時常見的研究設計，本研究旨在討論如何有效運用交叉延宕結構方程模型分析以探討生涯介入之有效性。透過回顧性檢視，並釐清在準實驗研究（Yang et al., 2024）採用變項之理論基礎，本研究將自我決定理論與既有生涯文獻結合，藉此建立理論框架來探究和這些研究變項有關的因果關係。根據該研究的前測後測數據進行分析，交叉延宕結構方程模型分析結果指出前測變項在預測後測這些變項時達到顯著性；此外，研究結果僅部分支持本研究提出之自我決定理論及假設，建議在採用準實驗研究設計時宜增加測量頻率，並在未來研究設計中至少應有三個評估時間點。由於本研究在分析時難以進行明確的因果推論，因此，強調在未來的準實驗研究設計中必須納入控制組。這些研究發現，對於未來進一步推進生涯介入研究領域之進展以及討論如何評估其有效性，具有重要意涵。

關鍵詞：生涯介入、交叉延宕結構方程模型、前後測、自我決定理論、由理論驅動之介入

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