



neurozone®

White Paper

VALIDATION OF THE NEUROZONE® BRAIN PERFORMANCE DIAGNOSTIC

JANUARY 2017

1. STUDY 1

1.1 Objectives

This study is aimed at psychometrically validating the Brain Performance Diagnostic (BPD).

1.2 Sample

Data was collected through online assessments over a period of five months. A total sample of $n = 713$ responses was collected. The mean age of participants is 37.05 (SD = 10.743) most of whom are female (55.0%).

1.3 Methodology

Maximum likelihood with oblique rotation via SPSS was used to conduct the Exploratory Factor Analysis (EFA). Factors that had an Eigenvalue > 1 was retained whilst factor loadings were considered sufficiently high if the loading was $> .35$ ^{1,2}. Internal consistencies for each subscale was considered satisfactory if $\alpha > .75$ ³.

1.4. Results:

1.4.1 Foundational Scale

| FOUNDATIONAL SCALE | | | | |
|--------------------|----------|-----------|------------------|--------------------|
| | EXERCISE | NUTRITION | SLEEP/WAKE CYCLE | SILENCING THE MIND |
| Exercise 1 | 0,814 | | | |
| Exercise 2 | 0,873 | | | |
| Exercise 3 | 0,727 | | | |
| Exercise 4 | -0,042 | | | |
| Exercise 5 | 0,629 | | | |
| Nutrition 1 | | 0,062 | | |
| Nutrition 2 | | 0,264 | | |
| Nutrition 3 | | 0,141 | | |
| Nutrition 4 | | 0,198 | | |
| Nutrition 5 | | 0,307 | | |
| Nutrition 6 | | 0,317 | | |
| Nutrition 7 | | -0,025 | | |
| Nutrition 8 | | -0,018 | | |
| Nutrition 9 | | 0,451 | | |
| Nutrition 10 | | 0,614 | | |
| Nutrition 11 | | 0,284 | | |
| Nutrition 12 | | 0,551 | | |
| Nutrition 13 | | 0,555 | | |
| Nutrition 14 | | 0,474 | | |
| Nutrition 15 | | -0,038 | | |
| Sleep/Wake Cycle 1 | | | 0,458 | |
| Sleep/Wake Cycle 2 | | | 0,528 | |
| Sleep/Wake Cycle 3 | | | 0,112 | |
| Sleep/Wake Cycle 4 | | | 0,4 | |
| Sleep/Wake Cycle 5 | | | 0,319 | |
| Sleep/Wake Cycle 6 | | | 0,437 | |
| Sleep/Wake Cycle 7 | | | 0,317 | |

¹ Costello, A. B., & Osborne, J. W. (2011). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Pract Assess Res Eval* 2005; 10. URL [http://pareonline.net/getvn.asp,10\(7\)](http://pareonline.net/getvn.asp,10(7)).

² Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological assessment*, 7(3), 286.

³ Nunnally, J. C., & Bernstein, I. H. (1994). The assessment of reliability. *Psychometric theory*, 3(1), 248-292.

1. STUDY 1 (CONTINUED)

| FOUNDATIONAL SCALE (CONTINUED) | | | | |
|--------------------------------|----------|-----------|------------------|--------------------|
| | EXERCISE | NUTRITION | SLEEP/WAKE CYCLE | SILENCING THE MIND |
| Silencing the Mind 1 | | | | 0,741 |
| Silencing the Mind 2 | | | | 0,733 |
| Silencing the Mind 3 | | | | 0,662 |
| Silencing the Mind 4 | | | | 0,633 |
| Silencing the Mind 5 | | | | 0,658 |
| Silencing the Mind 6 | | | | 0,745 |
| Silencing the Mind 7 | | | | 0,749 |

1.4.1.1 Exercise

The Exercise items explained 58.75% of the variance in Exercise (Eigenvalue = 2.585). Exercise 4 was removed due to an inadequate loading with the remaining items successfully loading (>.35) onto Exercise with a mean inter item correlation of .576. The internal consistency for the scale was found to be sufficiently high ($\alpha = .846$).

1.4.1.2 Nutrition

The Nutrition items explained 12.18% of the variance in Nutrition (Eigenvalue = 2.738). Nutrition 1,2,3,4,5,6,7,8,11 and 15 was removed due to inadequate loadings with the remaining items successfully loading (>.35) onto Nutrition with a mean inter item correlation of .282. The internal consistency for the scale was found to be subpar ($\alpha = .662$).

1.4.1.3 Sleep/Wake Cycle

The Sleep/Wake Cycle items explained 15.10% of the variance in Sleep/Wake Cycle (Eigenvalue = 1.87). Sleep/Wake Cycle 3,5 and 7 was removed due to inadequate loading with the remaining items successfully loading (>.35) onto Sleep/Wake Cycle with a mean inter item correlation of .201. The internal consistency for the scale was found to be subpar ($\alpha = .500$).

1.4.1.4 Silencing the Mind

The Silencing the Mind items explained 49.64% of the variance in Silencing the Mind (Eigenvalue = 1.87). No items were removed due to inadequate loading with all the items successfully loading (>.35) onto Silencing the Mind with a mean inter item correlation of .495. The internal consistency for the scale was found to be excellent ($\alpha = .871$).

1.4.2 Emotional Scale

| EMOTIONAL SCALE | | | |
|------------------|---------------|-------------------|-----------------------|
| | SOCIAL SAFETY | GOAL DIRECTEDNESS | COLLECTIVE CREATIVITY |
| Social Safety 1 | 0,462 | | |
| Social Safety 2 | 0,514 | | |
| Social Safety 3 | 0,593 | | |
| Social Safety 4 | 0,739 | | |
| Social Safety 5 | 0,702 | | |
| Social Safety 6 | 0,589 | | |
| Social Safety 7 | 0,701 | | |
| Social Safety 8 | 0,587 | | |
| Social Safety 9 | 0,526 | | |
| Social Safety 10 | 0,559 | | |

1. STUDY 1 (CONTINUED)

| EMOTIONAL SCALE (CONTINUED) | | | |
|-----------------------------|---------------|-------------------|-----------------------|
| | SOCIAL SAFETY | GOAL DIRECTEDNESS | COLLECTIVE CREATIVITY |
| Goal Directedness 1 | | 0,233 | |
| Goal Directedness 2 | | 0,449 | |
| Goal Directedness 3 | | 0,597 | |
| Goal Directedness 4 | | 0,551 | |
| Goal Directedness 5 | | 0,473 | |
| Goal Directedness 6 | | 0,303 | |
| Goal Directedness 7 | | 0,512 | |
| Goal Directedness 8 | | 0,473 | |
| Goal Directedness 9 | | 0,532 | |
| Goal Directedness 10 | | 0,564 | |
| Goal Directedness 11 | | 0,603 | |
| Goal Directedness 12 | | 0,556 | |
| Goal Directedness 13 | | 0,528 | |
| Goal Directedness 14 | | 0,494 | |
| Goal Directedness 15 | | 0,556 | |
| Goal Directedness 16 | | 0,503 | |
| Collective Creativity 1 | | | 0,304 |
| Collective Creativity 2 | | | 0,36 |
| Collective Creativity 3 | | | 0,442 |
| Collective Creativity 4 | | | 0,552 |
| Collective Creativity 5 | | | 0,645 |
| Collective Creativity 6 | | | 0,674 |
| Collective Creativity 7 | | | 0,273 |
| Collective Creativity 8 | | | 0,277 |
| Collective Creativity 9 | | | 0,556 |
| Collective Creativity 10 | | | 0,319 |

1.4.2.1 Social Safety

The Social Safety items explained 36.65% of the variance in Social Safety (Eigenvalue = 4.27). No items were removed due to inadequate loading with all the items successfully loading (>.35) onto Social Safety with a mean inter item correlation of .359. The internal consistency for the scale was found to be excellent ($\alpha = .849$).

1.4.2.2 Goal Directedness

The Goal Directedness items explained 25.47% of the variance in Goal Directedness (Eigenvalue = 4.797). Goal Directedness 1 and 6 was removed due to inadequate loading with all the remaining items

successfully loading (>.35) onto Goal Directedness with a mean inter item correlation of .278. The internal consistency for the scale was found to be excellent ($\alpha = .835$).

1.4.2.3 Collective Creativity

The Collective Creativity items explained 21.56% of the variance in Collective Creativity (Eigenvalue = 2.869). Collective Creativity 1,7,8 and 10 was removed due to inadequate loading with all the remaining items successfully loading (>.35) onto Collective Creativity with a mean inter item correlation of .288. The internal consistency for the scale was found to be subpar ($\alpha = .689$).

1. STUDY 1 (CONTINUED)

1.4.3 Higher Order Scale

| HIGHER ORDER SCALE | | | |
|----------------------|----------|-------------|--------------------|
| | LEARNING | ABSTRACTION | EXECUTIVE FUNCTION |
| Learning 1 | 0,108 | | |
| Learning 2 | 0,365 | | |
| Learning 3 | 0,407 | | |
| Learning 4 | 0,541 | | |
| Learning 5 | 0,624 | | |
| Learning 6 | 0,301 | | |
| Learning 7 | 0,11 | | |
| Learning 8 | 0,229 | | |
| Learning 9 | 0,144 | | |
| Learning 10 | 0,536 | | |
| Learning 11 | 0,372 | | |
| Learning 12 | 0,214 | | |
| Learning 13 | 0,006 | | |
| Learning 14 | 0,43 | | |
| Learning 15 | 0,372 | | |
| Abstraction 1 | | 0,426 | |
| Abstraction 2 | | 0,118 | |
| Abstraction 3 | | 0,145 | |
| Abstraction 4 | | 0,518 | |
| Abstraction 5 | | 0,574 | |
| Abstraction 6 | | 0,628 | |
| Abstraction 7 | | 0,689 | |
| Abstraction 8 | | 0,503 | |
| Abstraction 9 | | 0,449 | |
| Abstraction 10 | | 0,464 | |
| Abstraction 11 | | 0,326 | |
| Abstraction 12 | | 0,395 | |
| Abstraction 13 | | 0,289 | |
| Executive Function 1 | | | 0,643 |
| Executive Function 2 | | | 0,783 |
| Executive Function 3 | | | 0,754 |
| Executive Function 4 | | | 0,297 |
| Executive Function 5 | | | 0,285 |
| Executive Function 6 | | | 0,114 |
| Executive Function 7 | | | 0,249 |

1.4.3.1 Learning

The Learning items explained 13.10% of the variance in Learning (Eigenvalue = 2.748). Learning 1,6,7,8,12 and 13 was removed due to inadequate loading with all the remaining items successfully loading (>.35) onto Learning with a mean inter item correlation of .180. The internal consistency for the scale was found to be subpar ($\alpha = .664$).

1.4.3.2 Abstraction

The Abstraction items explained 20.75% of the variance in Abstraction (Eigenvalue = 3.414). Abstraction 2,3,11 and 13 was removed due to inadequate loading with all the remaining items successfully loading (>.35) onto Abstraction with a mean inter item correlation of .266. The internal consistency for the scale was found to be satisfactory ($\alpha = .765$).

1. STUDY 1 (CONTINUED)

1.4.3.3 Executive Function

The Executive Function items explained 26.26% of the variance in Executive Function (Eigenvalue = 2.393). Executive Function 4,5,6 and 7 was removed due to inadequate loading with all the remaining

items successfully loading (>.35) onto Executive Function with a mean inter item correlation of .529. The internal consistency for the scale was found to be satisfactory ($\alpha = .771$).

1.4.4 Condition Scale

| CONDITION SCALE | | | | |
|---------------------|-------------------|------------|---------------------|-----------------|
| | LEARNING CAPACITY | RESILIENCE | INNOVATION CAPACITY | SELF-LEADERSHIP |
| Learning Capacity 1 | 0,829 | | | |
| Learning Capacity 2 | 0,797 | | | |
| Learning Capacity 3 | 0,683 | | | |
| Resilience 1 | | 0,556 | | |
| Resilience 2 | | 0,814 | | |
| Resilience 3 | | 0,762 | | |
| Innovation 1 | | | 0,6 | |
| Innovation 2 | | | 0,662 | |
| Innovation 3 | | | 0,651 | |
| Self Leadership 1 | | | | 0,441 |
| Self Leadership 2 | | | | 0,757 |
| Self Leadership 3 | | | | 0,46 |

1.4.4.1 Learning Capacity

The Learning Capacity items explained 59.57% of the variance in Learning Capacity (Eigenvalue = 2.181). No items were removed due to inadequate loadings with all the items successfully loaded (>.35) onto Learning Capacity with a mean inter item correlation of .590. The internal consistency for the scale was found to be good ($\alpha = .812$).

1.4.4.2 Resilience

The Resilience items explained 51.72% of the variance in Resilience (Eigenvalue = 2.003). No items were removed due to inadequate loadings with all the items successfully loaded (>.35) onto Resilience with a mean inter item correlation of .50. The internal consistency for the scale was found to be good ($\alpha = .75$).

1.4.4.3 Innovation Capacity

The Innovation Capacity items explained 40.76% of the variance in Innovation Capacity (Eigenvalue = 1.594). No items were removed due to inadequate loadings with all the items successfully loaded (>.35) onto Innovation Capacity with a mean inter item correlation of .406. The internal consistency for the scale was found to be subpar ($\alpha = .67$).

1.4.4.4 Self-Leadership

The Self-Leadership items explained 32.64% of the variance in Self-Leadership (Eigenvalue = 1.813). No items were removed due to inadequate loadings with all the items successfully loaded (>.35) onto Self-Leadership with a mean inter item correlation of .295. The internal consistency for the scale was found to be subpar ($\alpha = .56$).

2. STUDY 2

2.1 Objectives

This study is aimed at confirming the factor structure of the instrument while further validating the measure.

2.2 Sample

An additional sample was collected over a three-month period via online assessments. A total sample of $n = 898$ responses was collected. The mean age of participants is 32.423 (SD = 14.080) most of whom are male (52.2%).

2.3 Methodology

Confirmatory Factor Analysis via LISREL was used to affirm the various factor structures uncovered by the EFA. The indices that was considered together with the acceptable standards was as follows ^{4,5}:

- Chi Square/df ratio (>3)
- Comparative Fit Index (>.9)
- Incremental Fit Index (>.9)
- Root Mean Square Error of Approximation (<.08)

2.4. Results

2.4.1 Foundational Scale

The goodness of fit statistics indicate that the four-factor foundational model shows good fit and comfortably meets the criteria set out above. The fitted measurement model is shown in the figure below.

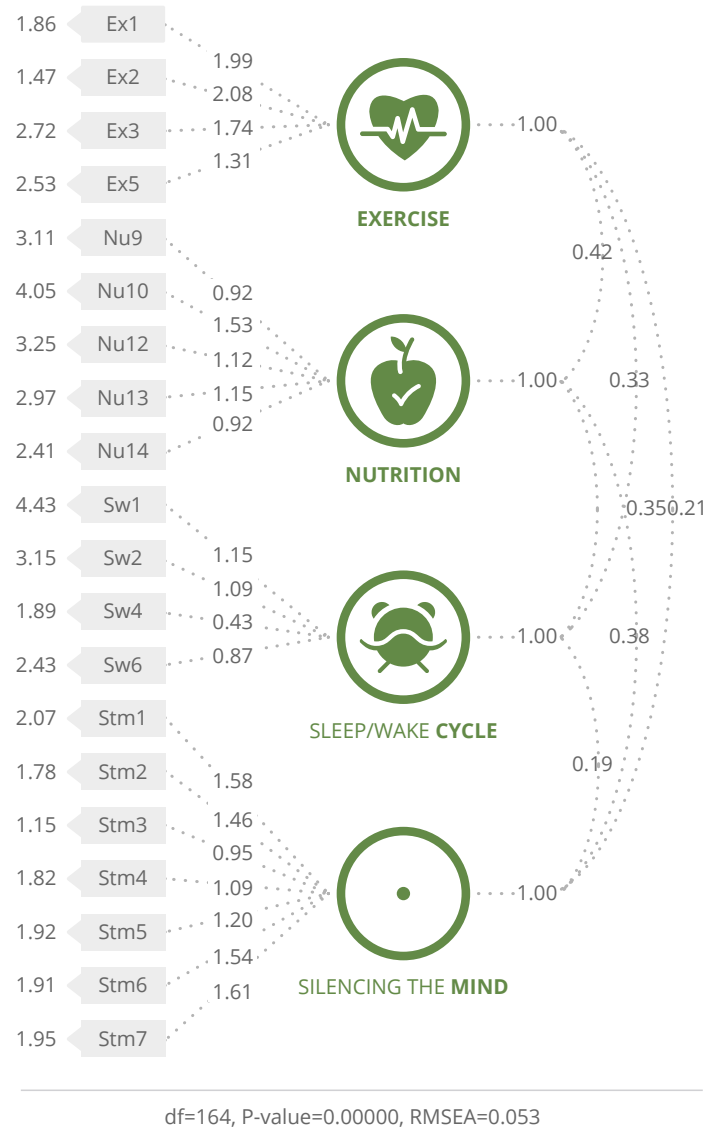


TABLE 2 GOODNESS OF FIT STATISTICS

| χ^2 | df | χ^2/df | CFI | IFI | RMSEA |
|----------|-----|-------------|------|------|-------|
| 625.77 | 164 | 3.82 | 0.96 | 0.96 | .053 |

⁴ Byrne, B. M. (2001). Structural equation modelling with AMOS, EQS, and LISREL: Comparative approaches to testing for the factorial validity of a measuring instrument. *International journal of testing*, 1(1), 55-86.

⁵ Kline, R. B. (1998). *Principles and practice of structural equation modelling*. New York: Guilford Press.

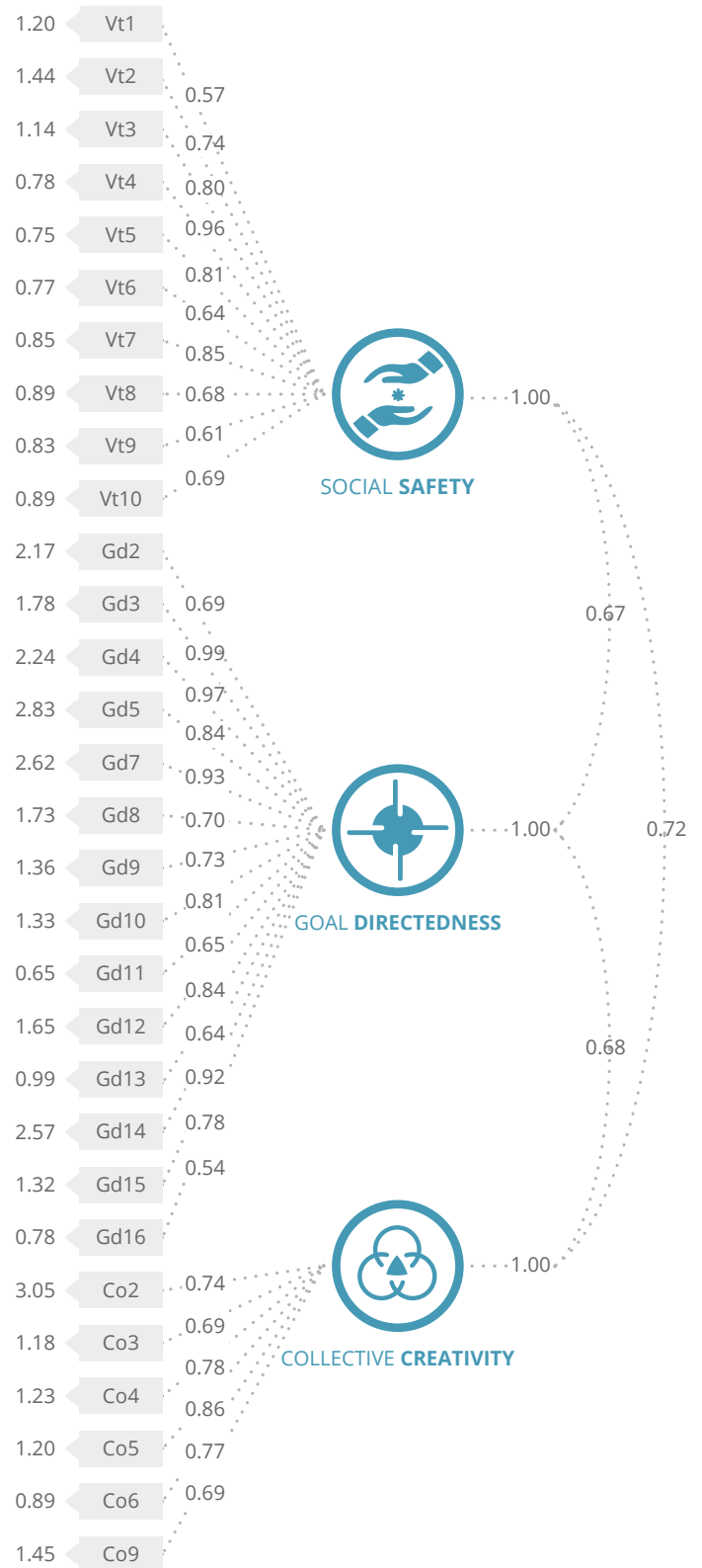
2. STUDY 2 (CONTINUED)

2.4.2 Emotional Scale

The goodness of fit statistics indicate that the three-factor emotional model shows good fit and comfortably meets the criteria set out above. The fitted measurement model is shown in the figure below.

TABLE 2 GOODNESS OF FIT STATISTICS

| χ^2 | df | χ^2/df | CFI | IFI | RMSEA |
|----------|-----|-------------|------|------|-------|
| 2965.75 | 402 | 7.38 | 0.95 | 0.95 | .058 |



47, df=402, P-value=0.00000, RMSEA=0.058

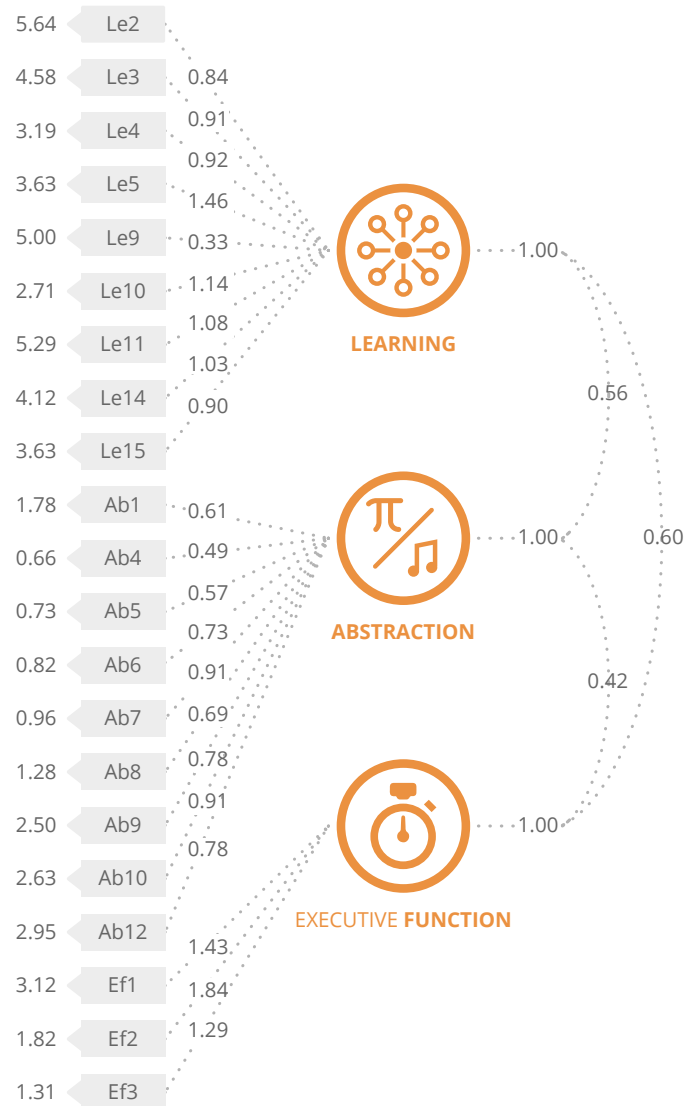
2. STUDY 2 (CONTINUED)

2.4.3 Higher Order Scale

The goodness of fit statistics indicate that the three-factor higher order model shows good fit and comfortably meets the criteria set out above. The fitted measurement model is shown in the figure below.

TABLE 2 GOODNESS OF FIT STATISTICS

| χ^2 | df | χ^2/df | CFI | IFI | RMSEA |
|----------|-----|-------------|------|------|-------|
| 698.17 | 186 | 3.75 | 0.94 | 0.94 | .053 |



Chi-Square=698.17, df=186, P-value=0.00000, RMSEA=0.053

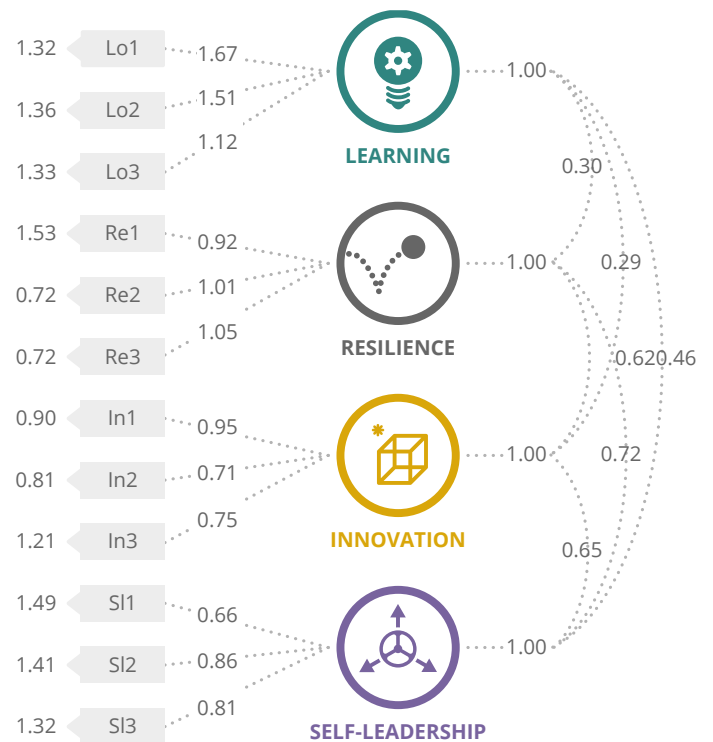
2. STUDY 2 (CONTINUED)

2.4.4 Outcome Scale

The goodness of fit statistics indicate that the four-factor model shows good fit and comfortably meets the criteria set out above (except for the χ^2/df ratio). The fitted measurement model is shown in the figure below.

TABLE 2 GOODNESS OF FIT STATISTICS

| χ^2 | df | χ^2/df | CFI | IFI | RMSEA |
|----------|----|-------------|------|------|-------|
| 122.13 | 48 | 2.54 | 0.99 | 0.99 | 0.4 |



Chi-Square=122.13, df=48, P-value=0.00000, RMSEA=0.04