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Towards Effective Collaborative Learning in Edu-Metaverse: A Study on Learners' Anxiety, Perception, and Behaviour

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I. Introduction

Remote Collaborative Learning (CL) in Edu-Metaverse in VR

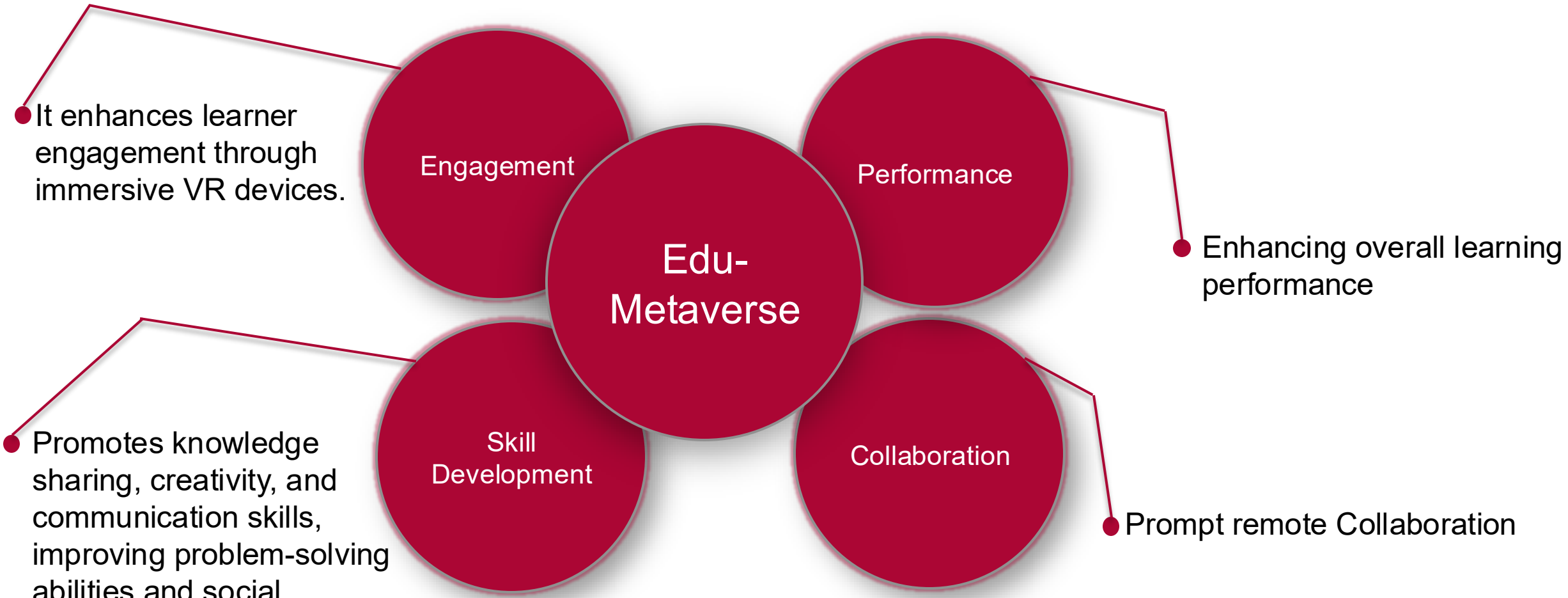
Edu-Metaverse:

- A type of Metaverse that is designed specifically for immersive educational purposes

Collaborative Learning:

- An educational approach where learners work together to achieve shared goals.

I. Introduction



I. Research Gap

Current Focus:

- Most studies focus on engagement and performance of CL in Edu-Metaverse

The Gap:

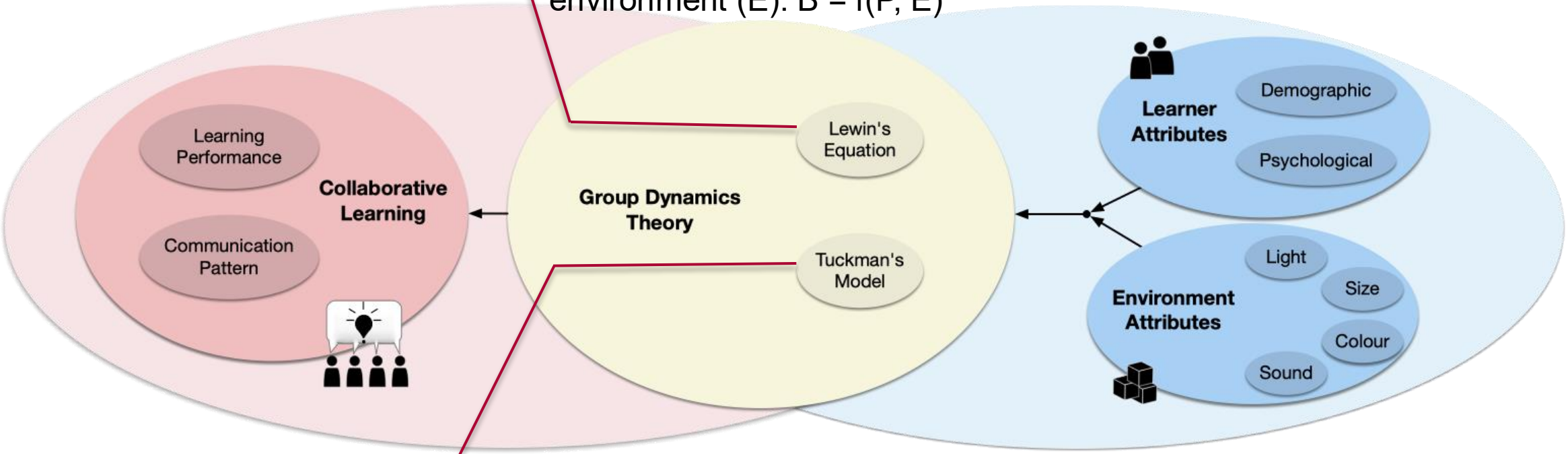
- Limited understanding of how **Learners' attributes** and **Environmental factors** affect CL behaviours and outcomes

Contribution:

- Investigate the under-explored factors influencing CL performance

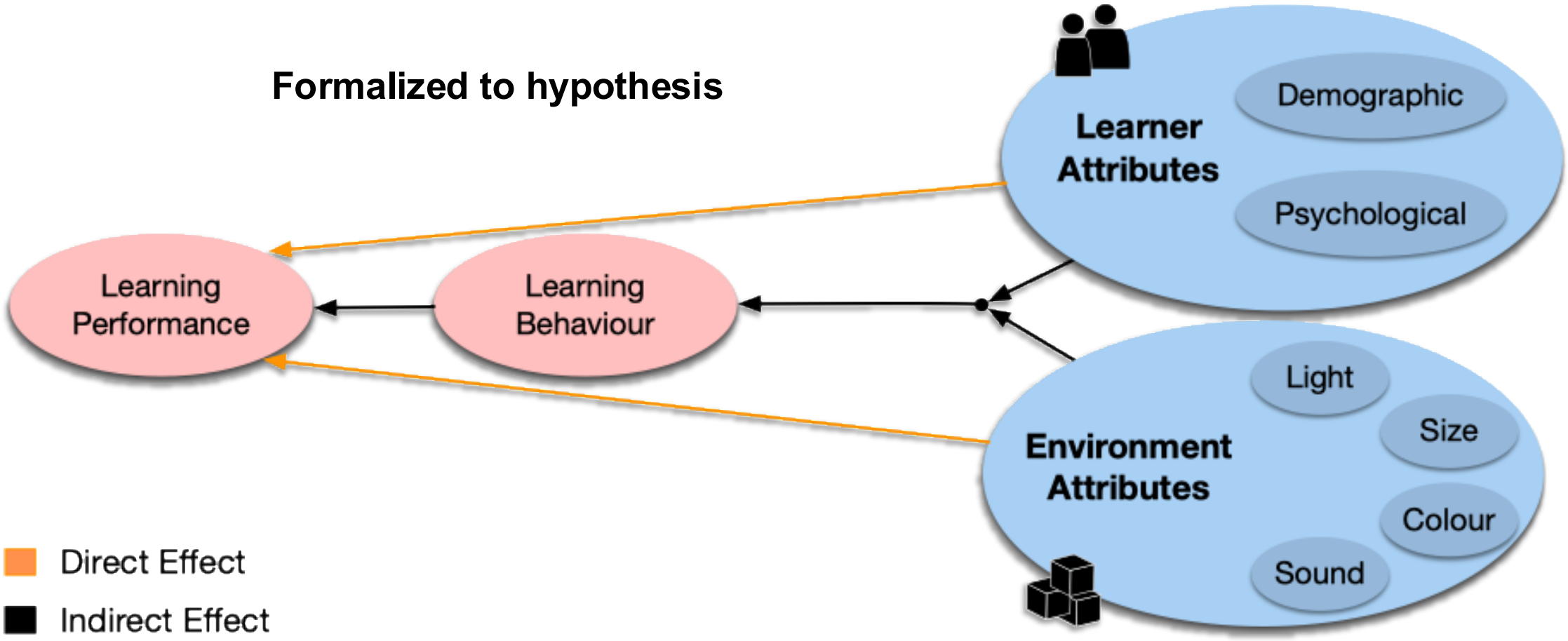
II. Theoretical Framework

Lewin's Equation: Behaviour (B) is a function of the person (P) and their environment (E): B = f(P, E)



Tuckman's Model: The five stages: Forming, Storming, Norming, Performing, Adjourning

II. Hypothesis

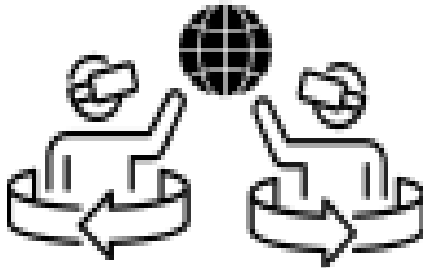


III. Measurements

Learners' Attributes:

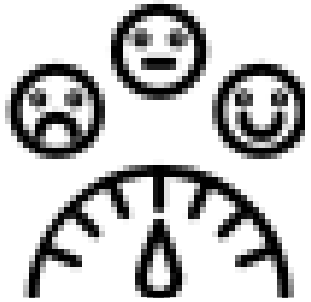
- Trait Anxiety：
  - ❖ Defined as a stable tendency to experience anxiety across various situations.

- Social Presence：
  - ❖ The feeling of being connected and effectively communicating with others in a virtual environment.



Environmental Attribute:

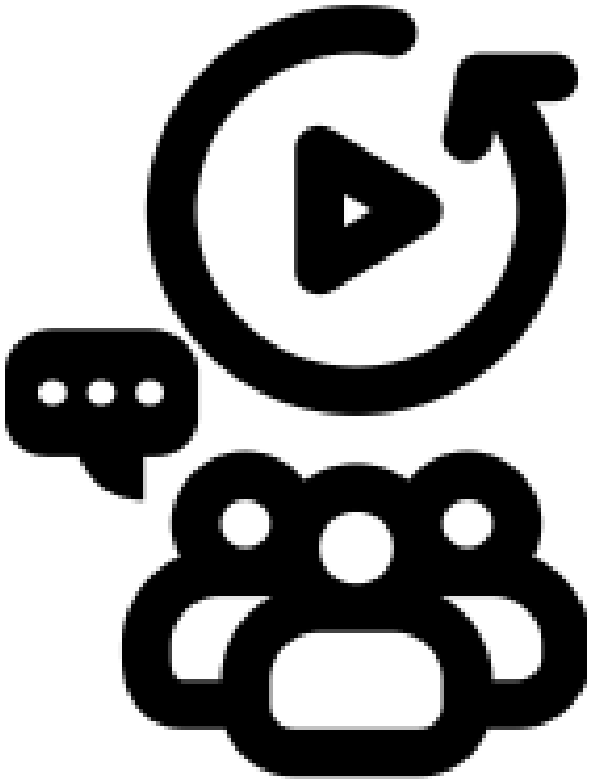
- Virtual Space Satisfaction
  - ❖ Participants' contentment with the virtual environment's design and functionality.



III. Measurements

Learning Behaviour:

- Speaking Time (Mean & SD)
  - ❖ Mean: The average speaking time of a group of participants
  - ❖ SD: The SD of a group of participants' speaking time
- Conversation Turns
  - ❖ Total Conversation turns to a group of participants



Learning Performance:

- CL Learning Outcome
  - ❖ The final presentation score for a CL group

III. Research Target and Objectives

Target:

- To explore how *learners' psychological* and *environmental factors* influence *CL behaviours* and *performance* in Edu-Metaverse

Objectives:

- Objective 1: Examine the impact of **Trait Anxiety** on CL.
- Objective 2: Assess the role of **Social Presence**.
- Objective 3: Analyze the influence of **Virtual Space Satisfaction**.
- Objective 4: Understand the **mediating role** of CL Behaviours

III. Methodology

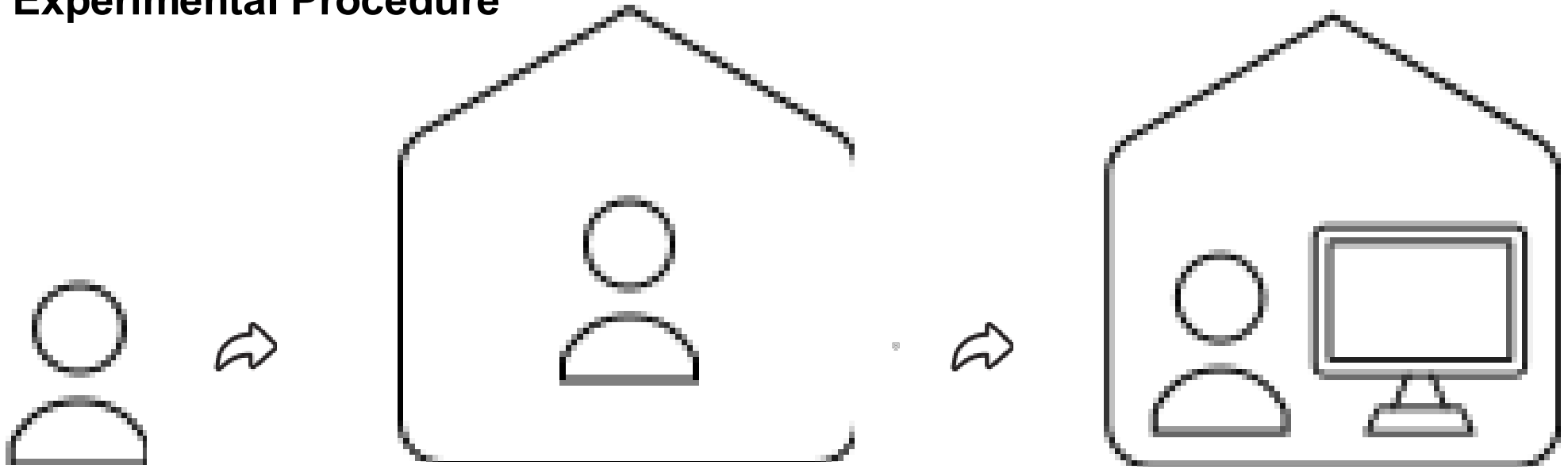
Study Design:

- Within-subjects design involving 32 participants.

Participants:

- Age range: Average age 25.44 years.
- Education: Undergraduate and postgraduate STEM (science, technology, engineering, and mathematics) students.

III. Experimental Procedure



One Participant

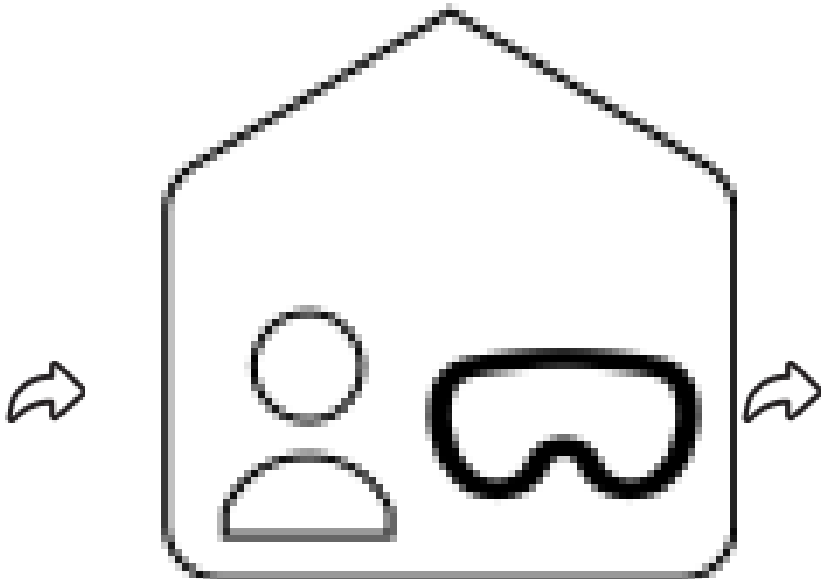
Pre-Questionnaire

- Trait Anxiety State-Trait Anxiety Inventory - Trait version (STAI-T)
- Demographic Survey

Gameplay Session

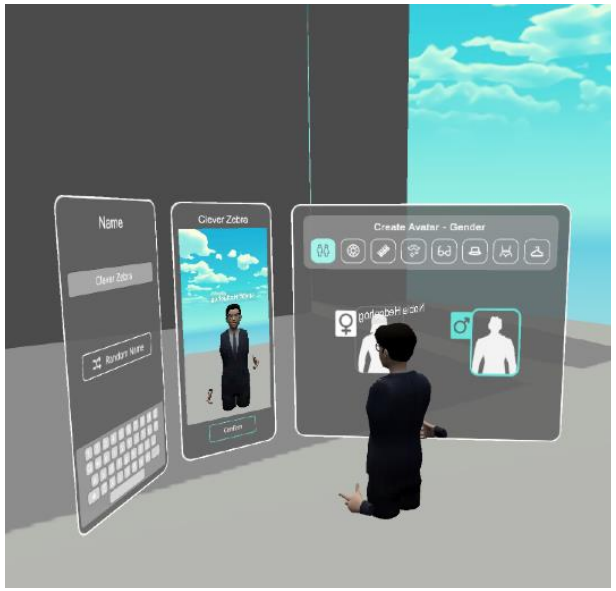
- Participants played 'Spent' for 15 minutes

III. Experimental Procedure

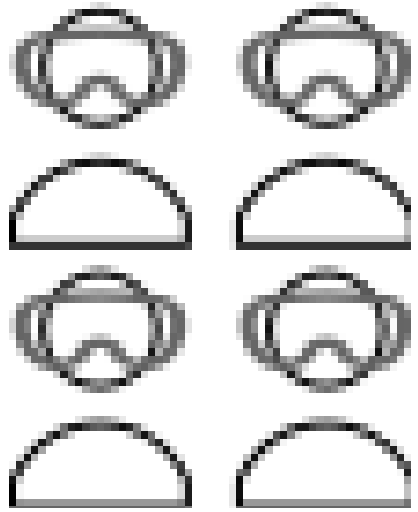


VR Training

- Introduction to how to use VR



Customized Virtual Avatar



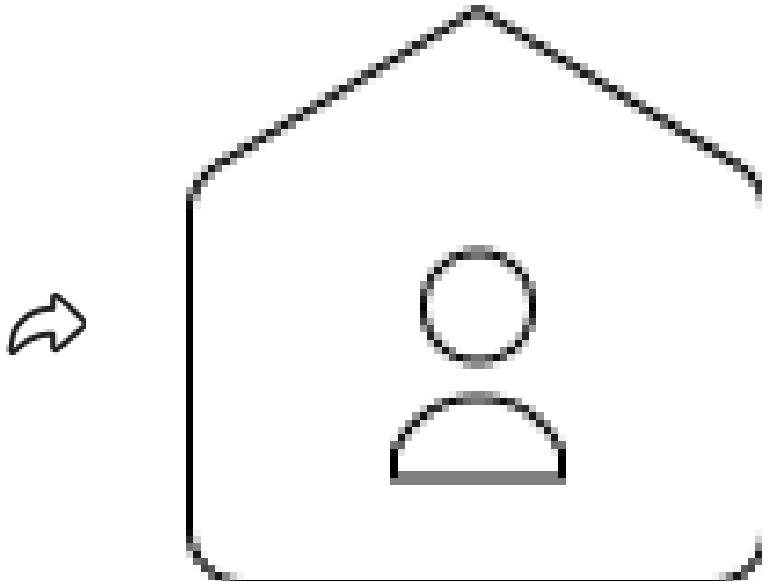
Meet other three Participants in VR

III. Experimental Procedure

Discussion three questions based on the Game experience (10mins max)

Discussion Result Presentation

III. Experimental Procedure



Post-Questionnaire

- The Networked Minds Measure of Social Presence (NMMSP) Demographic Survey
- Virtual Space Satisfaction

III. Data analysis

Confirmatory Factor Analysis:

Objective:

•**Purpose:** Predict learners' performance on intended outcomes

•**Method:** Confirmatory Factor Analysis (CFA) using SPSS Amos 28.10

Process:

- **Model Initialization:**
  - Integrated potential predictors based on theoretical framework.
- **Analysis Execution:**
  - Examined complex relationships among variables.
  - Accounted for measurement errors.
- **Model Refinement:**
  - Iterative process to refine and specify the model.
  - Identified significant predictors with direct and indirect effects.

IV. Descriptive Statistic Results

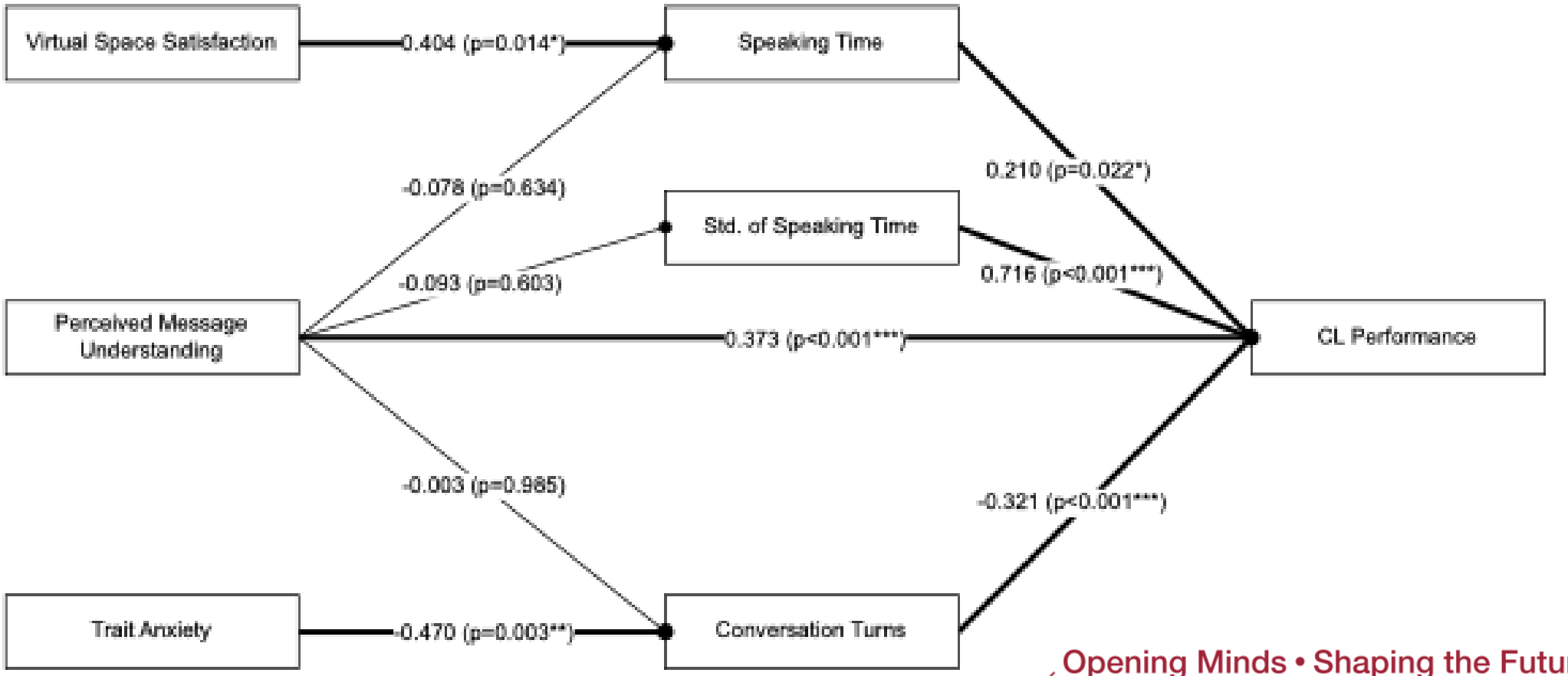
	Variable	Minimum	Maximum	Mean	SD	α
	STAI-T	26	69	42.28	10.062	0.926
	Satisfaction	2	7	5.5	1.459	
NMMSP	Co-presence	22	42	34.66	5.592	0.84
	Attentional Allocation	11	42	28.25	6.672	0.781
	Perceived Message Understanding	7	42	30.19	8.667	0.944
	Perceived Affective Understanding	6	42	25.84	8.85	0.924
	Perceived Emotional Interdependence	7	36	23.28	7.867	0.869
	Perceived Behavioural Interdependence	16	42	29.06	6.942	0.906

IV. Descriptive Statistic Results

Variable	Minimum	Maximum	Mean	SD	α
Conversation Turns	1	19	8.91	5.269	
Speaking Time	0.03	0.65	0.25	0.16	
SD. Time	0.13	0.28	0.18	0.044	
CL Performance	1.5	8	4.5	2.286	

IV. Results

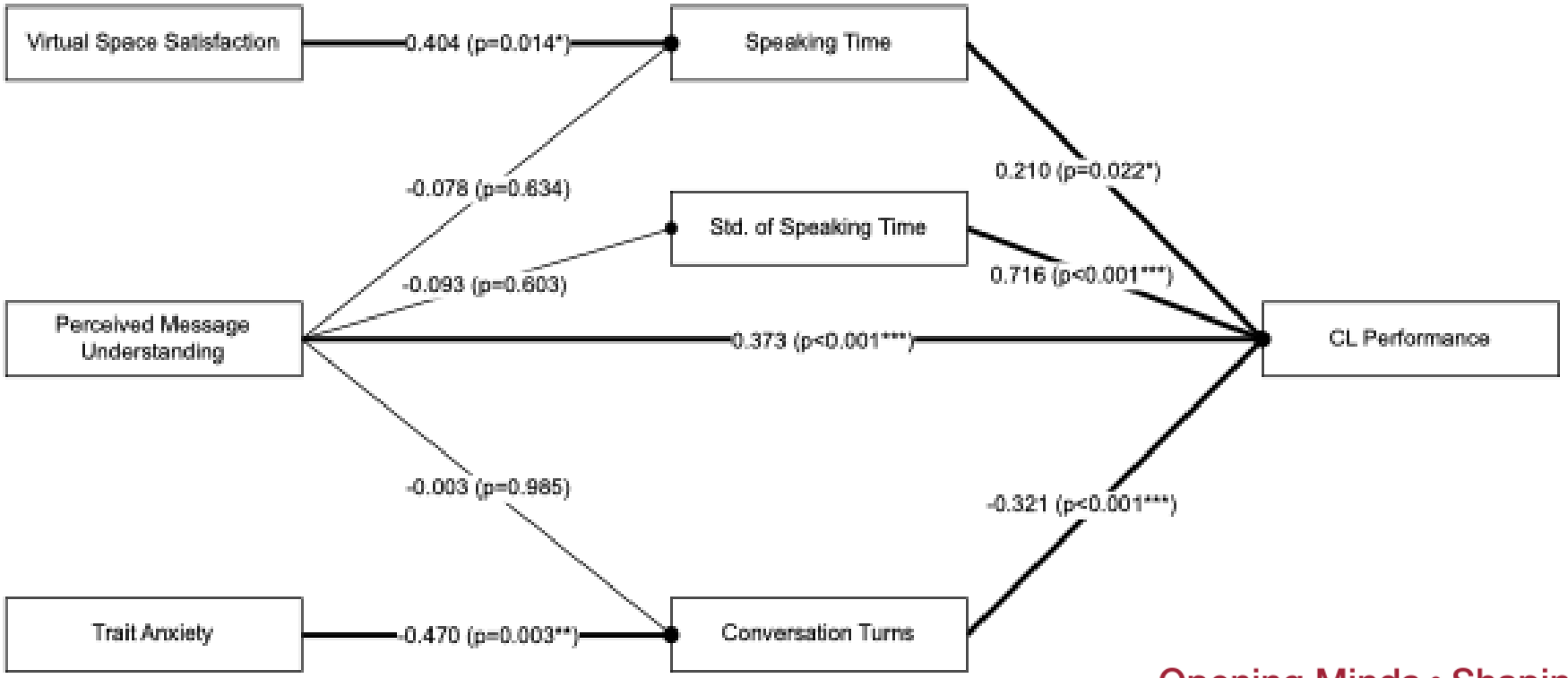
Confirmatory Factor Analysis (CFA)



V. Discussion of Key Findings

Trait Anxiety：

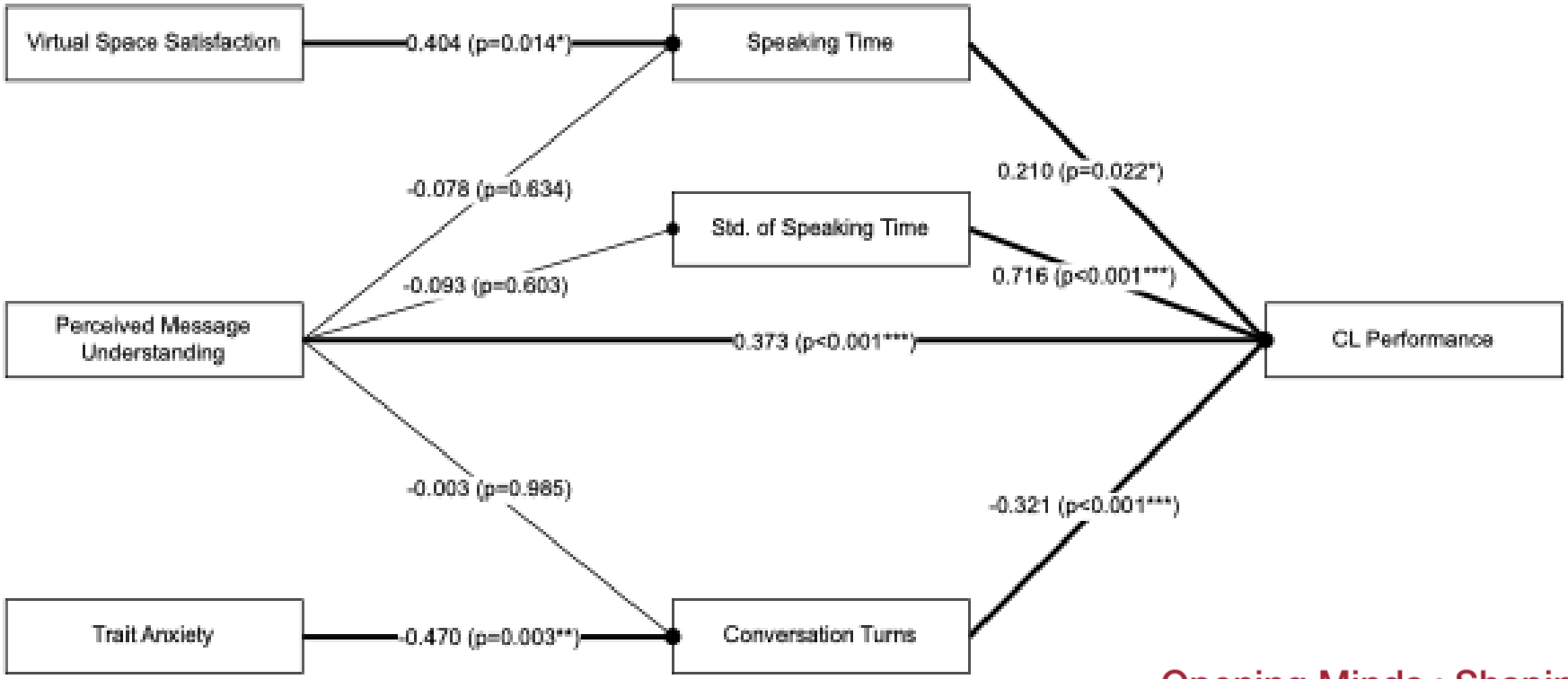
- Indirect effect on CL performance mediated by conversation turns.



V. Discussion of Key Findings

Social Presence：

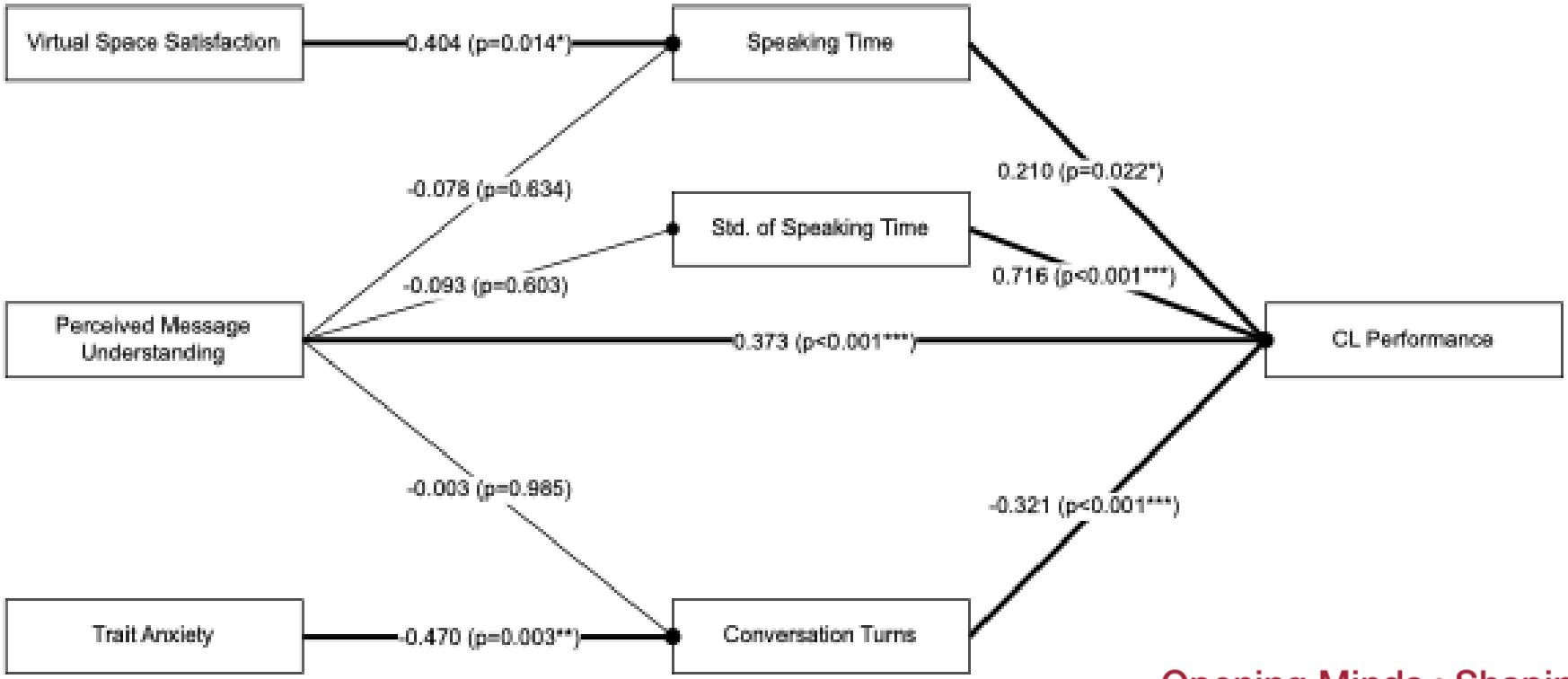
- Perceived message understanding directly enhances CL performance.



V. Discussion of Key Findings

Virtual Space Satisfaction：

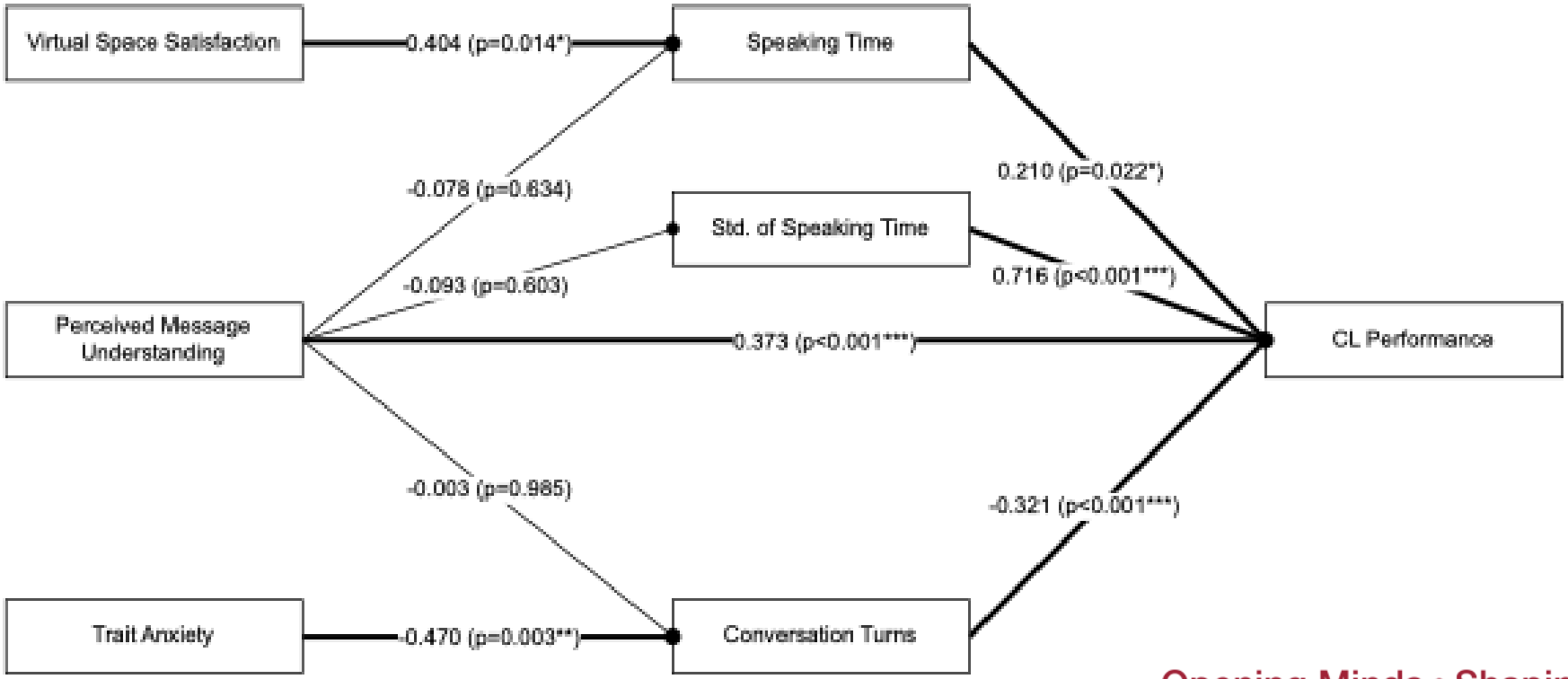
- Indirect negative effect on CL performance mediated by conversation turns



V. Discussion of Key Findings

Behavioural

- Higher standard deviation of speaking time associated with better performance.



V. Conclusions and Future Directions

Conclusions:

- Learners' attributes and environmental factors significantly affect CL performance in Edu-Metaverse.
- Optimizing these factors can enhance the effectiveness of CL.

Future Research:

- Incorporate advanced VR technologies to capture non-verbal cues
- Conduct studies with larger, more diverse samples.
- Explore additional psychological and environmental variables.

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