Optimizing Collective Intelligence: The Impact of Cultural Orientations on Team Performance

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Abstract

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Optimizing Collective Intelligence: The Impact of Cultural Orientations on Team Performance

N/A for now

Data and Method

Participants

The study will recruit 120 to 150 participants from two culturally distinct populations: China and the United States. These populations are selected based on their representative alignment with collectivist and individualist cultural orientations, respectively, following Hofstede's framework. Recruitment will be conducted through university mailing lists, international student associations, and cultural clubs. To isolate the specific influence of individualism–collectivism from other potential cultural differences (e.g., language style, educational background), all participants will complete the Individualism–Collectivism Scale (Triandis Gelfand, 1998) prior to group assignment. This will allow cultural orientation to be treated not only as a group-level variable but also as a continuous individual-level predictor in subsequent analyses. Participants will then be grouped into teams of 3–5 individuals under three conditions: (1) culturally homogeneous collectivist teams, (2) culturally homogeneous individualist teams, and (3) culturally mixed teams.

Experimental Procedure

The experiment will be conducted in a university lab setting. Each team will be asked to complete a collaborative optimization task based on the Travelling Salesman Problem (TSP). Teams will be provided with a map of cities and instructed to identify the most efficient route that visits each city once and returns to the starting point. The task is designed to simulate real-world problem-solving under pressure and encourages verbal negotiation, coordination, and distributed reasoning—key indicators of collective intelligence. Teams will be given 30–40 minutes to complete the task. All sessions will be audio- and video-recorded with participant consent. In mixed-cultural teams, language-matching will be managed through pre-screening and bilingual

facilitation, and teams will be allowed to choose a mutually intelligible working language.

Measures and Data Collection

Team performance will be evaluated using a composite Collective Intelligence (CI) Score, integrating:

- Task accuracy (proximity to the optimal solution),
- Time to completion, and
- Communication quality (analyzed via both NLP and manual coding).

Audio recordings will be transcribed and processed using Natural Language Processing (NLP) methods. Speech will be segmented at the turn level, and key features such as lexical diversity, term frequency, and idea repetition will be extracted using Python-based tools (e.g., spaCy, Jieba). Topic shift detection will be performed using sliding-window analysis to trace transitions in discussion themes over time. Custom dictionaries will be developed to account for bilingual or culturally embedded terms. Additionally, a Social Network Analysis (SNA) framework will be applied: directed graphs will be constructed based on conversational interactions (i.e., who addresses whom), and network metrics including degree centrality, betweenness centrality, and participation equality will be used to quantify leadership distribution and information flow.

Analytical Strategy

Quantitative analysis will include ANOVA to test for statistically significant differences in CI Scores across the three group types. Multiple regression models will be used to explore how variables such as cultural orientation (both group-level and individual-level), leadership distribution, and communication dynamics predict collective intelligence. Triangulating behavioral, linguistic, and network indicators will allow for a rich, multidimensional analysis of how culture shapes team performance.

Feasibility and Infrastructure

The lab-based design is logistically feasible within the university setting. Rooms equipped with audio and video recording devices and collaborative materials (e.g., printed maps, whiteboards) are already available. A pilot session has demonstrated the clarity of instructions, the quality of recorded data, and the suitability of the TSP task. Participant recruitment is manageable over a two-month window. The estimated project cost (1,500˘2,000) will cover incentives, transcription, and analytical tools. IRB approval will be obtained before data collection begins, and all privacy and ethical standards will be upheld.

Proof of Concept

To demonstrate the feasibility of this lab-based experimental design, a small-scale pilot run has been conducted to simulate the core elements of one experimental session. First, a simplified version of the Travelling Salesman Problem (TSP) was created using a printed city map and numbered markers to represent nodes. A team of three volunteer participants was assembled to complete the task under a 30-minute time constraint. Instructions were delivered verbally and on paper, with a facilitator present to time the session, observe group dynamics, and note logistical issues. The task elicited active discussion, strategy coordination, and role differentiation—suggesting that the TSP format is well-suited for evaluating team interaction and decision-making under pressure.

To prepare for the main study, a preliminary audio and video recording setup was tested in a university lab room using laptop webcams and standalone microphones. The pilot confirmed that participant voices were clearly captured and distinguishable for transcription purposes. A test transcription of a 5-minute clip was coded manually using a predesigned rubric focused on leadership behaviors, turn-taking frequency, and information repetition. This coding scheme will later be adapted into a digital annotation workflow using tools such as ELAN or Praat. In parallel, a small Natural Language Processing (NLP) pipeline was trialed using spaCy to process pilot transcripts, extracting term frequency patterns and topic shifts as indicators of communication richness. Social Network Analysis (SNA) was also simulated using manually extracted

interaction data to construct adjacency matrices, which were then visualized in Gephi to examine network centrality measures across different group roles.

This pilot run has provided valuable insight into session duration, group facilitation logistics, and data processing workflows. It affirms that the proposed experiment can be implemented with available resources and tools, and has helped refine the materials, timing, and analytic templates needed for the full-scale study. Additional pilot sessions with culturally matched teams will be conducted in the next phase to further test the feasibility of cross-cultural group coordination and bilingual facilitation.

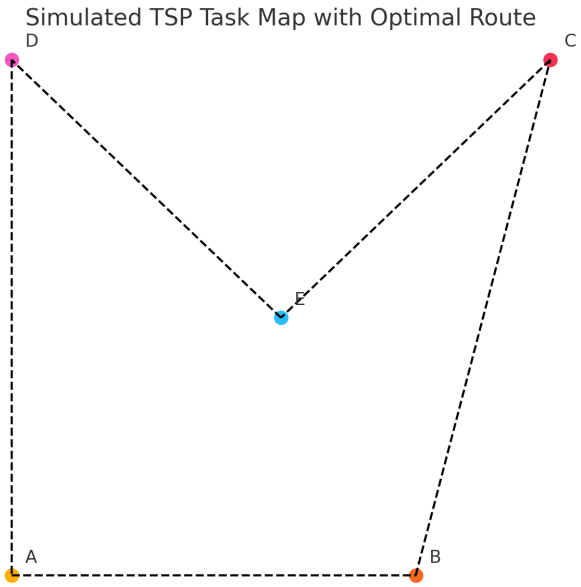

Figure 1

TSP

Discussion

Evaluation

The proposed lab-based experimental design offers strong internal validity by enabling real-time observation of group dynamics, communication behavior, and decision-making processes in a controlled setting. By grouping participants based on self-reported cultural orientation and assigning them to culturally homogeneous or mixed teams, the design allows for

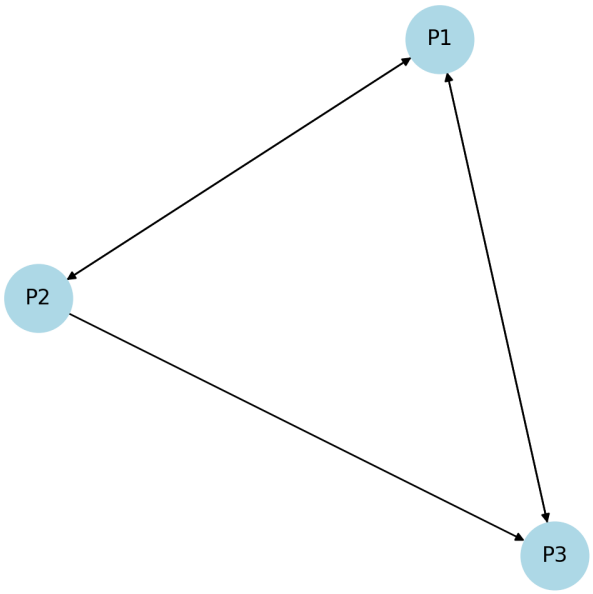

Figure 2

SNA

direct comparison of cultural composition effects on collective intelligence outcomes. The use of both behavioral and linguistic metrics—such as task performance, conversational structure, and information flow—enables a multidimensional analysis of team effectiveness. However, there are certain limitations. Recruiting a culturally balanced sample may be logistically challenging, especially within a limited time frame. Additionally, language matching in mixed teams may introduce complexity in session management, even with bilingual facilitation. While the Travelling Salesman Problem offers a cognitively demanding collaborative task, it may not reflect the full spectrum of team-based problem-solving encountered in professional environments. Nonetheless, this design provides a solid foundation for testing the central research question in a replicable and scalable way.

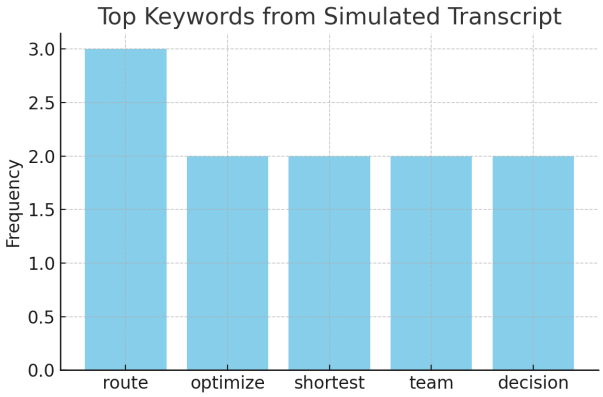
Top Keywords from Simulated Transcript
Frequency
3.0
2.5
2.0
1.5
1.0
0.5
0.0
route
optimize
shortest
team
decision

Figure 3

NPL