Leveraging Sternberg's Theory of Thinking Style to Enhance Theory of Mind for Predicting Collective Intelligence

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I. Introduction

The relation between thinking styles (Sternberg, 1997) and group performance represents a new and yet to be explored field in understanding collective intelligence. While recent research has demonstrated that Theory of Mind (ToM) which is a social-cognitive ability, can strongly predict group performance across both face-to-face and online settings (Engel et al., 2014), less attention has been paid to how understanding different thinking styles might enhance these social-cognitive capabilities. This study proposes that Sternberg's Theory of Thinking Styles could provide critical as well as insightful understanding into strengthening ToM abilities and, consequently, improving collective intelligence.

1.1 Research Objectives

This research aims to combine two significant theoretical frameworks - Sternberg's Theory of Thinking Styles and ToM - to enhance our understanding as well as application of collective intelligence. Recent findings by Engel et al. (2014) shows that ToM abilities, as measured by the Reading the Mind in the Eyes test, predict collective intelligence equally well in both face-to-face and online environments. This somewhat surprising discovery suggests that ToM represents a fundamental social-cognitive capability that goes beyond specific communication modalities. We present the idea that that understanding Sternberg's Theory of Thinking Styles - which describes how individuals prefer to use their cognitive abilities - could enhance our ability to understand and predict others' mental states, thereby deepening ToM capabilities.

1.2 Significance of the Study

The relationship between understanding thinking styles and ToM is in particular relevant given that there is an increase in the prevalence of collaboration even in online environment and as well as the demonstrated importance of ToM in predicting Collective Intelligence. On the surface, the way in which people process and interact with information through various thinking styles of Sternberg's theory may theoretically and potentially increase our capacity to understand and predict other persons' mental states and behaviors. This could potentially provide more information on the dynamics of teams across both physical and virtual environments.

1.3 Scope and Limitations of Theory of Mind in Collective Intelligence

While ToM appears to be a significant predictor of collective intelligence, it represents just one facet of collaborative capabilities and there are many more theories out there that uses a different modal and understanding. This paper contemplates and examines why ToM has become a primary focus in CI research while acknowledging other important ideas that contribute to a favorable collaborative environment.

By looking at how social-cognitive abilities and intelligence might enhance our ability to work better together collaboratively, we seek to identify new pathways for improving group performance across diverse collaborative contexts through having a firm grasp on thinking styles.

II. Literature Review

The field of collective intelligence (CI) has over the years, changed significantly after the idea was first presented. While initial research focused more on crowd wisdom and group decision-making (Surowiecki, 2004), modern understanding and application of CI has expanded to include more complex dimensions of group cognition and performance with differing point of view often clashing with each other.

2.1 Definition and Scope of Collective Intelligence

Woolley et al. (2010) provided a fresh and a new definition of collective intelligence as the general ability of a group to perform together across a wide variety of tasks. Their work demonstrated that this collective intelligence factor, which they termed "c factor", exists in groups similar to how general intelligence exists in individuals. This finding ultimately changed how researchers approached group performance, moving its focus from an individual ability to that of an emergent group property.

Continuing on building on this foundation, Malone and Bernstein (2015) expanded the understanding of CI to include and identify key components that contribute to group intelligence, namely; (1) Task organization and division (2) Motivation and engagement (3) Group composition and diversity (4) Communication patterns and structures

2.1.1 Distinguishing CI from Other Collaborative Forms

Not all group tasks involve collaboration hence it is necessary for us to first determine what collaborative task is and what differentiates it from a simple group work. Woolley et al. (2010) had shown that collective intelligence is a distinct and measurable entity or factor, thereby proving that groups have properties that predicts and enhances performance across different types of tasks. It can be understood now that CI is not simply a collection or an aggregation of individual capabilities, rather it has an emergent property that forms from group interaction.

The research by Engel et al. (2014) on the effects of ToM in online and offline environment further cements our understanding by showcasing that this collective

capability operates consistently across both face-to-face and online environments, thereby concluding that CI represents a fundamental aspect of group functioning rather than being dependent on specific collaboration modes.

2.1.2 Analysis of Collaborative Tasks

Engel et al.'s (2014) research made a significant contribution by examining how ToM relates to collective intelligence in both face-to-face and online settings. Their study confirmed that ToM abilities predict group performance equally well across both environment, providing empirical evidence for the role of social-cognitive abilities in collective intelligence.

Additionally, recent work by Woolley and Aggarwal (2019) further helped us understand which tasks best demonstrate collective intelligence (1) Complex problem-solving requiring multiple perspectives (2) Tasks involving integration of diverse knowledge (3) Situations demanding adaptive group responses (4) Problems requiring synchronized group cognition

This evolving understanding of CI has implications in research methodology as well as practical applications in organizational settings.

2.2 Theory of Mind in Collective Intelligence Research

Reading the Mind in the Eyes Test (RMET) which was developed by Baron-Cohen et al. (2001), has become a standard measure for ToM capabilities in adults. Many subsequent researches used this test such as both Woolley et al. (2010) and Engel et al. (2014), thereby give it relevance to group performance measurement.

2.2.1 Theory of Mind in Collective Intelligence Research

Although considered a state of the art ToM test, the Reading the Mind in the Eyes Test (RMET) has faces it shares of criticisms. Olderbak et al. (2015) pointed out the internal consistency and factorial structure, while Oakley et al. (2016) pointed out whether the test truly measures cognitive empathy rather than emotion recognition. Despite these long lines of criticisms, RMET remains widely used and is still considered as a state of the art test in collective intelligence research for several reasons:

1. Predictive Validity: Woolley et al. (2010) and Engel et al. (2014) demonstrated RMET's strong predictive relationship with collective intelligence
2. Cross-Cultural Application: While cultural differences exist, studies by Adams et al. (2010) showed RMET's applicability across different cultural contexts
3. Practical Implementation: The test's visual nature and straightforward approach and handling makes it particularly suitable for group research settings

Another test called the Tromsø Social Intelligence Scale (TSIS) developed by Silvera et al. (2001), offers a broader assessment of social cognitive abilities. The TSIS measures three distinct aspects: social information processing, social skills, and social awareness. However, due to its broader scope, this makes it less suitable for collective intelligence and ToM research for several reasons:

1. Construct Specificity: While TSIS measures general social intelligence, RMET focuses specifically on mental state attribution, which Engel et al. (2014) identified as crucial for collective intelligence
2. Length and Administration: TSIS's longer format and self-report nature make it less practical for group studies
3. Behavioral vs. Self-Report: RMET provides a behavioral measure rather than self-reported abilities, potentially reducing social desirability bias.

2.2.2 Enhancement of Theory of Mind

Contemporary and new researches have shown that ToM capabilities can be developed and enhanced through various methods. Navarro (2022) and Workman & Reader (2015) emphasize that while ToM has an innate predisposition, it naturally develops through stages, particularly during childhood through social interactions and experiences.

Several empirical studies have identified effective methods for enhancing ToM abilities:

1. Meditation Practices: Tan, Lo, & Macrae (2014) demonstrated that meditation practices can improve individuals' ability to understand mental states, suggesting a connection between mindfulness and social cognition.
2. Literary Engagement: Research by Kidd & Castano (2013) revealed that reading literary fiction enhances ToM capabilities, potentially due to the practice of considering multiple perspectives and complex character motivations.
3. Behavioral Synchrony: Baimel et al. (2015) showed that coordinated activities with others, or "keeping together in time," strengthens social cognitive abilities, including ToM.
4. Feedback Mechanisms: Dorn, Rief, & Mehl (2020) found that positive feedback has demonstrated effectiveness in improving ToM capabilities.

2.2.3 Potential Role of Thinking Styles in Enhancing Theory of Mind

By having an understanding of Sternberg's thinking styles, this can provide additional pathways for enhancing ToM capabilities. While direct empirical evidence linking thinking styles to ToM enhancement is currently limited, almost non-existent,, several potential theoretical connections can logically suggests relation:

1. Style Awareness: Understanding diverse thinking styles could enhance one's ability to recognize and interpret others' cognitive approaches, potentially improving mental state attribution.
2. Cognitive Flexibility: Awareness of different thinking styles might promote the cognitive flexibility necessary for effective ToM application.

3. Perspective Taking: Knowledge of thinking style variations could provide a structured framework for understanding different approaches to information processing and decision-making.

2.3 Alternative Constructs for Understanding Collaboration

Several established frameworks offer complementary perspectives on collaborative awareness:

1. Transactive Memory Systems (Wegner, 1987): Demonstrated how groups develop shared systems for encoding, storing, and retrieving information
2. Team Mental Models (Cannon-Bowers & Salas, 1990): Showed how shared understanding among team members influences coordination
3. Team Situational Awareness (Endsley, 1995): Established the importance of shared understanding of dynamic situations

2.4 Distinguishing Cognitive and Thinking Styles

The difference between cognitive styles vs. thinking styles matters a lot when looking at how they connect to ToM skills. Both ideas focus on how people handle information but Sternberg's thinking styles framework offers several benefits for understanding and possibly improving CI.

Riding and Rayner (1998) define cognitive styles as fixed personal traits based on neural mechanisms. These styles stay stable, resist change and focus on basic information patterns with little flexibility in social settings. Such traits make cognitive styles less suitable for improving ToM because stability limits growth potential. They work at a basic processing level and they don't directly address social cognitive aspects.

Sternberg's (1997) theory about thinking styles fits more easily with ToM growth through several key traits. Firstly, thinking styles show flexibility along with adaptability; experience modifies them, people develop various style preferences, and these styles can and are able to adjust to different social situations. Such adaptability matches ToM's potential for growth through training plus experience.

Secondly, thinking styles are social-cognitive focused. The theory looks at how people prefer interacting with others, includes social parts like external vs. internal orientations – reflecting preferences in handling different social scenarios. These social aspects closely match ToM's focus on understanding others' mental states.

Thirdly, thinking styles show context sensitivity by changing based on situational needs. Different situations may draw out different style preferences, and people do use styles strategically. Such context sensitivity mirrors ToM's need for understanding various social settings. People develop thinking styles through learning and social interactions influence these styles, along with responses to environmental needs. Developing thinking aligns with research showing ToM improves through training.

Thinking styles and ToM show a clear connection. Both change easily react to social settings, grow with focused efforts and help in seeing others' viewpoints. This link makes Sternberg's thinking styles more promising than cognitive styles for grasping individual differences in ToM skills, thus creating ways to grow ToM skills along with improving social cognitive abilities in group environments thereby enhancing collaborative tasks' outcome.

2.5 Sternberg's Theory of Thinking Styles Review

Sternberg (1988, 1997) created the theory of mental self-government as a way to understand thinking styles. He suggested that people control their mental activities like societies manage themselves. This comparison led to finding several key aspects:

Functions:

a) Legislative: Preference for creating, formulating, and planning

b) Executive: Preference for implementing and following directions

c) Judicial: Preference for evaluating and comparing

Forms:

d) Monarchic: Focus on one goal or aspect at a time

e) Hierarchic: Attention to multiple prioritized goals

f) Oligarchic: Attention to multiple equally important goals

g) Anarchic: Random approach to goals and problems

Levels:

h) Global: Preference for dealing with abstract and larger issues

i) Local: Preference for concrete and specific details

Scope:

j) Internal: Preference for working independently on tasks

k) External: Preference for working with others and in collaborative environments

Leanings:

l) Liberal: Preference for going beyond existing rules and procedures, seeking novelty

m)Conservative: Preference for following existing rules and procedures, minimizing change

n) Progressive: Preference for working with moderate levels of change and novelty

These dimensions were empirically validated through multiple studies (Zhang, 2002; Sternberg & Zhang, 2005).

2.5.1 Sternberg's Theory of Thinking Styles Review

Several studies have provided empirical support for Sternberg's theory:

Zhang and Sternberg (2000) demonstrated the theory's validity across different varying cultural contexts, particularly in Hong Kong and mainland China. Their research showed that:

1. *Thinking styles correlate meaningfully with academic achievement*

2. *Different cultural contexts may favor different thinking styles*
3. *Styles show consistent patterns across various domains*

Zhang (2002) further validated the theory through factor analysis, confirming the structural integrity of the proposed dimensions and their relationships.

2.5.2 Critical Analysis and Limitations

Several researchers have identified important critiques and limitations of Sternberg's theory:

Theoretical Critiques:

1. Complexity:

- The model's numerous dimensions and subtypes may be overly complex
- Potential overlap between different style categories (Zhang, 2005)
- Questions about the distinctiveness of certain styles

2. Cultural Considerations: As noted by Sternberg himself (1997), the theory was developed primarily in Western contexts, raising questions about:

- Western assumptions in the governmental metaphor
- Cultural bias in style preferences
- Need for culture-specific validation

3. Practical Applications: Research on the application of thinking styles has identified several challenges:

- Difficulty in translating theoretical constructs into practical interventions
- Questions about the stability of thinking styles over time
- Need for more evidence about the effectiveness of style-based interventions

2.5.3 Contemporary Applications

Sternberg's theory of thinking styles continues to inform research and practice in various domains. In his original work, Sternberg (1997) suggested several potential applications of the theory:

Educational Applications:

1. Understanding different approaches to learning
2. Considering diverse thinking styles in curriculum design
3. Acknowledging style variations in assessment methods

Gridley (2007) studied how artists think vs. how engineers think, showing the theory's application in understanding professional differences. The study found very different thinking patterns among these groups suggesting that:

1. Different career paths may attract individuals with specific thinking style preferences
2. Understanding these differences could inform career counseling approaches
3. Professional development programs might benefit from considering thinking style variations

More research is needed to fully validate broader applications, nonetheless, these findings open the door to the theory's potential in understanding cognitive preferences across different domains.

III. Discussion

This discussion will highlight the bigger picture and explore how thinking styles and ToM can be integrated into collective intelligence research

3.1 Methodological Considerations

Studying the link between thinking styles, ToM, and collective intelligence poses some challenges. While tools like the RMET measure ToM and Sternberg's Thinking Styles Inventory assesses thinking styles, we need new methods to understand how these two interact in group settings. Traditional approaches that study these constructs in isolation won't fully capture their dynamic relationship within groups.

3.2 Educational and Training Implications

The potential to boost collective intelligence by combining thinking style awareness and ToM skills has important implications for education and professional development. Current team-building programs usually focus on either social skills or cognitive strategies, but our findings suggest the need for integrated training that develops both metacognitive awareness of thinking styles and the social-cognitive skills that underpin effective group collaboration.

3.3 Technology and Virtual Collaboration

Engel et al. (2014) found that ToM predicts collective intelligence equally well in face-to-face and online settings. This raises an important question: how does thinking style awareness play out in virtual collaborations? With remote work and virtual teams becoming more common, future research should explore whether the benefits of thinking style awareness extend to online environments and how digital tools could support this awareness in virtual teamwork.

3.4 Cross-Cultural Considerations

The interaction between thinking styles, ToM, and collective intelligence may differ across cultures. While Sternberg's theory has been studied in various cultural settings and ToM is considered a universal human ability, the way these elements combine to enhance group performance may depend on cultural factors. Understanding these differences could be critical for improving collaboration efforts.

3.5 Distinguishing Cognitive and Thinking Styles

The link between Sternberg's thinking styles and group intelligence offers a fresh view on improving team performance. A key idea in Sternberg's (1997) theory says thinking styles do not stay the same but are preferred ways of using skills that change with situations. Such flexibility makes

thinking styles important to group intelligence, especially when viewed in tandem to ToM abilities.

3.5.1 Thinking Styles and CI

When people see that thinking styles change and use them wisely, they adapt how they think to fit group needs. For example someone might use a legislative style when the group looks for creative answers, choose an executive style during implementation phases or pick a judicial style when evaluation matters most. Such flexibility – together with ToM skills – helps people not only adjust their own thinking styles but also really understand and respond to how others thinking style.

Sternberg's (1997) focus on how thinking styles develop, socially fits well with group intelligence settings. In teams, knowing that everyone can change how they think leads to better teamwork. For example noticing when a teammate uses a global vs. local thinking style helps others change their ways of talking and working together.

The true value of thinking styles in collective intelligence doesn't come from having a specific style or mix of styles within a group. Instead, it is about being aware of how thinking styles can be applied when needed. When paired with strong ToM abilities, this awareness can boost group performance in several ways:

First, it helps individuals identify and understand the thinking styles others are using in a given situation. This makes it easier to anticipate how others will approach problems or react. Second, it allows group members to adjust their own thinking styles to complement or support what others are doing. Third, it improves communication by helping people present their ideas in ways that align with the current thinking styles of others.

This approach suggests that improving collective intelligence is not about assembling teams based on specific thinking style preferences. Instead, it is about developing group members' awareness of thinking styles and their ability to adapt them as needed. When combined with strong ToM skills, this flexibility can lead to better problem-solving and decision-making as a group.

IV. CONCLUSION

This analysis highlights how understanding thinking styles can enhance ToM and, in turn, collective intelligence. The real takeaway isn't about finding the "perfect" combination of thinking styles. Instead, it's about recognizing how awareness and flexibility in applying these styles can improve social cognition and group performance. Research in this area should shift from focusing on fixed combinations of thinking styles to exploring how awareness and adaptability of these styles impact group performance. This aligns with Sternberg's theory and reflects the dynamic nature of collective intelligence.

1. Building on existing research, several key questions emerge:
2. How do different thinking styles influence group performance?
3. What role does thinking style diversity play in collective intelligence?

How do thinking styles interact with ToM capabilities in group settings?

Future research can explore:

1. The relationship between thinking style awareness and ToM development
2. The impact of thinking style flexibility on collective intelligence
3. Methods for enhancing metacognitive awareness of thinking styles in group settings

While ToM remains a key factor in predicting collective intelligence, integrating it with thinking style theory opens up exciting possibilities. By helping individuals recognize and adapt their thinking styles, we can complement and strengthen the social-cognitive skills that drive effective teamwork.

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