The interplay of conflict and analogy in multidisciplinary teams

Susannah B.F. Paletz [a,*], Christian D. Schunn [b], Kevin H. Kim [c]

[a] Room 816, Learning Research and Development Center, University of Pittsburgh, 3939 O'Hara Street, Pittsburgh, PA 15260, USA
[b] Room 821, Learning Research and Development Center, University of Pittsburgh, 3939 O'Hara Street, Pittsburgh, PA 15260, USA
[c] School of Education, University of Pittsburgh, 5918 Wesley W. Posvar Hall, Pittsburgh, PA 15260, USA

A B S T R A C T

Creative teamwork in multidisciplinary teams is a topic of interest to cognitive psychologists on the one hand, and to both social and organizational psychologists on the other. However, the interconnections between cognitive and social layers have been rarely explored. Drawing on mental models and dissonance theories, the current study takes a central variable studied by cognitive psychologists—analogy—and examines its relationship to a central variable examined by social psychologists—conflict. In an observational, field study, over 11 h of audio–video data from conversations of the Mars Exploration Rover scientists were coded for different types of analogy and micro-conflicts that reveal the character of underlying psychological mechanisms. Two different types of time-lagged logistic models applied to these data revealed asymmetric patterns of associations between analogy and conflict. Within-domain analogies, but not within-discipline or outside-discipline analogies, preceded science and work process conflicts, suggesting that in multidisciplinary teams, representational gaps in very close domains will be more likely to spark conflict. But analogies also occurred in reaction to conflict: Process and negative conflicts, but not task conflicts, preceded within-discipline analogies, but not to within-domain or outside-discipline analogies. This study demonstrates ways in which cognition can be bidirectionally tied to social processes and discourse.

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1. Introduction

1.1. Background

Innovation and creativity increasingly occur in teams, particularly multidisciplinary teams (e.g., Squyres, 2005). Such teams create some of our most popular products and are essential for solving some of the world's most pressing problems. Team innovation and creativity have been increasingly studied by cognitive scientists (e.g., Ball & Christensen, 2009; Christensen & Schunn, 2007, 2009; Dunbar, 1995; Okada & Simon, 1997) while being a long-standing topic of social psychology (e.g., Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Levine & Moreland, 1998).[1] This disciplinary separation has resulted in theoretical and empirical gaps in our understanding of these constructs. The first gap is a segregation between organizational/social and cognitive perspectives. Some cognitive variables thought highly instrumental to team innovation are generally neglected in the social literature, and critical and contentious social variables are often ignored in the cognitive literature. Second, in the social literature, few studies unpack the 'black box' of mediating and moderating

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* Corresponding author. Tel.: +1 412 624 2679; fax: +1 412 624 7439.
E-mail addresses: paletz@pitt.edu, sbfpaletz@gmail.com (S.B.F. Paletz), schunn@pitt.edu (C.D. Schunn), khkim@pitt.edu (K.H. Kim).

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[1] While creativity involves the dimensions of both novelty and appropriateness (or usefulness), innovation additionally includes the elements of relative rather than absolute novelty, application/implementation, and the intentional benefit to others (West & Farr, 1990). For the purposes of this study, we are not distinguishing between innovation and creativity, as we are not examining outcomes directly.

variables to explain weak and inconsistent findings linking knowledge diversity to performance (van Knippenberg & Schippers, 2007). Third, there is a general shortage of field studies that examine real-world behavior, especially compared to the wealth of psychological research utilizing self-report and reaction times (Baumeister, Vohs, & Funder, 2007). Brief actions can elude perception, making self-report instruments a poor measure of fine-grained behaviors (Gottman & Notarius, 2000). Connections between cognitive and social variables are likely best unpacked through behavioral observation rather than self-report (Ericsson & Simon, 1993; Nisbett & Wilson, 1977).

This study addresses those three gaps via linking two key but little-connected variables together in real-time behavior. We focus on multidisciplinary teams: Research on disciplinary knowledge diversity has, on the cognitive side, implicated analogy as an important factor in problem solving team success (Dunbar, 1995, 1997). For example, mixed-background microbiology laboratories, compared to single-background labs, used a broader set of analogies and were better able to solve problems and be overall more successful. On the social/organizational side, knowledge diversity has, in certain circumstances, been found to increase performance via task conflict and disagreements about ideas (Jehn, Northcraft, & Neale, 1999; Pelled, Eisenhardt, & Xin, 1999). Analogy and conflict individually have been valuable in past research, and examining their interrelationship provides new theoretical avenues for accounting for mixed prior results. The purpose of this study is thus to explore the moment-by-moment interplay between analogy and conflict, here examined as micro-conflicts, in a real-world, multidisciplinary, long-term, large team, providing possible explanatory routes for why analogy and conflict on their own have complex relationships to success.

Using what is known about analogy and conflict separately, we will first break them down into the taxonomies used in their respective literatures (Table 1). Our aim is to explore whether there are connections between analogy and conflict based on their typical dimensions and to unpack likely explanations for any discovered relationships.

1.2. Analogy

Analogy is considered a fundamental cognitive process (e.g., Gentner, 1983; Holyoak & Thagard, 1997). An analogy involves drawing from and accessing past knowledge such as objects, attributes, or relationships (the source) to assist with the problem at hand (the target; Ball & Christensen, 2009). The process of applying information from the source to the target is referred to as mapping (Gentner, 1983). In a famous example, Christiaan Huygens suggested a wave theory of light, drawing from existing knowledge about sound traveling in waves (Sawyer, 2006). In this example, light was the *target*, sound was the *source*, and the shared properties that suggested traveling in waves was the *mapping*. Mapping and inferences that can be made from such mapping are different conceptually (e.g., Holyoak, Lee, & Lu, 2010), which is critical to the ways individuals may respond to an analogy posed by a team member.

Cognitive psychologists have examined analogy in naturalistic settings such as in science (Dunbar & Blanchette, 2001; Nersessian & Chandrasekharan, 2009), engineering (Ball & Christensen, 2009; Ball, Ormerod, & Morley, 2004; Christensen & Schunn, 2007), and politics (Blanchette & Dunbar, 2001). Analogies can help team problem solving (Dunbar, 1995), persuade others in political contexts (Whaley & Holloway, 1997), and teach concepts (Loewenstein, Thompson, & Gentner, 2003; Richland, Zur, & Holyoak, 2007; Young & Leinhardt, 1998). Our study focuses on scientific experts. Experts, compared to novices, are more likely to be able to correctly transfer elements, especially when the source has underlying similarities but surface dissimilarities (Novick, 1988). In other words, experts are better at seeing underneath superficial dissimilarities to recognize the utility of similar structural features.

Analogies can serve a variety of functional roles. Bearman, Ball, and Ormerod (2007) distinguished between analogies used to generate ideas for solving problems and those illustrating an existing idea. Illustrative analogies in the management decision-making domain "were designed not to facilitate directly the generation or development of a new solution idea, but instead for the purpose

Table 1
Different categories of analogies and micro-conflicts.

Analogy categories		Micro-conflict categories	
Distance	Within-domain Within-discipline Outside-discipline	Type	Science (task) Planning (task) Process Relationship
Mapping valence	Positive Negative Neutral Both positive and negative	Conflict sparked by	Simple correction Analogy Other
Problem-related vs. descriptive	Descriptive Problem-solving, explanatory, problem-finding	Conflict resolved immediately/quickly	No (unresolved) Yes (resolved)
Persuasive or not	Not used to persuade Persuasive	Conflict negativity presence	No negative affect Presence of negative affect
Depth	Superficial (1) to deep (5)	Conflict negativity intensity	None (0) to high (5)