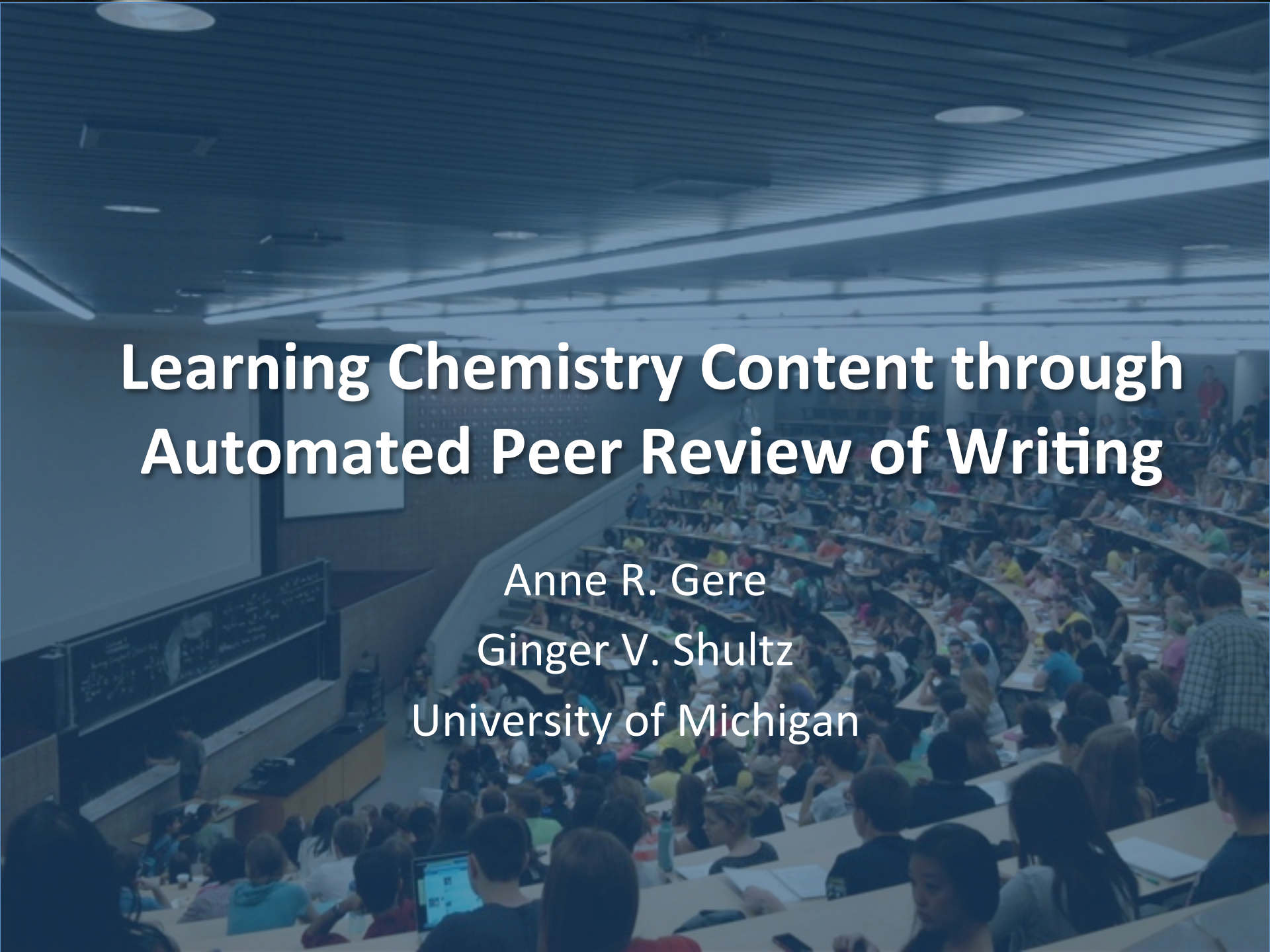


Learning Chemistry Content through Automated Peer Review of Writing

Anne R. Gere
Ginger V. Shultz
University of Michigan

Overview

- Making writing feasible in large intro courses
- Tailoring writing prompts and rubrics for productive peer review
- Understanding the connection between review and revision

Making Writing Feasible in Large Intro Courses

Organic Chemistry

1400

Molecular Biology

1200

General Chemistry

1800

Economics

3200

Statistics

4000

Physics

900

Computer Science

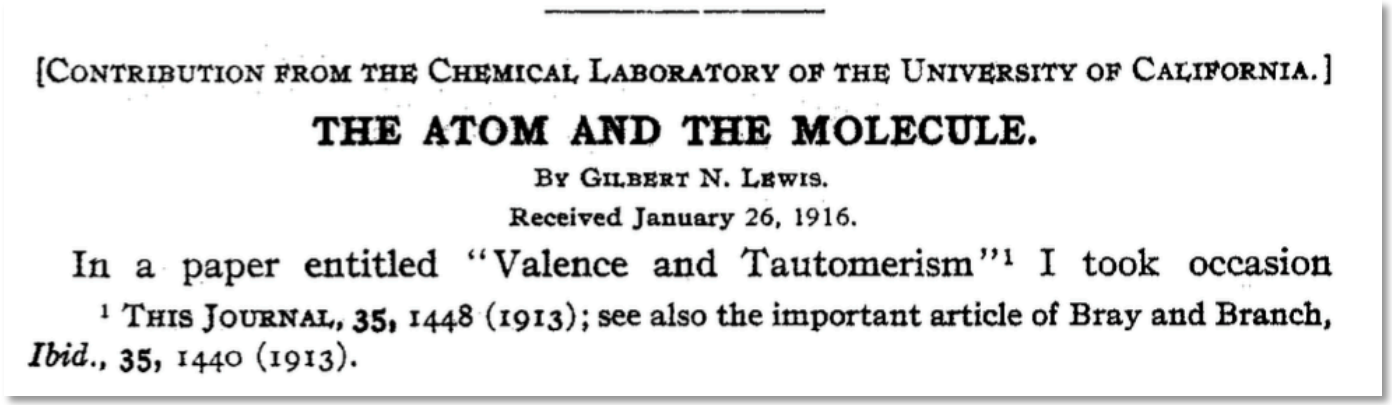
1500

Materials Science Engineering

150

**numbers correspond to annual enrollment*

Tailoring writing prompts and rubrics for productive peer review



[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CALIFORNIA.]

THE ATOM AND THE MOLECULE.

BY GILBERT N. LEWIS.

Received January 26, 1916.

In a paper entitled "Valence and Tautomerism"[1] I took occasion

[1] THIS JOURNAL, **35**, 1448 (1913); see also the important article of Bray and Branch, *Ibid.*, **35**, 1440 (1913).

Read and Write

- Students read and write about Lewis paper

Peer Review

- Students read and respond to 3 other students writing

Revise

- Students received feedback and revise writing

Shultz, G.; Gere, A.R. Journal of Chemical Education 2015, 92 (8) 1325-1329

Content-directed prompt and peer review rubric

Objectives (aligned between prompt and rubric):

I. Can you use your understanding of Lewis structures, nearly 100 years later, to summarize it more clearly and concisely than Lewis did? What are the most important points that Lewis proposed in the nine pages he published in 1916?

II. How did Lewis improve on previous theories of molecular structure and bonding?

III. How are the ideas that Lewis proposed in 1916 different from how we understand bonding and molecular structure today?

Shultz, G.; Gere, A.R. Journal of Chemical Education 2015, 92 (8) 1325-1329

Lewis D1-D2 ranking

Objectives	Mean Score (N = 58)		t-Test	Effect Size
	Draft 1	Draft 2		
I. Summary of important themes	5.2155	5.6207	2.770	0.364
II. Discussion of pre-Lewis theories	3.1983	4.2931	7.117	0.765
III. Comparison to conventional theory	2.6379	3.5345	4.232	0.444

- Expert ranking on a 7-point scale
- All differences are significant between $p<0.01$ and $p<0.001$ levels

Shultz, G.; Gere, A.R. Journal of Chemical Education 2015, 92 (8) 1325-1329

How does participation in peer review contribute to learning?

- Reading the writing of others and receiving peer feedback contributes to *learning to write*

- What about *learning from writing*?

1. Lundstrom, K.; Baker, W. Journal of Second Language Writing 18 (2009) 30-43
2. Prior, P. Chapter 4 In "Handbook of Writing Research" MacArthur, Graham, Gitzgerald Eds.

Analysis

- Tracked and analyzed revisions Draft 1 to Draft 2

- Categorized peer review comments using existing framework – adapted from “learning to write” to “writing to learn” context

Patchan, M.; Charney, D.; Schunn, C. Journal of Writing Research 2009, 1 (2) 124-251

Tracking Revisions

Revision Category	Rank (3 point scale)
Degree	0 = no change 1 = 2-3 sentences 2 = paragraph or more
Content	0 = no change to content 1 = minor changes to content (i.e. new terms added, clarification of existing terms) 2 = substantial changes to content (i.e. new topic introduced and elaborated on)
Structural	0 = no change to structure 1 = sentence level change 2 = global changes to draft

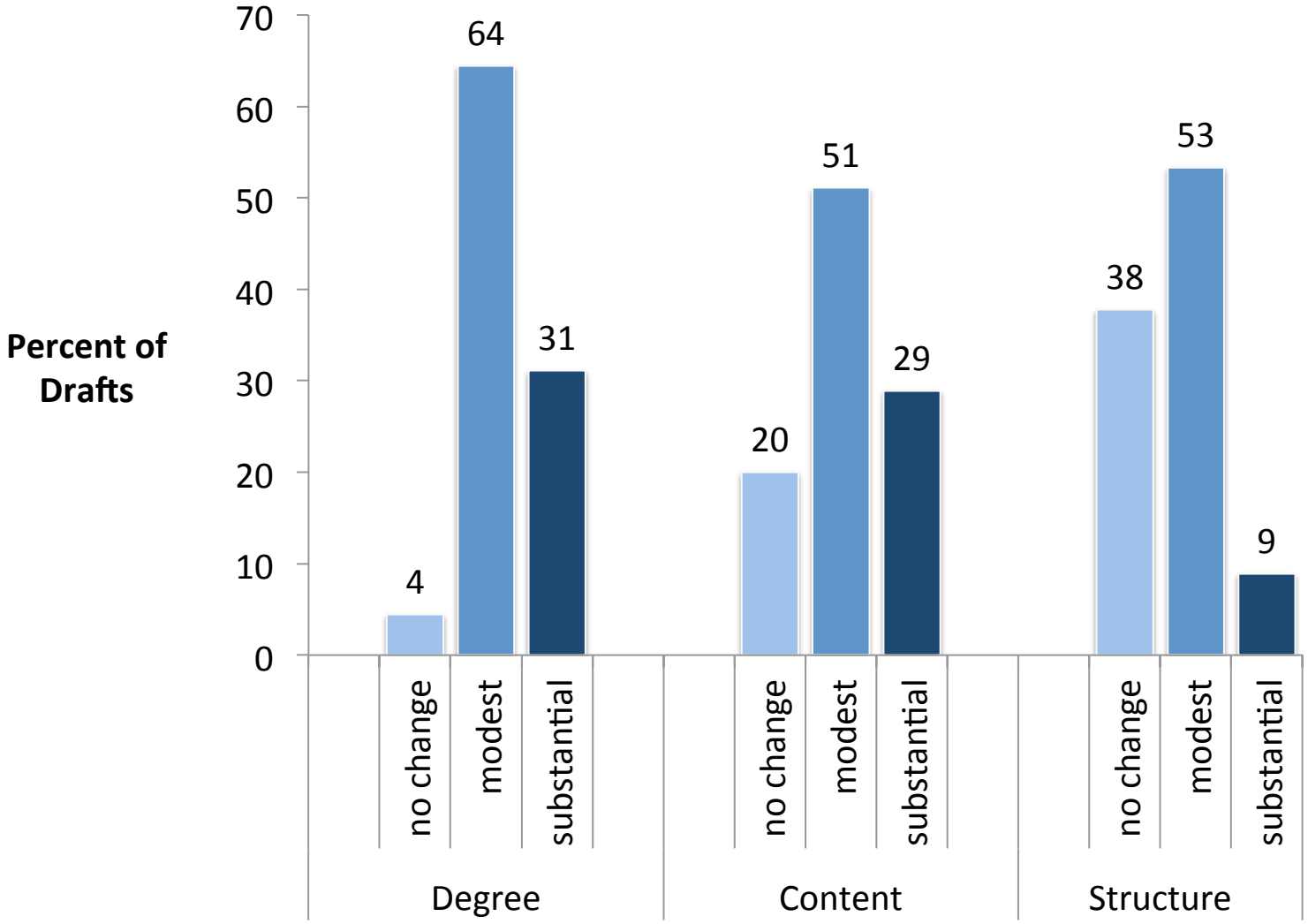
Connecting Revisions to Comments

"You did not discuss how Lewis' conclusions are different from how we depict molecules now….."

is completely ionized, while diagrams B and C represent a molecule that is covalently bonded.

The way Lewis depicted covalent bonding in 1916 is vastly different that how we draw Lewis Structures today. Lewis structures today are not drawn in cube formation because it is difficult to comprehend when trying to explain the bonding of more

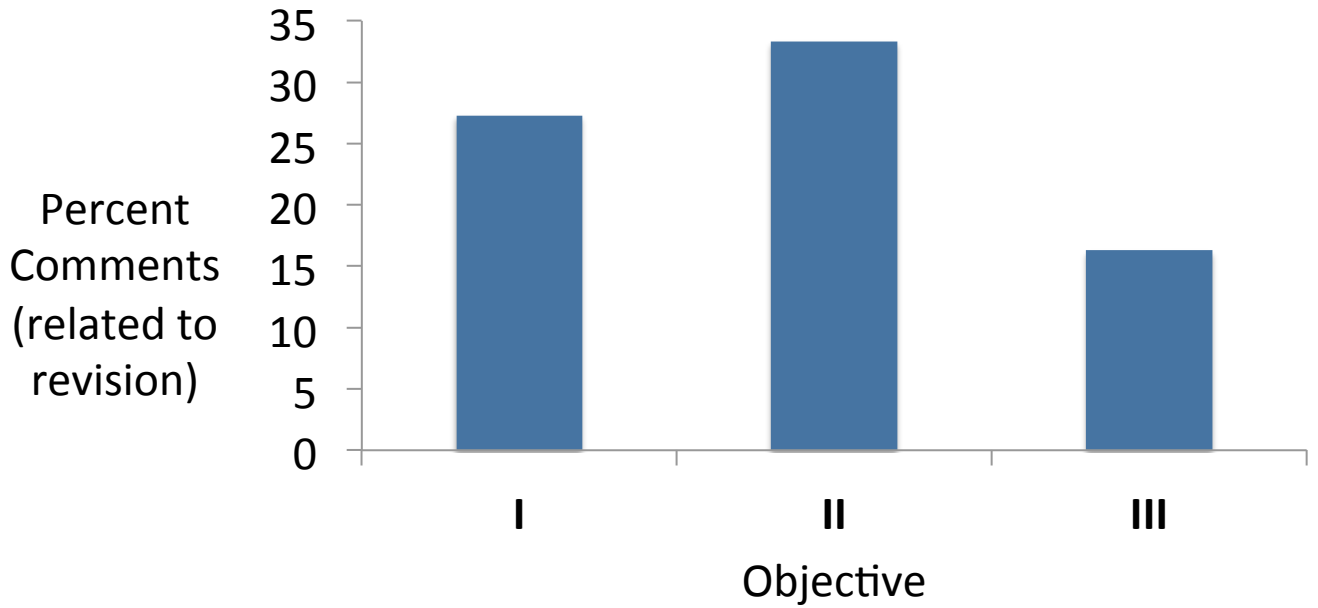
What was the nature of students' revisions?



Note: structural changes were not emphasized in the rubric and papers were 350-500 words in length

Revisions connected to peer review comments

- 21% of all comments made were connected to a specific revision



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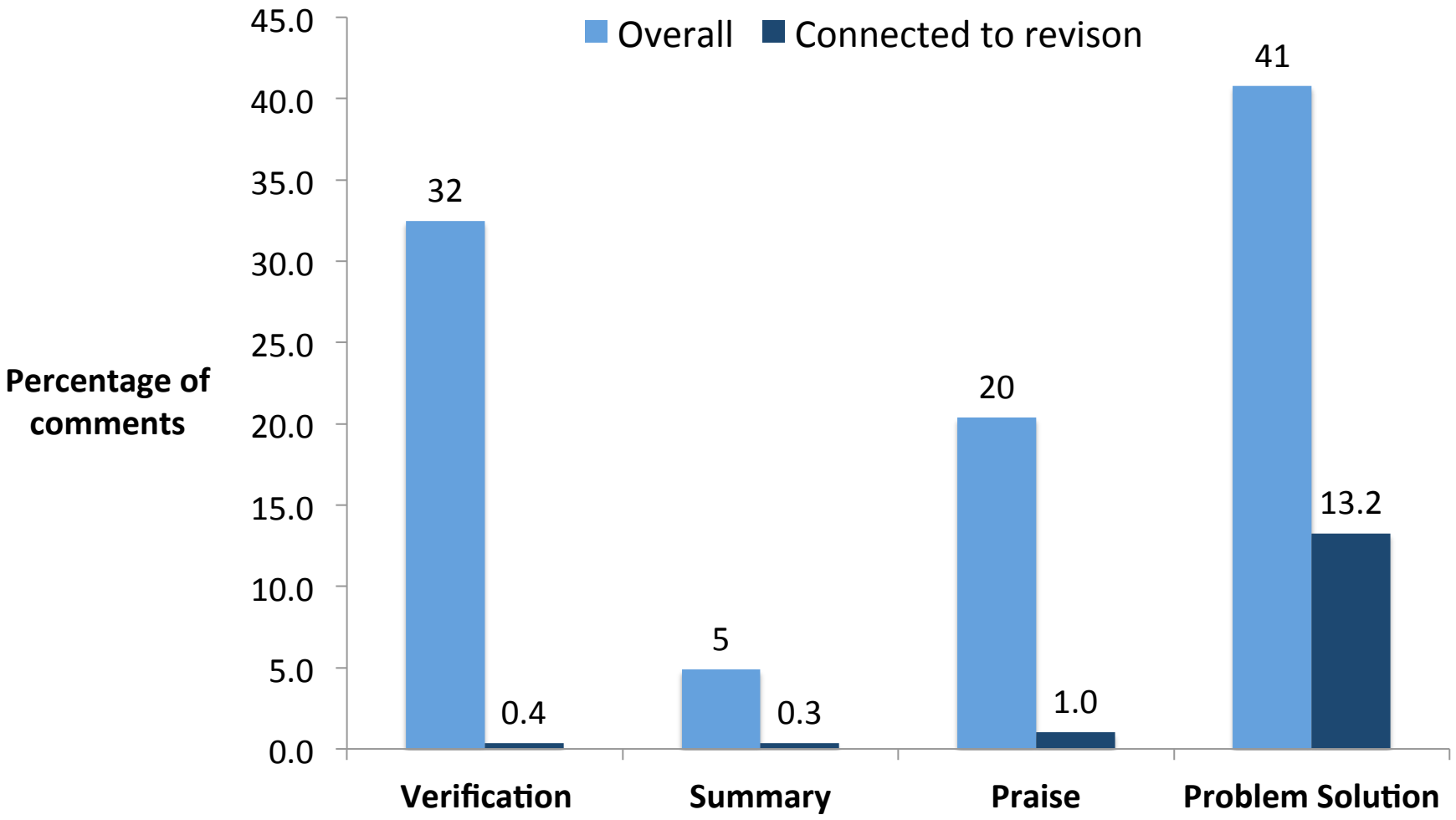
Does the type of comment matter?

Type of Feedback	Definition	Example
Verification	Identifies that rubric criteria was addressed	*"yes, it does."*
Summary	A list of topics, a description of claims, or an identified action	*"The paper cited VSEPR and molecular orbital theory as two new additions that have improved our understanding of bonding and molecular structure."*
Praise	A complimentary comment of identification of a positive feature	*"Did a good job of touching on the shortcomings of 2-d vs. 3-d models of today."*
Problem/solution	Identifies what needs to be fixed and/or suggests a way to fix issue	*"The paper does not provide a clear and concise summary of Lewis structures. You use all the necessary terms that Lewis used in his theory, but you do not necessarily explain what they mean.."*

Patchan, M.; Charney, D.; Schunn, C. Journal of Writing Research 2009, 1 (2) 124-251

What type of feedback is more frequently associated with changes?



Summary and Implications

- WTL approach: *content-directed* prompt *and* rubric

- Many students did not give useful feedback, make substantial revisions, or employ useful feedback
- Fewer students gave useful feedback on more difficult content objective

- When automated peer review is used students need in class instruction on effective *content-based* peer review and revision
- A more nuanced understanding of the content as it relates to peer review is needed

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Analysis

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