Assessing Writing 24 (2015) 35–58

Contents lists available at ScienceDirect

Assessing Writing

Predicting EFL writing ability from levels of mental representation measured by Coh-Metrix: A structural equation modeling study

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ARTICLE INFO

Article history:
Received 24 September 2014
Received in revised form 10 March 2015
Accepted 10 March 2015
Available online 3 April 2015

Keywords:
Coh-Metrix
Construction–integration model
Situation model
Structural equation modeling
Surface structure
Textbase

ABSTRACT

This study aims to invoke a theoretical model to link the linguistic features of text complexity, as measured by Coh-Metrix, and text quality, as measured by human raters. One hundred and sixty three Chinese EFL learners wrote sample expository and persuasive essays that were marked by four trained raters using a writing scale comprising Word Choice, Ideas, Organization, Voice, Conventions, and Sentence Fluency traits. The psychometric reliability of the writing scores was investigated using many-facet Rasch measurement. Based on the construction–integration (CI) model of comprehension, three levels of mental representation were delineated for the essays: the surface level (lexicon and syntax), the textbase, and the situation model. Multiple proxies for each level were created using Coh-Metrix, a computational tool measuring various textual features. Using structural equation modeling (SEM), the interactions between the three levels of representation, text quality, and tasks were investigated. The SEM with the optimal fit comprised 23 observed Coh-Metrix variables measuring various latent variables. The results show that tasks affected the situation model and several surface level latent variables. Multiple interactions were identified between writing quality and levels of representation, such as the Syntactic Complexity latent

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http://dx.doi.org/10.1016/j.asw.2015.03.001

variable predicting the situation model and the situation model latent variable predicting Conventions and Organization. Implications for writing assessment research are discussed.

Coh-Metrix (Graesser, McNamara, Louwerse, & Cai, 2004) is a computational tool that measures various surface- and deep-level text features related to comprehension including lexicon, syntax, and discourse levels (McNamara, Graesser, McCarthy, & Cai, 2014). Unlike traditional measures of textual features such as sentence and word count (Connor, 1990; Jarvis, Grant, Bikowski, & Ferris, 2003; Nation, 2001), Coh-Metrix examines the meaning of the text and its underlying discourse. Coh-Metrix provides statistical measures corresponding to three levels of mental representation when readers are engaged with texts: the surface structure (lexicon and syntax), the textbase (a mental representation of the text that maintains the text meaning), and the situation model (the "subject matter" described in the text including topics, persons, and locations) (McNamara et al., 2014). In the construction–integration (CI) model (Kintsch, 1998), which informed the development of Coh-Metrix, these levels of mental representation create an integrated network that determines text clarity, cohesion, and sophistication (Crossley & McNamara, 2010; McNamara et al., 2014).

A considerable amount of literature has been published on Coh-Metrix that corroborates the relationship between Coh-Metrix indices and the quality of texts written by English as a second/foreign language (ESL/EFL) students and assessed by human raters (e.g., McNamara, Crossley, & McCarthy, 2010). Coh-Metrix research has primarily relied on multivariate regression analysis where several important relationships between dependent variables (e.g., text quality) and independent variables (e.g., Coh-Metrix measures) are tested. However, regression models are incapable of evaluating the integrated network of levels of representation that is integral to the CI model (e.g., independent-independent and independent-dependent variable relationships), thereby minimizing the theoretical outreach of Coh-Metrix research.

Raters' cognitive processes involved in comprehension and their judgments of text quality are affected by learners' choice of vocabulary and accuracy of syntax which, in turn, determines the coherence of the textbase and the situation model (Crossley & McNamara, 2010; McNamara et al., 2014). Wolfe (2005) suggested that less experienced raters tend to focus on the features of the essay that determine coherence, whereas highly proficient raters pay attention to all textual features. In addition, the first group continuously makes decisions about the essay while reading, whereas the second group tends to pass judgement when they develop a reliable mental representation of the essay. This indicates that raters' cognitions and decisions regarding the essay are determined by the interplay between raters' backgrounds and textual features (Aryadoust, 2012). The present study aims to invoke a theoretical model to connect the linguistic features of text complexity, as measured by Coh-Metrix, and text quality, as measured by human raters, on an analytical scale across two text genres: expository and persuasive essays. Three research questions will be investigated:

(1) Can the surface structure (lexicon and syntax), the textbase, and the situation model levels of representation be represented (measured) by Coh-Metrix indices in texts written by EFL learners?
(2) Are the surface structure, the textbase, and the situation model interconnected? Can they explain (predict) the writing quality of EFL texts as assessed by human raters?
(3) Do the indices representing these levels of representation and writing scores vary across genres?

To address these questions, we operationalize a conceptual framework for Coh-Metrix described by Crossley and McNamara (2010) and McNamara et al. (2014), thus postulating two groups of contesting hypotheses. We assess the fit of these models to the data (corpus) using structural equation modeling (SEM), a multivariate latent trait technique that allows for evaluating direct and indirect relationships.