

Exploring the Dynamics of Willingness to Communicate in Written Communication: A Case Study

Ann Tai Choe¹

Teachers College, Columbia University

ABSTRACT

This paper investigates the dynamics of willingness to communicate (WTC) in written communication between a native and non-native speaker of English. Although research into WTC has identified topic as an interacting variable affecting L2 learners' WTC during task performances (MacIntyre & Legatto, 2011) and classroom interactions (Cao, 2013), fewer studies have explored the nature of written WTC, its relationships with topics, as well as L2 writing development. This study addresses this gap by exploring the dynamism of WTC in writing from a Complex Dynamic Systems Theory (CDST) perspective. Through the employment of three methods—WTC analysis, complexity and accuracy analysis, and functional analysis—the findings suggest that WTC in written communication also reflects the characteristics of a dynamic system. Specifically, it fluctuates as the interlocutors organically move from one topic to the next. Results from the complexity and accuracy analysis and functional analysis provide further evidence to confirm that L2 development is a highly variable and nonlinear process. Overall, these findings lend support to the CDST perspective of interlanguage (IL) development, including dynamism in WTC and L2 writing development.

INTRODUCTION

Originating from the *first language* (L1) communication literature, *willingness to communicate* (WTC) is defined as an individual's tendency to communicate across various contexts (McCroskey & Baer, 1985; McCroskey & Richmond, 1990). In *second language acquisition* (SLA) literature, WTC is referred to as the probability of initiating communication in the target language when an opportunity arises (MacIntyre, Baker, Clément & Donovan, 2003). As a psychological construct, WTC was, in the past, always measured through direct approaches like questionnaires (e.g., Hashimoto, 2002; MacIntyre & Charos, 1996; MacIntyre et al., 2003) or stimulated-recall interviews (e.g., Cao, 2011; Kang, 2005; MacIntyre & Legatto, 2011; Zhong, 2013). More recently, however, an alternative approach was documented by Khazaei, Zadeh, and Ketabi (2012), who measured thirty *second language* (L2) learners' WTC by calculating learners' talk-time and turns of talk in relations to different class sizes. Their findings revealed that as the class size increased, L2 learner's WTC decreased, and vice versa. Additionally, the authors advocated for the implementation of different instruments to further understand the connections between WTC and L2 writing development.

¹ Ann Tai Choe is currently pursuing her Ed. M. degree in Applied Linguistics at Teachers College, Columbia University. Her research interest centers on discourse analysis and Second Language Acquisition. Correspondence should be sent to Ann Tai Choe, 316 Zankel, Teachers College, Columbia University, 525 W 120th Street, New York City, NY 10027. Email: adt2135@tc.columbia.edu

Despite the growing body of research on WTC, currently the nature of WTC in written communication remains largely unexplored. For instance, little is known about the relationship between L2 learner's WTC and their writing development. Moreover, while previous research has shown that topic can influence learners' WTC, there is far less research that examines the effects of topic selection on WTC. For this reason, the current paper presents a preliminary analysis focusing on two interlocutors' WTC in written communication. The paper also examines the relationship between interlocutors' WTC in different topics and their writing performance over time. In recognizing WTC as a dynamic variable (Cao, 2013; Kang, 2005; MacIntyre & Legatto, 2011), this paper adopts a *Complex Dynamic Systems Theory* (CDST) approach to analyzing email exchanges between a *native speaker* (NS) of English and a *non-native speaker* (NNS). Three methods of data analysis: (1) WTC analysis, (2) complexity and accuracy analysis, and (3) functional analysis, are employed to address the following research questions:

1. To what extent do different topics affect the NS's and NNS's WTC?
2. What is the relationship between the NNS's complexity and accuracy over time? How do they relate to WTC?
3. How does the NNS's use of the article system vary over time?

In the first section, the key characteristics of CDST will be reviewed. The second section will provide a description of the three methods as well as the coding procedures for each method. Results from each method will be presented in the third section. The paper will then conclude with a discussion of the results.

REVIEW OF THE LITERATURE

As SLA research shifted away from Chomsky's nativism towards emergentism in the 1990s, *interlanguage* (IL) development was no longer seen as a result merely driven by the learner's innate mechanisms; rather, it was an outcome of the interactions between the learner and their social environments (De Bot, Lowie & Verspoor, 2007; Ellis, 1998). A theory consistent with this view is CDST. From this perspective, language development is portrayed as a complex system comprised of multiple interacting, interdependent subsystems; a small change in one subsystem can generate enormous fluctuations in other subsystems, eventually affecting the larger system over time (Larsen-Freeman, 1997). In this regard, variability is an integral part of the developmental process (De Bot et al., 2007).

Research within a CDST framework has been widely applied to explore various linguistic aspects of IL development (e.g., Larsen-Freeman, 2006; Polat & Kim, 2014; Rosmawati, 2014; Spoelman & Verspoor, 2010; Verspoor, Lowie & Van Dijk, 2008). Several studies have looked at *complexity, accuracy, and fluency* (CAF) to examine language development. When looking at language development in terms of CAF, the underlying assumption is that learners may prioritize one aspect over another (Ellis & Barkhuizen, 2005; Skehan, 1998). Using all components of the CAF constructs, Larsen-Freeman (2006), for example, examined the L2 development of five Chinese-speaking English learners. Data included oral and written narratives produced by the learners over a course of six months. Employing CAF indices such as type-token ratio, the proportion of error-free T-units to T-units, and the average number of words per T-unit, results showed a great degree of intraleaner and interlearner variability as the learners experienced progression and regression in their IL development. Although all learners displayed improvements in their language use by the end of the observation, each of them appeared to follow a unique developmental pattern. This was attributed to participants allocating their resources to different aspects at different times. When drawing a comparison between vocabulary complexity and

grammatical complexity, for instance, Larsen-Freeman found that a learner prioritized the former while the other learners focused on the latter. For another example, when plotting grammatical complexity against fluency, a learner improved in fluency while another in grammatical complexity.

While CAF has been explored within a CDST framework, it is not the only method that is capable of capturing dynamism in IL development. Huebner (1979) explored the development of the article system in an adult English learner through a *dynamic paradigm model*. In this model, IL was viewed as a fluid system within which variability exists as a result of a learner's continual revisions of their hypotheses toward the *target language* (TL). Data were four selected oral narratives produced by a Hmong learner of English, Ge. Huebner performed a form-function analysis following Bickerton's (1975) 'semantic wheel', during which instances of noun phrases marked with *da* (Ge's way of pronouncing *the*), *a/an*, and zero article were coded according to their intended meaning. In accordance with the CDST perspective, although it had not been introduced into SLA research at the time, the results indicated a high level of variability within Ge's IL development. Although Ge did not initially use the articles in a target-like way, his form-function mappings for *da* gradually became more native-like over time. These findings led Huebner to conclude that IL evolved in a nonlinear fashion, within which fluctuations occurred as learners continued to reassess the associations between linguistic forms and their meanings and functions.

More recently, CDST has been applied to study the dynamic nature of a nonlinguistic variable—WTC (e.g., Cao, 2013, MacIntyre & Legatto, 2011). Despite its introduction as a fixed personality trait in the L1 literature (McCroskey & Baer, 1985; McCroskey & Richmond, 1990), L2 researchers, MacIntyre, Dörnyei, Clément, and Noels (1998), have redefined WTC as a situation-specific variable, one that may vary depending on the context. Later research seemed to lend support to this claim by identifying a link between L2 learners' WTC and other interacting variables such as topic (e.g., Cao, 2011; Kang, 2005), interlocutors (e.g., Cao, 2011; Cao, 2013; MacIntyre et al., 1998; Zhong, 2012), and even classroom size (Khazaei et al., 2012). In a later study, MacIntyre and Legatto (2011) argued in favor of viewing WTC as a dynamic variable. In their study, data consisted of self-reports from six college students at a French immersion program in Canada. After completing eight communicative tasks with varying degrees of topic difficulty, participants submitted self-reports with regards to WTC trait, anxiety level, and extraversion. Adopting an idiodynamic approach to analyzing the data, the findings confirmed that WTC was a dynamic variable as it fluctuated from task to task. Interpreting data from a CDST perspective, the researchers found that WTC entered a repeller state when the participants were performing more challenging tasks. This was attributed to some participants' lack of vocabulary knowledge to respond under a difficult topic (e.g., discussion of education or political system). As a result, a higher level of fluctuation in their WTC was detected. On the other hand, WTC as an attractor state—that is, a state of relative stability in which the system remains for a certain period—was more evident in participants who were more fluent and confident.

Unlike MacIntyre and Legatto (2011), Cao (2013) examined dynamism in L2 learners' WTC during classroom interactions at an *English for Academic Purposes* (EAP) program in New Zealand over a period of five months. When coding the data, Cao calculated the sum for number of turns in each lesson and categorized them according to a WTC scheme. The tokens of WTC behavior were determined by a ratio of time per learner. The findings revealed a high degree of fluctuation in learners' WTC from one lesson to another. Through qualitative measures like reflective journals and stimulated-recall interviews, Cao found that these fluctuations were caused by the joint impact between L2 learners' cognitive and linguistic subsystems. For example, learners tend to display higher WTC when discussing a topic that is of interest to them or easy for them to talk about. Essentially,

findings from both MacIntyre and Legatto's (2011) and Cao's (2013) studies pointed to another critical facet of CDST, namely, the interconnectedness between L2 learners' affective system and cognitive system (De Bot et al., 2007). Both studies also showed that a contextual factor, such as topic, may have a direct impact on L2 learners' WTC.

Studies framed within a CDST perspective have shown that IL development is a nonlinear and complex process. Such a framework has provided researchers a window into the dynamic nature of IL, both at a linguistic and nonlinguistic level. Nonetheless, a gap in research still exists when examining a relationship between individuals' WTC and their L2 writing development. Although WTC has been noted as "the most immediate determinant of L2 use" (Clément, Baker & MacIntyre, 2003, p. 191), research has not yet shown the relationship between WTC and IL development. Furthermore, little is known about the effects of topic on individuals' WTC. The present study thus aims to explore the nature of WTC variation in written communication from a CDST perspective, focusing specifically on the interrelationships between L2 WTC and topics, as well as L2 writing development.

DATA AND ANALYSES

Data in this study consisted of 11 back-and-forth email exchanges between a NS and NNS of English over the course of a month and a half. The NS, Michelle, is an American of Mexican heritage living in Texas, USA. The NNS, Belinda, is an advanced learner of English living in Shandong Province, China. Michelle and Belinda, both university-level students at the time, were partners for an email exchange project in an Intercultural Communication course. Without any predetermined topics, the main purpose of this project was for students to receive hands-on experience in intercultural communication by writing to a peer from another culture.

WTC analysis

L2 researchers have employed a variety of indirect measures to explore learners' WTC. These measures include calculating the number of turns, categorizing them into coding schemes, and determining the WTC ratio (e.g., Cao, 2013; Khazaei et al., 2012). In a similar vein, the present study aimed to explore whether WTC could be measured through an inductive approach, which entailed a combination of qualitative and quantitative methods. To this end, two levels of analyses—macro and micro—were employed to address the first research question: *To what extent do different topics affect the NS's and NNS's WTC?*

The data were first divided into six periods (Period 1-6) with two back-and-forth email exchanges in each period (except Period 6 because it only contained 1 back-and-forth exchange). The data were first analyzed at a macro-level, where the total number of words produced by the interlocutors within each period were calculated. The approach was guided under the assumption that WTC in writing may be measured indirectly by looking at the amount of words an individual is willing to produce in a given timeframe. To avoid ambiguity, all instances of emoticons, Chinese characters, and email openings and closings (e.g., *-Michelle-*, *Best,*) were removed from the analysis. The results were then graphed out, and a correlation coefficient between Michelle's and Belinda's WTC was computed.

Next, a micro-level analysis was conducted by first coding the data qualitatively and then quantifying the data. When coding the data qualitatively, topics that were discussed in each email were first identified and then categorized into major themes. Initially, a total of seven themes emerged as a result of this process: (1) personal life, (2) native language, (3)

local culture, (4) local climate, (5) pop culture, (6) traditional food, and (7) current events. Having identified the most salient topics, the data were then reduced to concentrate on four major themes: (1) personal life, (2) native language, (3) local culture, and (4) pop culture. In order to determine Michelle's and Belinda's WTC ratio of these topics, the total number of words produced under each topic was divided by the total number of words produced in that period (i.e., the percentage of their discussion on a particular topic in each period). The results were then graphed to show variability in Michelle's and Belinda's WTC ratio of these topics over time.

Complexity and accuracy analysis

The second research question in this study asked: *What is the relationship between the NNS's complexity and accuracy over time? How do they relate to WTC?* First, a *type-token ratio* (TTR) was calculated and then a *target-like use* (TLU) analysis was conducted to measure Belinda's lexical complexity and accuracy of article usage, respectively. According to Ellis and Barkhuizen (2005), TTR is "the total number of different words used (types) divided by the total number of words in the text (tokens)" (p. 154). TTR has been widely used within CDST studies to trace L2 learners' development of vocabulary complexity, as well as its interaction with other CAF indices (e.g., Larsen-Freeman, 2006; Verspoor et al., 2008; Zheng, 2016). In this study, both interlocutors' TTR were measured using Compleat Lexical Tutor (Cobb, 2016), an online computer-generated analyzer. The individual outcomes were then mapped out against their article accuracy determined by the TLU analysis.

A TLU analysis is defined as the total number of correct suppliance in context divided by the number of obligatory contexts plus oversuppliance in non-obligatory contexts (Pica, 1983). Unlike the obligatory occasion analysis (Brown, 1973), which solely focuses on the obligatory contexts of a given morpheme, a TLU analysis accounts for both correct use and overuse of a morpheme. The morpheme targeted in this study is the English article system, which is notoriously difficult to acquire for L2 learners whose native language lacks an equivalent structure (Miller, 2005). This applies to many topic-comment languages, such as Russian and Belinda's L1, Chinese (Celce-Murcia & Larsen-Freeman, 1999). The participant from Huebner's (1979) study, Ge, also lacked the article system in his L1, Hmong. As an English beginner at the time, Ge experienced a high degree of variability in his use of the English articles in his IL development. While Huebner's (1979) study focused on Ge's form-function mappings of the article system, in this study, both the TLU analysis and form-function analysis were employed in hopes of gaining a more in-depth understanding into Belinda's article development.

Using a TLU analysis, Belinda's use of indefinite article *a/an* and definite article *the* were tallied according to each time period. This coding process was done iteratively until saturation. Although an inter-coder reliability was not computed, any ambiguous instance of article usage in the data was discussed with another colleague from the Teaching English to Speakers of Other Languages (TESOL) program at Teachers College, Columbia University. Next, a correlation coefficient between Belinda's accuracy and complexity was calculated to identify the interactions between the two measures. The overall results were visualized and compared to the findings generated from the WTC analysis in hopes of understanding the interrelationships between her complexity, accuracy, and WTC over time. As a point of reference, Michelle's lexical complexity and accuracy were also analyzed following the same procedure.

Functional analysis

The last method, functional analysis, was conducted to address the third research question: *How does the NNS's form-function mappings for the English article system vary over time?* Unlike the complexity and accuracy constructs, functional analysis recognizes language as a system consisting of form-function mappings as opposed to merely grammatical features; rather than investigating IL with respect to the TL norms, functional analysis places an emphasis on how a learner uses forms to fulfill her intended meaning, thus treating IL in its own right (Ellis & Barkhuizen, 2005).

In performing the analysis, this paper followed Huebner's (1979) procedure for form-function analysis carefully. All instances of noun phrases (hereafter NPs) marked with *the*, *a/an*, and zero article \emptyset produced by Belinda throughout the six periods were identified and coded according to Bickerton's (1975) 'semantic wheel' (see Table 1). NPs containing proper nouns (e.g., *the Rio Grande Valley*), lexical phrases (e.g., *by the way*, *in the future*), idiomatic expressions (e.g., *an apple a day*), and possessives (e.g., *my*, *our*) were eliminated from the analysis as they may distort the data (Huebner, 1979). Likewise, subsequent NPs in a series (e.g., *a boy and a girl*) were also eliminated from the analysis.

TABLE 1
Bickerton's (1975) 'semantic wheel' extracted from Huebner (1979)

Noun phrase type	Form(s)	Function(s)
+Specific/+Hearer	<i>the</i>	a. Unique reference b. Conventionally assumed unique reference c. Referent physical present d. referents previously mentioned in discourse
-Specific/+Hearer	<i>a</i> , <i>the</i> , or \emptyset	Generics
-Specific/-Hearer	<i>a</i> or \emptyset	a. NPs in scope of negation b. NPs in modal, irrealis scope c. NPs in scope of questions d. NPs with indefinite number
+Specific/-Hearer	<i>a</i> or \emptyset	First mention of NP [+Specific] in a discourse

Additionally, in order to observe whether there is a tendency of avoidance (Schachter, 1974), cases of absences were also taken into account. Michelle's article usage was also analyzed following the same procedure to show discrepancies between NS-NNS form-function mappings.

RESULTS

WTC analysis

The present study was an attempt to examine the dynamism of WTC in written communication. More specifically, the study sought to investigate the effects of topics on interlocutors' WTC. To this aim, the data were coded and analyzed at both a macro- and micro-level.

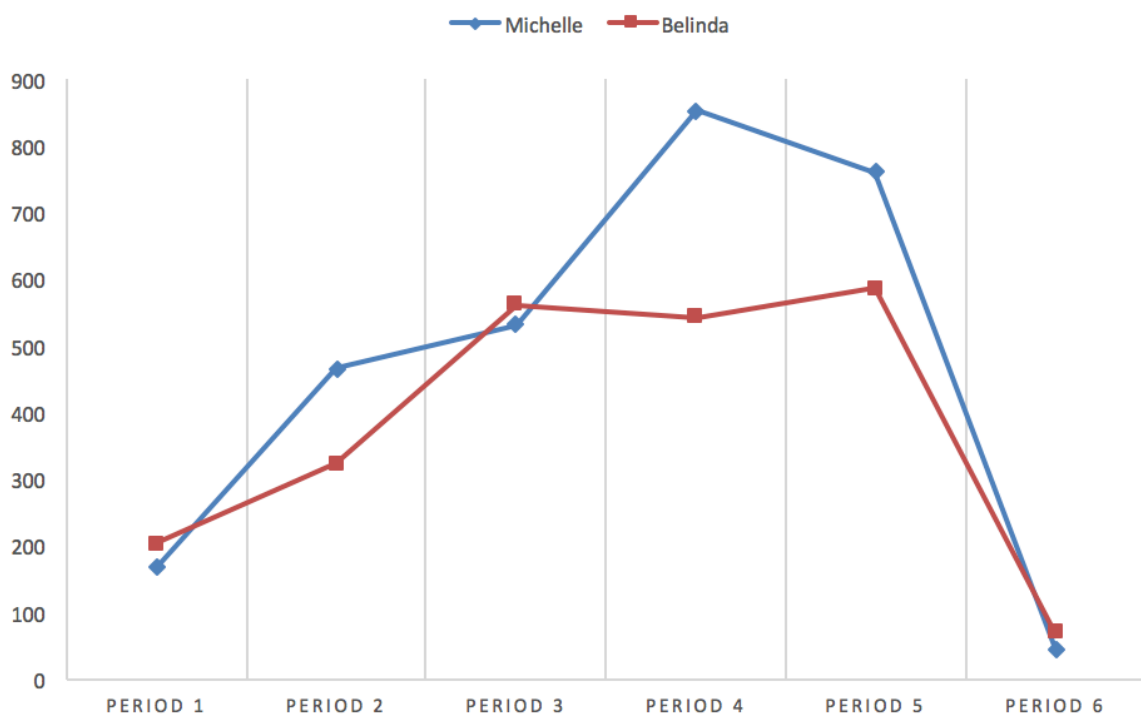
Macro-level analysis

Results from the macro-level analysis are shown in Table 2 and visualized in Figure 1. At a glance, Michelle and Belinda seemed to share a similar pattern of WTC throughout the duration of their project: both shared a rapid inclination from Period 1 to 4, and then fell dramatically together in Period 6 as their project came to an end. The correlation coefficient was calculated to be .93, suggesting a high positive correlation. Considering that the overarching goal of their intercultural exchange project was to foster greater competence between intercultural communicators, a high correlation was expected and preferred. Nevertheless, an apparent gap was found in Period 4, when Michelle's trajectory reached its peak and Belinda's remained somewhat consistent with her WTC in Periods 3 and 5. Thus, a micro-level analysis was conducted to further delve into the forces that could have driven these fluctuations.

TABLE 2
Michelle's and Belinda's WTC from Period 1 through 6

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Michelle	167	465	531	853	761	44
Belinda	203	322	561	543	586	69

FIGURE 1
Michelle's and Belinda's WTC from Period 1 through 6; $r=.93$



Micro-level analysis

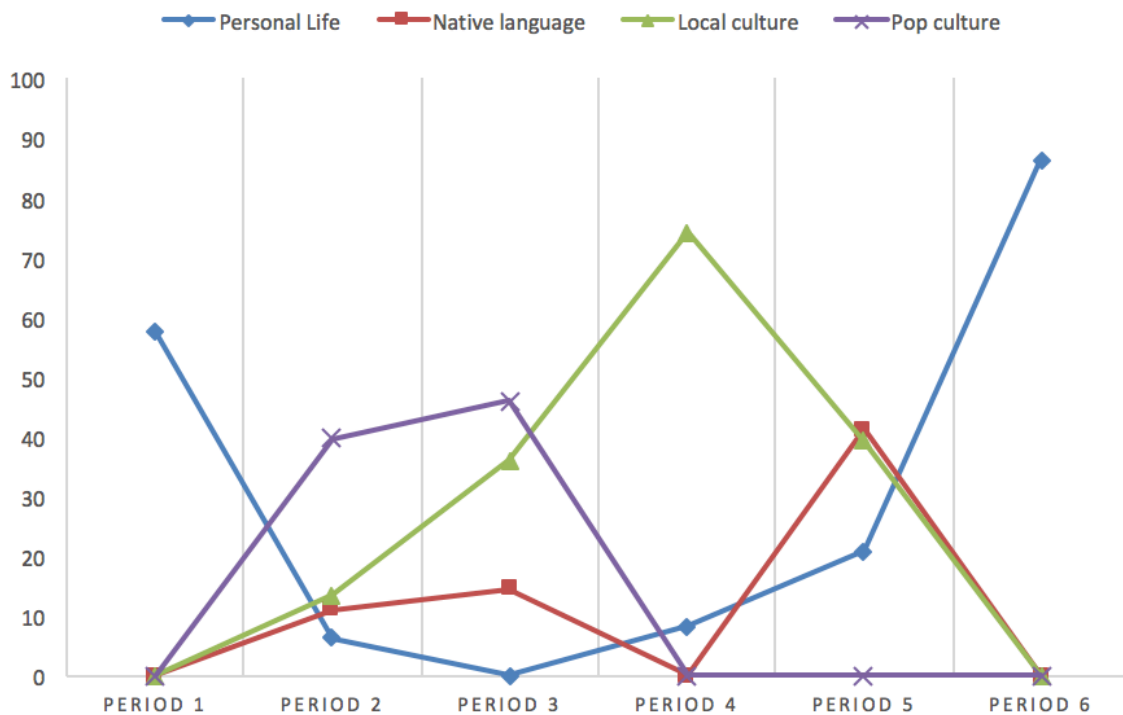
The micro-level analysis was conducted by determining the interlocutor's WTC ratio of four major topics: (1) personal life, (2) native language, (3) local culture, and (4) pop

culture. Table 2 shows Michelle’s and Belinda’s WTC ratio of each topic from Period 1 through 6. Their results are visualized in Figures 2 and 3.

TABLE 2
Michelle’s and Belinda’s WTC ratio categorized by topics (Period 1 through 6)

	Period 1		Period 2		Period 3		Period 4		Period 5		Period 6	
	M	B	M	B	M	B	M	B	M	B	M	B
Personal life	57.5	34	6.5			11.6	8.3	13.8	20.9	31.2	86.4	72.5
Native Lang.		9.4	11.2		14.7	10.3			41.4	1.7		
Local culture		17.7	13.6		48.2	44.2	74.3	61	39.3	68.1		
Pop culture			39.8	65.8	46	32.6						

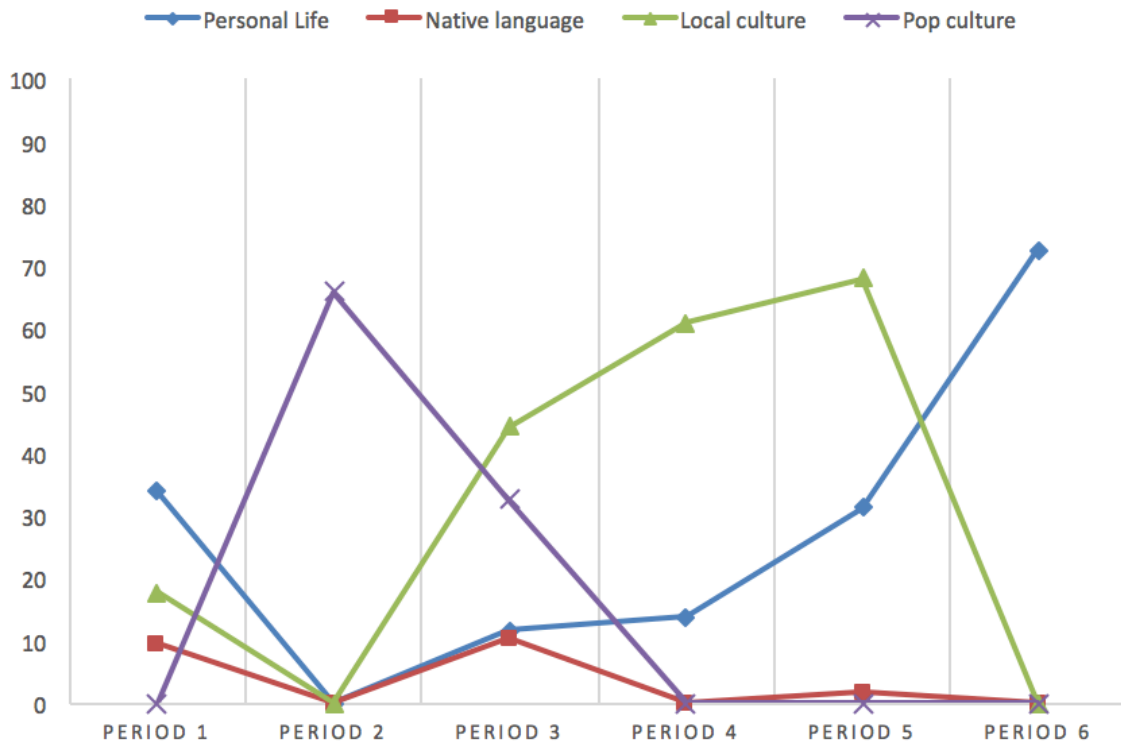
FIGURE 2
Michelle’s WTC ratio categorized by topics (Period 1 through 6)



As seen in Figures 2 and 3, Michelle’s and Belinda’s WTC ratio of each topic displayed a great degree of variation throughout its trajectory. Although discussing topics such as personal life, pop culture, and native language were not required by the project, they had organically emerged during the process of getting acquainted with an assigned project partner. Both Michelle and Belinda showed a high WTC ratio of personal life topics in Period 1, with Michelle at 57.5% and Belinda at 34%. As other topics began to emerge, however, their WTC ratio of personal life topics showed a quick drop in Period 2 and remained consistently at a lower trajectory (Period 2 through 5). In Period 6, both interlocutors once again displayed a high WTC ratio of personal life topics, with Michelle at 86.4% and Belinda at 72.5%. When interpreting these results from a CDST perspective, it seems that Michelle’s and Belinda’s WTC ratio of personal life topics settled into an attractor state from Period 2 to Period 5, and a repeller state in Periods 1 and 6. Apparently, personal life topics were used as

a vehicle by Michelle and Belinda for opening and ending their conversation. For example, identifying their name, age, major, and interests (Period 1), and using excuses like preparing for their finals or attending family gatherings as a way to exit their conversation (Period 6).

FIGURE 3
Belinda's WTC ratio categorized by topics (Period 1 through 6)



Given the overarching goal of their project, it is not surprising to find that Michelle and Belinda both displayed the highest WTC ratio of local culture topics, with Michelle at 74.3% (Period 4) and Belinda at 68.1% (Period 5) (Table 2). The micro-level analysis seems to suggest that the sudden fluctuation in Michelle's WTC in Period 4 (Figure 1) could be attributed to the topics under discussion, namely, local culture. As for Belinda, Figure 3 shows that her WTC ratio of local culture topics appeared to settle into somewhat of an attractor state from Period 3 through 5, where she had a consistently high WTC ratio. Once their goal had been accomplished, in Period 6, the discussion on local culture topics was completely abandoned. Perhaps a more interesting observation can be made in the sudden increase of the interlocutors' WTC ratio of pop culture during Period 2, with Belinda at 65.8% and Michelle at 39.8%. However, while Michelle's WTC ratio of pop culture topics seemed to settle into a short attractor state from Period 3 to 4, Belinda's evolved in a less predictable manner. Despite these differences, as shown in Figures 2 and 3, their discussion on pop culture had correspondingly lasted from Period 2 to 4. A transition from pop culture to local culture was identified in Period 3 as they started sharing information about the cultural aspects of their hometown (e.g., games, festivals, and traditional food). Thus, it seems that pop culture, a less threatening and perhaps more interesting topic, was used as a stepping-stone for Michelle and Belinda to work collaboratively toward accomplishing their main goal.

It is interesting to note that native language stayed predominantly at a lower trajectory compared to other topics. This was not so surprising, given that the purpose of their project was for students to conduct a cultural exchange as opposed to a language exchange. Notice,

however, the sudden spike of Michelle’s WTC ratio of native language topics in Period 5 (Figure 2). Further examination into the data revealed that during the second email exchange in Period 4, Belinda asked Michelle about the metaphorical use of colors in English. In return, Michelle answered the question by providing several examples in Period 5. Although Belinda was the initiator of these topics, as evidenced by her low WTC ratio of native language topics in Period 5 (Figure 3), she did not persist in pursuing these topics. Instead, she began to display high interest in topics related to local culture.

In short, a high degree of individual variation was identified at both a macro and micro level. The macro-level analysis revealed that, despite a great degree of fluctuation in both interlocutors’ WTC trajectories, Michelle and Belinda achieved a high level of collaboration ($r=.93$) throughout their project. The micro-level analysis, on the other hand, revealed that the interlocutors’ WTC fluctuated as a result of topic shift. Particularly, Michelle and Belinda both showed a somewhat consistently high WTC ratio of local culture topics, and low for personal life topics. Altogether, these results seem to suggest that personal topics lead to low WTC and culture topics lead to high WTC in their email exchanges.

Complexity and accuracy

To explore the relationship between complexity and accuracy, a TTR and TLU were calculated for both Michelle and Belinda. Their results are presented and visualized below.

TABLE 3
Michelle’s accuracy of article usage (TLU) and lexical complexity (TTR) in %

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Accuracy	100	95	100	97	95	100
Complexity	62	46	49	43	44	79

FIGURE 4
Michelle’s lexical complexity (TTR) and accuracy of article use (TLU) in %; $r=.69$

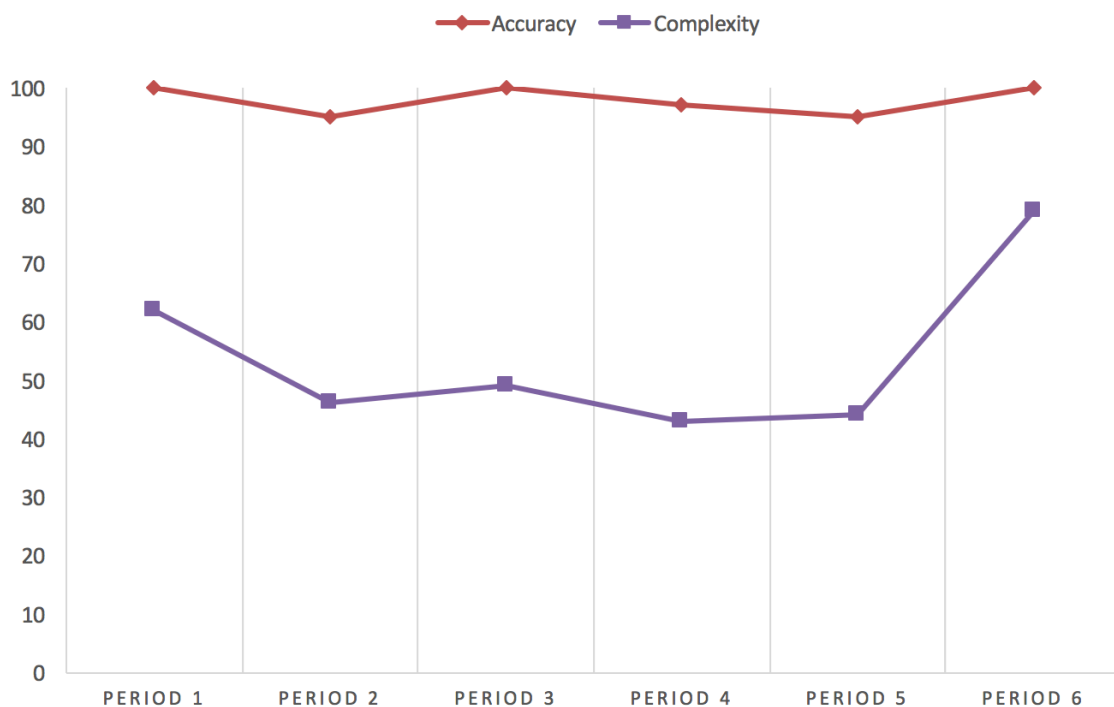
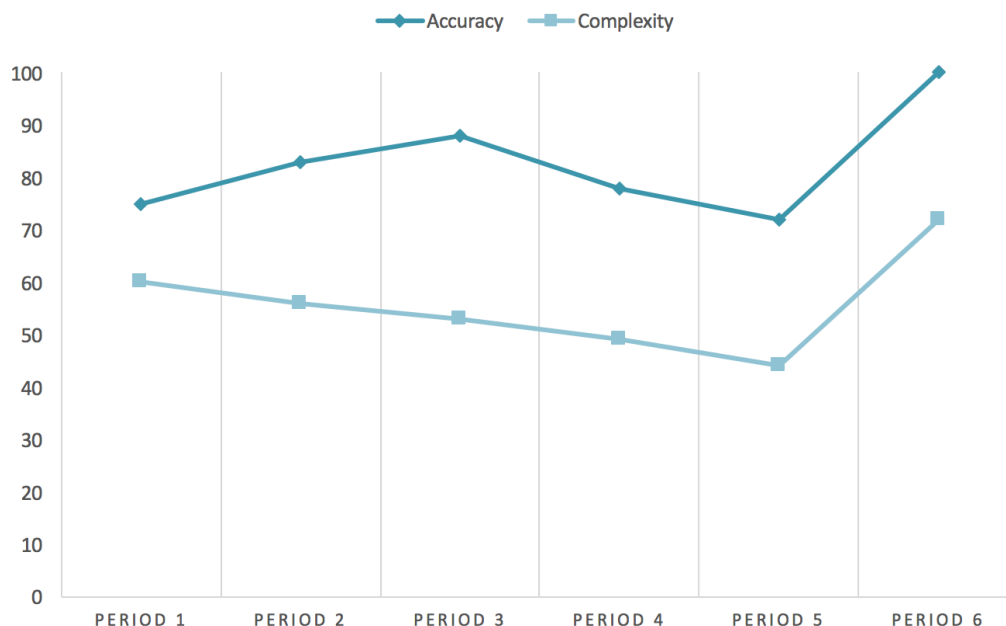


TABLE 4
Belinda's accuracy of article usage (TLU) and lexical complexity (TTR) in %

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Accuracy	75	83	88	78	72	100
Complexity	60	56	53	49	44	72

FIGURE 5
Belinda's lexical complexity (TTR) and accuracy of article use (TLU) in %; $r=.79$

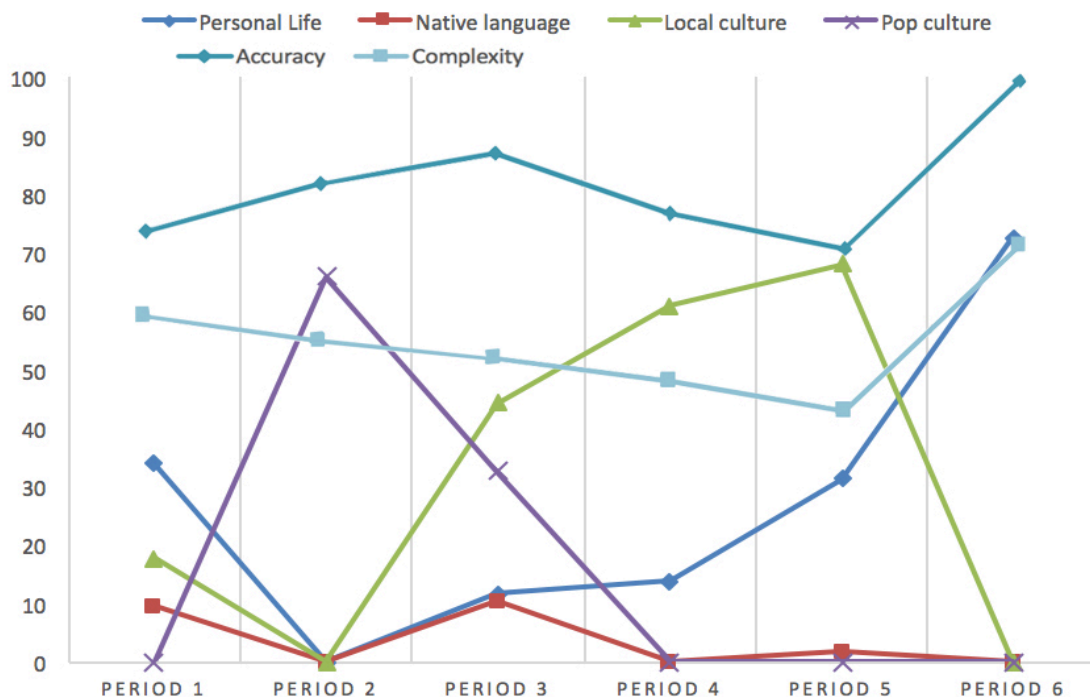


Michelle's trajectory of article use accuracy seldom fluctuated compared to Belinda, who experienced a relatively higher degree of variation. This result was not at all surprising, given Michelle's NS status; hence, less variability in article usage was to be expected. In contrast, Belinda's accuracy of article use evolved in a more dynamic manner, beginning with an initial incline during Period 1 to 3, a decline during Period 3 to 5, and ending with a score of 100% accuracy by Period 6. However, it is worth noting that Belinda's article accuracy trajectory fell within a 72% to 100% accuracy range, suggesting only a moderate level of variability compared to, say, a beginner of English. Since Belinda is an advanced NNS and English major at her university, such a range of variability was expected.

In terms of lexical complexity, results from the TTR analysis seemed to suggest a greater amount of fluctuation in Michelle's vocabulary use. On the other hand, Belinda's lexical complexity showed less variability from Period 1 to 5 as it underwent a steep decline. Interestingly, the correlation coefficient between Belinda's lexical complexity and article use accuracy was calculated to be .79, suggesting a relatively high positive correlation. In comparison, the correlation between Michelle's complexity and accuracy appeared slightly lower ($r=.69$), though still indicating a positive relationship. The high positive correlation between complexity and accuracy for Belinda ($r=.79$) was somewhat expected given her status as an advanced English learner and English major at her university. Although it was unclear as to why Michelle's correlation coefficient appeared slightly lower than Belinda's, from a CDST perspective, a positive correlation between two subsystems would indicate that they are connected growers as opposed to competing for resources (De Bot et al., 2007).

Having determined the interactions between complexity and accuracy in Belinda's L2 writing development, the results were then mapped out against the findings generated from the micro-level WTC analysis (Figure 6).

FIGURE 6
Belinda's complexity and accuracy measures in relation to WTC ratio



Looking at Period 5 specifically, a concomitant loss in accuracy and complexity occurred despite Belinda's rising WTC ratio of local culture topics. In fact, the connected growers began to show signs of regression as early as back in Period 3, during which Belinda also showed a high WTC ratio of topics related to local culture. Taken from there, the joint regression lasted all the way to Period 5 before they finally began to incline. Such results seem to imply that Belinda's complexity and accuracy were negatively influenced by the topic under discussion in Period 5. In other words, despite her high WTC ratio of local culture topics in Period 5, she employed articles least accurately and used the least complex vocabulary. However, as the topics shifted away from local culture back to personal life from Period 5 to Period 6, her complexity and accuracy also rose concurrently.

In brief, results from this analysis show that Belinda's complexity and accuracy subsystems worked in tandem as connected growers. Furthermore, their conjoined regression and progression might have been influenced by a change in her WTC ratio of certain topics. While results from this analysis provided us descriptive details as to how Belinda's complexity and accuracy evolved over time, the exact manner in which she used the target forms to convey her intended meaning remains unclear.

Functional analysis

A form-function analysis was conducted to see how Belinda used definite article *the* and indefinite article *a/an* to convey her intended meaning. As a point of reference, Michelle's article usage was also analyzed following the same procedure. The results are presented in Table 5. The four types of NPs based on Bickerton's (1975) 'semantic wheel' are shown in the far left column; while, the vertical axis represents their use of *the*, *a/an*, and zero article \emptyset from Period 1 to 6.

TABLE 5
Michelle's and Belinda's form-function mappings for article usage

Michelle	Period 1			Period 2			Period 3			Period 4			Period 5			Period 6		
(+S/+H)	1			5			16			19			21	2		1		
(-S/+H)		4	1	2	6	5		4	6		3	14	1	6	18		1	1
(-S/-H)			5		1	3		3	7		4	6		4	6			
(+S/-H)		1			4	6		2	3		4	9		6	3			
	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅
Belinda	Period 1			Period 2			Period 3			Period 4			Period 5			Period 6		
(+S/+H)	1			15	1	4	2	15	5	39	14	1	1					
(-S/+H)		4	4	1	1	2	7	12	1	3	7	4						
(-S/-H)		1			5	1	9		7		4							
(+S/-H)		1		1	6	9	3		6	7	5	9	2					
	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅	<i>the</i>	<i>a</i>	∅

As seen in Table 5, both Michelle and Belinda marked +Specific/+Hearer NPs most frequently with *the*, an environment in which only the definite article is permitted in Standard English. As an NS, Michelle's distribution in this environment only showed a minuscule amount of change (Period 5). Such results echo the findings reported from the previous complexity and accuracy analysis (Table 4). In contrast, Belinda's use of *the* displayed a higher degree of variability throughout the observation. In Period 2, for example, 15 out of 16 (about 94%) NPs were marked with *the* whereas only one was left unmarked. Moving further down the vertical axis, her percentage of using *the* to mark +Specific/+Hearer NPs seemed to evolve in a zigzag fashion (e.g., a drop to 67% in Period 3, an increase to 75% in Period 4, etc.). Such results seem to indicate that although Belinda initially used *the* in a target-like way (Period 1 to 2), in the later stages (Period 3 to 6) she began to display variability in article usage.

In terms of their frequency of use, it can be seen that Michelle's usage of *the* to mark +Specific/+Hearer NPs increased at a steady pace whereas Belinda's patterning was less predictable. However, this could perhaps be explained by her handling of topics. Recall the results presented in the micro-level WTC analysis (Figure 3), which showed that Belinda obtained a high WTC ratio of pop culture topics in Period 2, and local culture in Periods 3 and 5. Because these topics required some level of shared knowledge and content specificity, it was not surprising to see a higher frequency of definite article use during these periods.

Focusing on Belinda's omission of article usage, this paper now turns to her first email message in Period 5, in which multiple instances of omission are evident. In this exchange, Belinda was explaining the rules and characters of a game she played with her friends to Michelle. Examples (1) to (3) occurred after she had introduced the characters: a judge, a killer, a murderer, a police, and two citizens.

(1) *First, the judge says: 'it's dark now; all close your eyes please.' All do what the judge says.*

(2) *Then, Judge says: 'ok, police, open your eyes please.' Police opens his/her eyes and motion the judge who he/she believes is the killer.*

(3) *Then Judge nods or shakes his/her head (just one chance).*

In example (1), her use of *the* to mark +Specific/+Hearer NPs phrases was accurate since all the characters had already been introduced. However, a closer examination of these examples shows that her use of the definite article *the* occurred mostly when 'judge' was placed in the object position of the sentence. This could be easily interpreted as a negative transfer from her L1, but the fact that she had used it in example (1) may lead to a different interpretation.

Specifically, in examples (2) and (3), notice that the initial letter of ‘judge’ was capitalized when placed in the subject position, but it wasn’t when it appeared in the object position. In other words, Belinda had mostly omitted definite article in instances when ‘judge’ was treated as a proper noun. Although in English, the word ‘judge’ is only a proper noun when followed by a specific name (e.g., *Judge Anderson*), her omission of *the* before what she deemed as a proper noun may seem to imply that she was testing out a new hypothesis about the article system.

With regards to her form-function mappings of the indefinite articles, Belinda seemed to avoid marking -Specific/-Hearer NPs with *a*. Of the six cases of NPs in scope of negation from Period 2 through 5, there was only one instance in which she used *a* to realize this function (Period 3) while the rest were unmarked. Further investigation into the data revealed something interesting, that Belinda showed a strong preference in using ‘no’ over ‘not’ when marking negation in her writing. Examples from Period 3 and 5 are presented as follows:

(4) *there is no certain kind of music I am obsessed with.*

(5) *we have no game like Chalupa or Bingo.*

Rather than stating “*there is not a certain kind of music I am obsessed with*”, and “*we don’t have a game like Chalupa or Bing*,” Belinda seemed to have purposely avoided marking NPs that would indicate negation with *not*. While these examples are all grammatically correct, there is indeed a stronger sense of formality embedded in the use of *no* given its historical background, i.e., *not-negation* had only begun to replace *no-negation* in Early Modern English (Van Ostade, Tottie & Van der Wurff, 1998). Although it cannot be definitively concluded whether such avoidance was caused by her intention to sound more formal in her writing, or by her weak form-function mappings of indefinite article, results generated by the form-function analysis seem to suggest that Belinda had distributed more energy to testing out her hypothesis about the usage of the definite article *the* than the indefinite article *a*.

DISCUSSION AND CONCLUSION

The present study has attempted to examine the dynamism of WTC in written communication from a CDST perspective. Adopting an inductive approach to analyzing the data, the findings from this study suggest that WTC in written exchanges also reflects the behavior of a dynamic system. In accordance with the findings of MacIntyre and Legatto (2011) and Cao (2013), this study has found that topics had a direct impact on the interlocutors’ WTC. As seen in the WTC analysis, Michelle’s and Belinda’s WTC fluctuated as a result of topic shift, a process that had naturally occurred during their interactions. In Period 4, for example, the micro-level analysis shows that Michelle’s sudden fluctuations were influenced by her high WTC ratio of local culture topics. Given the motive behind their exchange, it is not surprising to find that both interlocutors obtained the highest WTC ratio of local culture topics—the theme behind this project. Moreover, Belinda showed a similar amount of WTC ratio for pop culture topics, which might have been considered as less threatening and more interesting to her. Together, Michelle and Belinda, whether consciously or not, used it as a channel before moving onto the more important topics. Perhaps a more interesting finding was that both interlocutors’ WTC ratio of personal life topics entered an attractor state from Period 2 to 5, and a repeller state in Periods 1 and 6. On the other hand, their WTC ratio of local culture topics seemed to somewhat remain consistently high from Period 3 to 5. This may indicate that personal life topics lead to low WTC while local culture topics lead to high WTC. Furthermore, despite a high degree of variability throughout both interlocutors’ WTC trajectories, the correlation coefficient ($r=.93$) from the macro-level analysis suggest that they shared a corresponding level of WTC throughout their exchange.

Therefore, it might be concluded that they were successful in meeting the objectives of their intercultural communication project.

This study has also attempted to examine the interactions between Belinda's lexical complexity and article accuracy. In accordance with the central tenets of CDST, results from the TLU analysis revealed a greater degree of fluctuation in the NNS's IL development than the NS's article usage. As an advanced English learner, Belinda's article use accuracy fluctuated within a range of 72% to 100%, a result that was expected and preferred. However, less variability was observed in her lexical complexity as the trajectory decreased in a rather linear manner (e.g., Period 1 through 5). Although the analysis was limited in terms of providing an account for such phenomenon, both interlocutors' complexity and accuracy measures were found to form a positive correlation ($r=.69$ for Michelle and $r=.79$ for Belinda). This implies that the two subsystems were supporting each other's growth as connected growers rather than competing against one another over resources. Although as connected growers, Belinda's complexity and accuracy trajectories simultaneously declined from Period 3 to Period 5. After drawing a comparison to the findings from micro-level WTC analysis, such joint regression may be attributed to the topics under discussion, during which Belinda showed a high WTC ratio of local culture. This seems to imply that topics related to local culture generated a negative impact on Belinda's writing performances. Contrary to the traditional beliefs, the findings in this study seem to suggest that higher WTC does not necessarily guarantee better performances, at least not for Belinda.

As for the functional analysis, in contrast to the findings reported in Huebner's (1979) study, results from this study showed that although Belinda used the definite article in a target-like way at first, there were prominent signs of progression and regression throughout her developmental trajectory. A closer look at the data revealed that she might be testing out new hypotheses of article usage during these stages. Particularly, Belinda showed a great degree of variation in her use of *the* to mark +Specific/+Hearer NPs as she supplied it before the word *judge*, and omitted it when it becomes a proper noun. Furthermore, there is strong evidence to show a tendency toward avoidance when using the indefinite article *a* in marking NPs in scope of negation. However, the motivation behind such a phenomenon remains somewhat ambiguous. Similar to the results generated by the TLU analysis, the form-function analysis shows that Belinda's form-function mappings of the article system also evolved in a dynamic manner. However, it is the form-function analysis that provides a window into Belinda's form-function mappings and how these varied because of her hypothesis-testing toward the TL use.

There are, however, several limitations to this study. First and foremost, although the current study has shown that WTC in written communication may be observed indirectly through an inductive approach, it is important to note that WTC is a psychological construct (MacIntyre, 2007), and thus it may still be more precisely captured through, or in tandem with, a form of direct measures (e.g., self-reports or interviews). Another alternative approach may be to develop WTC coding schemes (c.f., Ciriani Dean, 2017). Second, no clear conclusion can be drawn regarding Belinda's lexical complexity development. As Ellis and Barkhuizen (2005) noted, TTR could very much be influenced by the length of the text. As an alternative to TTR, *Mean Segmental Type-Token Ratio* (MSTTR) appears as a more suitable choice since the mean score of each segment is taken into account. On this note, it is hoped that future studies may continue to explore dynamism within WTC in written communication and generate more in-depth insights into the dynamic interactions between WTC and L2 writing development.

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