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Variability in L2 Written Performance Across Email Interaction: A Longitudinal Case Study

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Abstract
Second language development is increasingly understood as a dynamic process characterized by variability rather than steady, linear progression. Drawing on a complex dynamic systems perspective, this longitudinal case study examined written English produced by a university EFL learner during sustained email interaction with a native English-speaking interlocutor. The dataset consisted of 21 emails exchanged over approximately six weeks as part of an international cultural exchange. Three complementary analyses examined target-like use of English prepositions, form–function mappings of the preposition in, and functional density at the discourse level. The learner demonstrated relatively high overall prepositional accuracy (89.9%), although performance fluctuated across individual emails and accuracy for in was lower (77.8%). Form–function analysis showed that the learner's use of in was concentrated primarily in relatively concrete functions, whereas the interlocutor used a broader functional range. Functional density also varied across the learner's messages. These findings illustrate how aggregate measures can obscure variability across repeated performances and suggest that multiple writing samples may provide a more nuanced picture of learner language than single-point assessments. The study highlights the value of examining variability when interpreting L2 written performance.

Keywords: complex dynamic systems theory; email interaction; L2 writing; prepositions; variability

1. Introduction

Second language (L2) development is a gradual and complex process in which learners' linguistic performance may vary considerably over time. Although improvement is often represented as movement toward increasingly accurate and complex language use, development

does not necessarily proceed in a steady or linear manner. Learners may demonstrate greater control of a linguistic feature at one point but less consistent performance at another, and periods of apparent stability may be followed by substantial fluctuation. Such variability is particularly relevant to the study of learner writing, where repeated samples can reveal developmental patterns that may remain invisible when performance is examined at only one or two points in time.

Complex dynamic systems theory (CDST) provides a useful framework for understanding this variability in L2 development. From a dynamic perspective, language development emerges through the interaction of multiple interconnected linguistic and contextual factors rather than through the uniform accumulation of linguistic knowledge (de Bot et al., 2005; Larsen-Freeman, 2006; Larsen-Freeman & Cameron, 2008; Verspoor et al., 2008). Variability is therefore not simply measurement error or random noise. Instead, fluctuations in learner performance may provide information about the developmental process itself as learners repeatedly use and reorganize their linguistic resources. This perspective has encouraged researchers to examine language development longitudinally and to attend more closely to intra-individual variation rather than relying exclusively on group averages or pretest–posttest comparisons.

Written interaction provides a potentially useful context for examining such variability. Sustained written exchanges involve repeated language use within an ongoing communicative relationship, requiring participants to draw on their linguistic resources to express meanings, respond to previous messages, and maintain interaction. Email communication is particularly useful in this respect because it produces a chronologically ordered series of written texts that can be examined across time. In structured intercultural exchanges, such correspondence can also provide repeated samples of learner production across changing communicative topics. Examining these exchanges can therefore offer a window into both the stability and variability of learner language across successive performances.

One linguistic domain in which such variability can be observed is English preposition use. Prepositions present persistent challenges for L2 learners because relationships between form and meaning are not always transparent or one-to-one. A single preposition can realize multiple spatial, temporal, and abstract functions, while similar meanings may be expressed through different forms. Overall accuracy alone may therefore provide an incomplete picture of development. Examining both target-like use and the functions associated with particular forms can provide a more detailed account of how learners deploy their linguistic resources over time. More general measures of written production can complement this analysis by showing whether changes in particular linguistic features occur alongside changes in the density of information expressed in learners' writing.

Although previous research has examined L2 writing development in asynchronous email exchanges and investigated the acquisition and functional use of English prepositions, these strands of research have largely addressed different aspects of written performance. Less is known about how overall grammatical accuracy, the functional distribution of an individual preposition, and broader discourse-level measures vary together across successive messages produced by the same learner. Examining these dimensions within a sustained email exchange may therefore provide a more differentiated account of L2 written performance, while also allowing for alternative explanations related to changing topics, communicative demands, and opportunities for particular forms to occur.

The present study addresses this issue by examining the written English produced during approximately six weeks of sustained email interaction between a university EFL learner and a native English-speaking interlocutor. Rather than treating development solely as a linear increase in accuracy or complexity, the study focuses on patterns of stability and variability across repeated

written production. Three complementary dimensions are examined: target-like use of English prepositions, form–function mappings associated with the preposition *in*, and functional density across messages. By bringing these analyses together, the study explores how different dimensions of learner language behave over time and considers what such variability can reveal about L2 development in written interaction. Given the relatively short observation period and the absence of baseline data preceding the exchange, the study does not attempt to establish acquisition or developmental causality. Instead, it uses a CDST-informed perspective to examine patterns of stability and variability across repeated learner production. In doing so, the study aims to contribute to a more process-oriented understanding of learner writing and to illustrate the value of repeated written production for teachers and researchers seeking to understand development beyond single-point assessments.

The following research questions guide the study:

1. How does the learner's target-like use of English prepositions vary across the email interaction?
2. What patterns of variability are observed in the learner's form–function mappings of the preposition *in* across the email interaction, and how do these patterns compare with those of the native English-speaking interlocutor?
3. How does the learner's functional density vary across the email interaction, and how does this pattern compare with that of the native English-speaking interlocutor?

2. Literature Review

2.1 Complex Dynamic Systems Theory and L2 Development

Complex dynamic systems theory (CDST) conceptualizes second language (L2) development as a dynamic process emerging from interactions among multiple interconnected components. Rather than viewing language development as the gradual and uniform accumulation of discrete linguistic forms, CDST emphasizes change, interaction, self-organization, and nonlinearity (de Bot et al., 2005; Larsen-Freeman, 2006; Larsen-Freeman & Cameron, 2008). Learner language is understood as a developing system that continually responds to both learner-internal and learner-external conditions. Consequently, development may involve periods of relative stability as well as substantial fluctuation rather than following a consistently linear trajectory.

Variability is therefore a central characteristic of L2 development from a CDST perspective. Fluctuations in learner performance are not necessarily treated as random error or irrelevant inconsistency; instead, they may reflect the dynamic nature of the developing language system (Larsen-Freeman & Cameron, 2008; Verspoor et al., 2008). A learner may demonstrate relatively stable performance at one point, greater variability at another, or different developmental patterns across linguistic dimensions. Even during periods of relative stability, some degree of variability can remain within the system.

This perspective has important methodological implications for the investigation of learner language. Cross-sectional comparisons and pretest–posttest designs can reveal differences between learners or between selected measurement points, but they provide limited information about fluctuations occurring between those points. CDST-oriented research has consequently placed particular emphasis on longitudinal observations and repeated measurements of individual learners. Recent reviews have reinforced this process-oriented emphasis while also highlighting the methodological diversity of CDST research in language development (Hiver et al., 2022). More specifically, Fogal's (2022) review of CDST-informed L2 writing research shows that longitudinal approaches have increasingly been used to examine how multiple dimensions of written

performance develop and interact over time. Studies examining complexity and accuracy over time have demonstrated that different dimensions of learner performance can follow different and nonlinear trajectories (Larsen-Freeman, 2006; Polat & Kim, 2014; Spoelman & Verspoor, 2010; Yu & Lowie, 2020). Such findings suggest that repeated observations can provide information about learner performance that may be obscured when development is represented only through aggregate scores or beginning-to-end differences.

Importantly, measures such as complexity and accuracy should not themselves be equated with underlying linguistic subsystems. Rather, they constitute observable manifestations of a developing system and provide different perspectives from which learner language can be examined. A systems-oriented approach therefore benefits from considering multiple dimensions of performance rather than relying on a single indicator of development. In the present study, this principle is applied through complementary analyses of grammatical accuracy, form–function mappings, and functional density in repeated written production.

2.2 Variability in L2 Written Performance

Written production provides a useful context for investigating variability because successive texts preserve observable records of learners' language use. When writing samples are collected repeatedly, they can be examined not simply as independent products but as multiple observations of learner performance over time. This perspective is consistent with the argument that multiple sources and occasions of performance data can provide a more complete picture of what a learner is able to do (Ellis & Barkhuizen, 2005).

Longitudinal research has shown that learner performance can fluctuate considerably even when broader measures suggest relative stability or improvement. Earlier case studies demonstrated dynamic patterns in the development of complexity and accuracy within individual learners (Polat & Kim, 2014; Spoelman & Verspoor, 2010; Yu & Lowie, 2020), while more recent research has extended this perspective to a wider range of L2 writing contexts and linguistic dimensions. Longitudinal classroom research has identified distinct writing-development trajectories among learners completing repeated writing tasks, illustrating that learners exposed to similar instructional conditions may nevertheless follow substantially different developmental paths (Baba & Nitta, 2021). Research on formulaic sequences has similarly demonstrated nonlinear longitudinal patterns in L2 academic writing (Duan & Shi, 2024). More recent work on written syntactic complexity has further shown how broader developmental patterns can emerge from variable local-level dynamics over time (Li & Zheng, 2025). Collectively, these studies reinforce the value of examining intra-individual and longitudinal variation rather than assuming that L2 writing development should appear as steady improvement across successive performances. From a complementary cross-sectional perspective, Li (2025) examined the frequency and structural distribution of who relative clauses in TOEFL essays and identified differences in the use of these constructions across proficiency levels. Such findings further illustrate the importance of examining individual grammatical constructions rather than relying exclusively on broad measures of written performance.

This issue is particularly relevant when interpreting grammatical accuracy. Aggregate accuracy scores can summarize a learner's overall performance but may conceal substantial variation across individual writing samples or linguistic forms. A learner may, for example, demonstrate relatively high accuracy for a grammatical category overall while showing less stable control of a particular form within that category. Examining both aggregate performance and individual instances can therefore reveal patterns that would be difficult to identify from a single overall score.

Sustained written interaction offers an additional context in which such variability can be observed. Unlike isolated writing tasks, an ongoing exchange requires participants to repeatedly mobilize their linguistic resources for communicative purposes while responding to changing topics and previous messages. Email correspondence also provides a chronologically ordered series of texts through which patterns of stability and fluctuation can be traced. Such data cannot, by themselves, establish that observed changes constitute acquisition or that an interlocutor caused changes in learner performance. They can, however, provide repeated observations of how linguistic resources are deployed within an evolving communicative context.

2.3 Asynchronous Email Interaction and L2 Written Performance

Asynchronous computer-mediated communication (CMC), particularly email exchange, provides L2 learners with opportunities to engage in sustained written interaction beyond the classroom. Unlike synchronous communication, asynchronous interaction allows learners additional time to plan, formulate, and revise their responses before sending them. Sotillo (2000), for example, compared synchronous and asynchronous discussions among ESL learners and found that the delayed nature of asynchronous communication offered greater opportunities for syntactically complex language production. Beyond linguistic production, email exchanges also create opportunities for meaningful interaction with geographically distant interlocutors. O'Dowd (2003), in a study of a Spanish–English email exchange, demonstrated how the development of intercultural understanding depended on the characteristics of the interaction and the relationships established between participants. These studies suggest that asynchronous exchanges provide a distinctive context in which learners' written language use can be examined in relation to ongoing communication.

Research has also investigated changes in L2 written performance across extended email exchanges. Schenker (2016) examined syntactic complexity in a twelve-week cross-cultural email exchange involving American learners of German and found significant increases in measures of global and subordination complexity in later emails. The qualitative findings further highlighted the potential importance of authentic audiences, feedback requests, and the interpersonal relationships developed through the exchange. Such findings suggest that learners' written performance may change over the course of sustained communication. However, changes in syntactic complexity do not necessarily indicate corresponding changes in grammatical accuracy or the functional use of individual linguistic forms. Examining these dimensions separately may therefore provide a more differentiated account of L2 written performance.

More recently, Kim and Choi (2025) investigated the functional development of English *of*-phrases in Korean EFL learners' written interactions with L1 English speakers. Their analysis across three stages of a virtual intercultural exchange suggested that learners' prepositional choices reflected both reliance on familiar constructions and increasing sensitivity to discourse contexts. This study highlights the value of examining prepositions not only in terms of grammatical correctness but also in relation to the meanings and communicative functions they express. Nevertheless, further research is needed to understand how prepositional accuracy and form–function relationships vary across individual messages within ongoing email interaction. From a complex dynamic systems perspective, such message-level analysis may help identify patterns of stability and fluctuation while also considering the potential influence of changing topics, communicative demands, and opportunities for particular forms to occur. The present study addresses this issue by examining prepositional accuracy, the functional uses of *in*, and functional density across a longitudinal email exchange.

2.4 Prepositional Accuracy and Form–Function Relationships

English prepositions provide a useful linguistic domain for examining the distinction between overall accuracy and more localized patterns of language use. Prepositions are widely recognized as challenging for L2 learners because their use involves relationships between linguistic form, meaning, and context (Bitchener et al., 2005; Celce-Murcia & Larsen-Freeman, 1999). Their polysemous nature further complicates acquisition because a single preposition may express multiple spatial, temporal, and abstract relationships (Taylor, 2011). Examining prepositions therefore provides an opportunity to consider not only whether learners select target-like forms but also the range of meanings for which those forms are used. Prepositions have also been examined as target grammatical structures in task-based language learning research. For instance, Li (2023) synthesized empirical findings concerning the acquisition of English prepositions alongside other morphosyntactic features, highlighting the relevance of task characteristics to grammatical development.

One approach to grammatical accuracy is target-like use (TLU), which evaluates learners' production in relation to the obligatory contexts they create while also accounting for oversuppliance in non-obligatory contexts (Pica, 1983). TLU can provide an overall indication of a learner's control of a grammatical feature across production. Nevertheless, an aggregate TLU score does not necessarily indicate that every form within a grammatical category is used with the same degree of stability. Examining an individual preposition alongside overall prepositional accuracy can therefore provide a more fine-grained perspective on learner performance.

The preposition in is particularly suitable for such an analysis because its functions extend beyond its prototypical spatial meaning. At its most concrete level, in expresses enclosure within physical space. This spatial relationship can be extended to increasingly abstract domains, including temporal spans, states, areas or fields, manner or means, circumstances, and causes (Celce-Murcia & Larsen-Freeman, 1999; Dirven, 2011). These functions can be conceptualized along a continuum from relatively concrete to relatively abstract meanings. The original framework used in this study distinguishes seven functions—spatial enclosure, time-span, state as enclosure, area, manner/means, circumstance, and cause.

An additional challenge in the acquisition of English prepositions lies in their polysemy, as a single prepositional form can express multiple, related meanings depending on its linguistic and communicative context. Boers and Demecheleer (1998) argued that the figurative meanings of prepositions can be understood through their relationships with more concrete spatial meanings, highlighting the importance of semantic connections in understanding prepositional use. Similarly, Tyler and Evans (2003) proposed that the multiple senses of English spatial prepositions are systematically related through conceptual processes grounded in spatial experience. Lindstromberg (2010) further illustrated how the meanings of common prepositions, including *in*, *on*, and *at*, vary across contexts and constructions. Together, these accounts suggest that examining prepositions solely in terms of target-like accuracy may overlook meaningful differences in how learners use individual forms to express different functions. A form–function perspective can therefore complement accuracy-based analysis by examining the range and distribution of meanings associated with a particular preposition.

Empirical studies have further demonstrated the challenges associated with L2 preposition use. Jiménez Catalán (1996), in an analysis of English compositions written by Spanish secondary school students, found that preposition substitution errors were more frequent than omissions or additions, with error patterns varying across linguistic contexts. Similarly, Back (2011) examined spoken and written learner corpora from 134 Korean university students and identified both cross-

linguistic influence and confusion within the English prepositional system as potential sources of errors. Focusing on learners' semantic knowledge, Mueller (2011) investigated how advanced L2 English learners from Chinese, Korean, and Spanish backgrounds used collocational information when interpreting prepositions, highlighting the importance of distinguishing familiarity with word combinations from knowledge of prepositional meanings. In a longitudinal case study, Sudhakaran (2015) examined seven Malaysian learners' written preposition use over three years and reported improvements alongside persistent errors. Together, these findings indicate that prepositional performance is shaped by linguistic context, semantic knowledge, and learner experience. They also suggest the value of examining accuracy and functional use across repeated writing samples rather than relying exclusively on aggregated error frequencies.

Taken together, these studies highlight the importance of considering both grammatical accuracy and the functional range of individual prepositions when examining L2 written performance. However, relatively little attention has been given to how these dimensions fluctuate across successive messages in sustained interpersonal communication. Examining both target-like use and form–function distributions across repeated writing samples may therefore provide a more differentiated account of L2 written performance, particularly within the context of asynchronous email interaction.

2.5 Thought Complexity and Functional Density

A further perspective on variability in written production concerns thought complexity. Han and Kang (2018) distinguish between thought breadth and thought depth and propose lexical and functional density as corresponding linguistic indices. Lexical density, based on the relative presence of content words, is associated with thought breadth, whereas functional density, reflecting the relative presence of function words, is associated with thought depth. From this perspective, examining the balance between content and function words can provide an additional way of characterizing variation across learner production. The original study therefore used functional density at the discourse level as its third analytical perspective.

Functional density is particularly relevant to the present study because it captures a dimension of written performance distinct from grammatical accuracy and the functional range of a specific linguistic form. Whereas TLU evaluates the target-likeness of preposition use and form–function analysis examines the meanings associated with in, functional density provides a broader descriptive measure at the level of the complete email. Examining these measures together is consistent with a systems-oriented approach in which no single measure is assumed to provide a complete representation of learner language.

However, interpreting thought complexity through linguistic production requires caution, particularly for L2 learners. Han and Kang (2018) argue that the relationship between conceptual and linguistic complexity may be nonlinear for L2 users because proficiency can constrain their ability to linguistically express conceptually complex meanings. A learner may possess a complex idea without having sufficient linguistic resources to encode it in correspondingly complex language. The original study similarly recognized this limitation and cautioned that functional-density findings are necessarily influenced by the learner's linguistic proficiency. Functional density should therefore not be interpreted as a direct measure of cognitive complexity. In the present study, it is used more cautiously as a descriptive index for examining fluctuations across successive written performances.

2.6 The Present Study

Taken together, a CDST-informed perspective suggests that understanding L2 development requires attention to variability across repeated individual performances and to multiple dimensions of language use. Aggregate measures can provide useful summaries of learner performance, but

they may obscure fluctuations across occasions or differences among individual linguistic forms. Similarly, examining one dimension of production alone may provide only a partial representation of a learner's developing linguistic system.

The present study brings together three complementary analytical perspectives—prepositional accuracy, form–function mappings, and functional density—to examine written English produced by a university EFL learner during sustained email interaction with a native English-speaking interlocutor. This combination makes it possible to consider whether relatively stable performance at one level coexists with greater variability at another and whether different dimensions of written production display similar or different patterns across successive messages.

The study adopts CDST as a conceptual lens rather than claiming to provide a comprehensive dynamic-systems analysis. The dataset covers approximately six weeks and provides no independent baseline measure of the learner's pre-exchange linguistic abilities; accordingly, it cannot establish whether particular fluctuations constitute acquisition or whether specific features emerged during the correspondence. This limitation was also recognized in the original analysis, which emphasized the need for caution when making developmental claims from the available data. Instead, the study examines what repeated observations can reveal about stability and variability in L2 written performance and considers the value of looking beyond single-point or aggregate measures when interpreting learner language.

3. Research Method

3.1 Participants and Data

The dataset consisted of a series of emails exchanged between two university students participating in an intercultural email exchange project during the spring 2011 semester. The project was designed to facilitate intercultural communication through sustained correspondence between students at different universities. Participants were expected to communicate regularly over approximately five to seven weeks.

Peko (pseudonym) was a Chinese university student majoring in English as a foreign language. She began learning English in primary school and had studied English for at least ten years by the time of the email exchange. She had passed the College English Test Band 6 (CET-6), indicating a relatively high level of English proficiency in the Chinese university context. Research aligning CET scores with international proficiency standards has associated CET-6 scores of 438 or above with the minimum requirements for CEFR B2 (Jin et al., 2022). Although her exact CET-6 score was unavailable, her examination background provided an approximate indication of her English proficiency. Her correspondence also indicated that she was preparing to pursue graduate study in translation and interpreting.

Felipe (pseudonym) was a university student in the United States who identified himself as a senior and reported balancing his studies with employment. He was understood to be a native English speaker in the original analysis. The available records did not provide his exact age or further details about his educational background.

Although the participants' exact ages were unavailable, Peko's educational background, English-learning history, and CET-6 qualification provided contextual information about her language proficiency. More detailed language-learning histories and independently verified proficiency measures were not available.

The correspondence took place over approximately six weeks and comprised 21 emails: 10 written by Peko and 11 by Felipe. Felipe initiated the correspondence, resulting in one initial

message preceding the first reciprocal exchange. The participants discussed a range of topics related to their experiences and cultural differences, including standards of beauty, campus life, physical fitness and sports requirements, future employment, and travel experiences. The emails therefore provided repeated samples of written production within an ongoing communicative interaction.

3.2 Target-Like Use of Prepositions

Prepositional accuracy was examined using target-like use (TLU), which takes into account obligatory contexts, correct suppliance, and oversuppliance. TLU was calculated following Pica (1983):

TLU = number of correct suppliances in obligatory contexts / (number of obligatory contexts + number of suppliances in non-obligatory contexts) × 100

The data were first coded to identify instances of preposition use, using the inventory provided by Saint-Dizier (2006) as a guide. Each occurrence was examined within its linguistic context to determine whether it functioned as a preposition. Items functioning as adverbs or as components of phrasal verbs and idiomatic expressions were excluded from the analysis. The emails were then examined to identify obligatory contexts for preposition use and to determine whether the supplied form was appropriate to the intended meaning and grammatical construction. A strict criterion for target-like use was applied, such that contextually dispreferred prepositions were coded as non-target-like.

The analysis distinguished between incorrect preposition selection and oversuppliance. At the level of the overall preposition category, using an inappropriate preposition where another preposition was required was treated as an incorrect selection within an obligatory context. Oversuppliance at this level referred to the insertion of a preposition where no preposition was required. In the form-specific analysis of *in*, however, the use of *in* where another preposition was required was classified as form-specific oversuppliance. This distinction allowed overall prepositional accuracy and accuracy for the individual form *in* to be examined separately.

Two researchers initially coded the data independently. Inter-rater agreement was 98%. All disagreements were subsequently discussed and resolved through examination of the functions of the relevant prepositions. Intra-rater agreement, assessed using the same coding procedure, was 100%.

TLU was calculated both for overall preposition use and separately for the preposition *in*, using the coding distinctions described above. The preposition *in* was selected for more focused analysis because it occurred relatively frequently in the correspondence and included non-target-like uses by both participants. Examining this form separately also allowed overall prepositional accuracy to be compared with performance on an individual preposition.

3.3 Form–Function Analysis of *in*

A form–function analysis was conducted to examine the range of meanings associated with participants' use of in. Each occurrence was first examined within its immediate linguistic context and assigned an appropriate definition using the *Oxford Advanced Learner's Dictionary* (10th ed.; Oxford University Press, 2020). These definitions were then mapped onto functional categories based on Dirven's (2011) classification and the account provided by Celce-Murcia and Larsen-Freeman (1999). The resulting functional classification was checked against the original context to ensure consistency between the assigned definition and function.

The functional categories represented a continuum from relatively concrete to increasingly abstract uses of in, including spatial enclosure, time-span, state as enclosure, area, manner/means,

circumstance, and cause. Comparing the distribution of these functions across the two participants provided a means of examining whether the learner's use was concentrated in relatively prototypical functions or extended to a broader range of form–function mappings.

3.4 Functional Density

The third analysis examined functional density at the discourse level, following Han and Kang (2018). Words in each email were classified as either content words (e.g., nouns, lexical verbs, adjectives, and adverbs) or function words (e.g., pronouns, articles, prepositions, and conjunctions). Functional density was calculated by dividing the number of function words by the total number of words in each email. This proportional measure allowed functional density to be compared across emails of different lengths.

Functional Density = Number of Function Words / Total Number of Words

Following Han and Kang (2018), functional density was examined as a linguistic index potentially associated with thought depth. However, because the relationship between linguistic production and conceptual complexity may be nonlinear for L2 learners, higher or lower functional-density values were not treated as direct evidence of differences in underlying thought complexity. Instead, functional density was used as a descriptive measure of variation across successive emails.

4. Results

4.1 Target-Like Use of Prepositions

The first analysis examined variability in the learner's target-like use (TLU) of English prepositions across the email exchange. Table 1 presents Peko's prepositional TLU for each of her 10 emails.

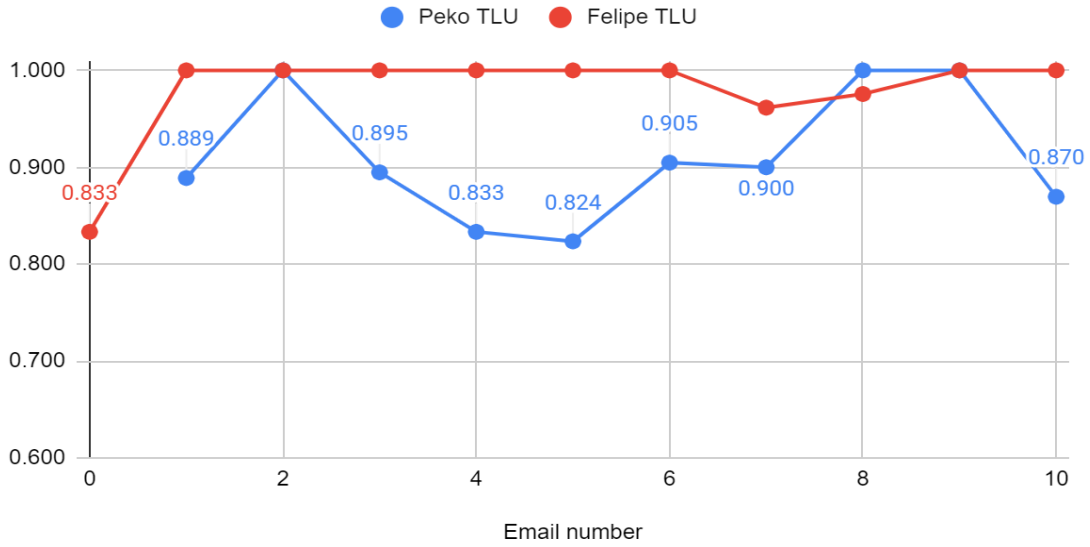
Across the 10 emails, Peko created 127 obligatory contexts for preposition use and supplied the target-like form in 116 of these contexts. Two additional instances of preposition use occurred in non-obligatory contexts. Her overall TLU was 89.9%. At the level of individual emails, TLU ranged from 82.4% to 100%, indicating variation across the correspondence. Peko achieved 100% TLU in Emails 2, 8, and 9, whereas the lowest value, 82.4%, occurred in Email 5. Non-target-like uses involved several prepositions, including *about, at, for, inside, of, to,* and *with.*

Table 1: *Peko's Target-Like Use of Prepositions by Email*

Email	Correct suppliance	Obligatory contexts	Category-level oversuppliance	TLU %
1	8	9	0	88.9
2	3	3	0	100.0
3	17	19	0	89.5
4	5	5	1	83.3
5	14	17	0	82.4
6	19	20	1	90.5
7	9	10	0	90.0
8	6	6	0	100.0
9	15	15	0	100.0
10	20	23	0	87.0
Overall	116	127	2	89.9

For comparison, Felipe created 242 obligatory contexts for preposition use, with 239 correct suppliances and no instances of category-level oversuppliance, resulting in an overall TLU of 98.8%. The three non-target-like instances involved the selection of an inappropriate preposition in contexts where a preposition was nevertheless required. These were therefore counted as incorrect selections rather than oversuppliance of the overall preposition category. His email-level TLU ranged from 83.3% in the initial message to 100% in most subsequent messages. The small number of non-target-like uses involved *in* and *for*.

Figure 1 presents the participants' prepositional TLU across the correspondence. Peko's performance showed greater fluctuation than Felipe's. Although several of Peko's later emails reached or exceeded 90% TLU, her final email decreased to 87.0%. Thus, the sequence did not show a consistently linear increase in prepositional accuracy.



Note. Email 0 represents Felipe's initial message, which preceded Peko's first reply.

Figure 1: *Target-Like Use of Prepositions Across the Email Exchange*

4.2 Target-Like Use of *in*

To examine whether overall prepositional accuracy was reflected in the use of a particular form, the analysis was narrowed to the preposition *in*. Table 2 summarizes the results.

Table 2*: Target-Like Use of* in *by Participant*

Participant	Correct suppliance	Obligatory contexts	Form-specific oversuppliance	Overall TLU (%)
Peko	14	16	2	77.8
Felipe	31	31	2	93.9

Peko created 16 obligatory contexts for *in* and supplied the target-like form in 14 of them, with two additional instances of oversuppliance. Her overall TLU for *in* was 77.8%, compared with 89.9% for prepositions overall. On individual occasions when *in* occurred, her TLU ranged from 50% to 100%. No instances of *in* occurred in Emails 2, 5, or 8.

Felipe produced 31 correct suppliances in 31 obligatory contexts for *in*, together with two instances of form-specific oversuppliance, resulting in a TLU of 93.9%. In these two instances, *in*

was selected where another preposition was considered more appropriate. Because a preposition was still required in each context, these occurrences were classified as incorrect preposition selections in the overall preposition analysis, but as oversuppliance of *in* in the form-specific analysis. This distinction explains why Felipe's overall preposition analysis reported no category-level oversuppliance, whereas the analysis of *in* identified two instances. His email-level performance was generally stable when *in* occurred, although the initial message and Email 7 contained oversuppliance.

Taken together, the TLU analyses showed different patterns depending on the level of analysis. Peko's overall prepositional accuracy was relatively high, but her accuracy for the individual preposition *in* was lower and showed greater fluctuation across occasions of use.

4.3 Form–Function Mappings of *in*

The second analysis examined the functions expressed through target-like uses of *in*. Table 3 presents the frequency and relative frequency of each functional category for Peko and Felipe.

Peko produced 14 target-like tokens of *in* across five of the seven functional categories. Her use was concentrated primarily in the two most concrete categories: time-span accounted for 50.0% (n = 7) and spatial enclosure for 21.4% (n = 3). Together, these categories accounted for 71.4% of her target-like uses of *in*. The remaining tokens represented area (14.3%), state as enclosure (7.1%), and manner/means (7.1%). No tokens were classified as circumstance or cause.

Felipe produced 31 target-like tokens distributed across all seven functional categories. Spatial enclosure was the most frequent category (38.7%, n = 12), followed by time-span (22.6%, n = 7) and circumstance (16.1%, n = 5). The remaining tokens occurred in state as enclosure, area, manner/means, and cause. His two most concrete categories, spatial enclosure and time-span, together accounted for 61.3% of his target-like uses.

Both participants therefore relied heavily on the relatively concrete functions of *in*. However, Peko's tokens were more concentrated in these functions, whereas Felipe's tokens were distributed across the full set of functional categories represented in the analytical framework.

Table 3: *Frequency and Relative Frequency of Functional Uses of* in *by Participant*

	Peko		Felipe	
Function	Frequency	Relative Frequency	Frequency	Relative Frequency
spatial enclosure	3	21.4%	12	38.7%
time-span	7	50.0%	7	22.6%
state as enclosure	1	7.1%	3	9.7%
area	2	14.3%	2	6.5%
manner, means	1	7.1%	1	3.2%
circumstance	0	0.0%	5	16.1%
cause	0	0.0%	1	3.2%
Total	14		31	

4.4 Functional Density

The third analysis examined functional density at the discourse level across the email correspondence. Figure 2 presents the functional-density values for Peko and Felipe by email.

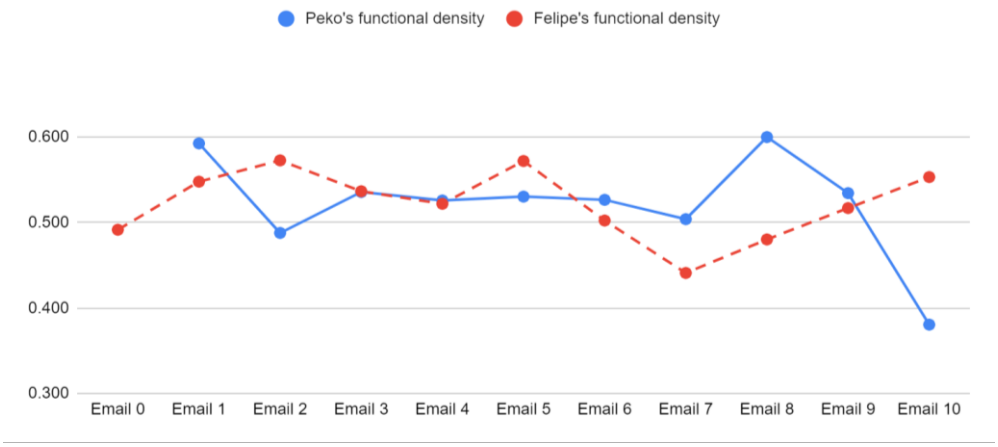


Figure 2: *Functional Density Across the Email Exchange*

Both participants displayed variation in functional density across their messages, although the extent of fluctuation differed. Peko showed a wider range of values and produced both the highest and lowest functional-density values observed across the correspondence. Her values were comparatively stable across several of the middle emails before showing greater fluctuation toward the end of the exchange. In particular, functional density increased to approximately .60 in Email 8 and subsequently decreased to approximately .38 in Email 10.

Felipe's functional-density values were comparatively more stable. Although his values also fluctuated across emails, most remained within a narrower range than Peko's. His lowest value occurred around Email 7, after which functional density increased across the remaining messages.

Under the framework proposed by Han and Kang (2018), higher functional density is potentially associated with greater thought depth, whereas lower functional density may be associated with greater thought breadth. However, these associations are interpreted cautiously in the present study, and the observed fluctuations are treated as descriptive differences in linguistic production rather than direct evidence of changes in thought complexity.

4.5 Summary of Findings

Across the three analyses, the learner's written production was characterized by both relative stability and variability. First, Peko demonstrated relatively high overall prepositional accuracy (89.9%), but her performance fluctuated across individual emails and her accuracy for *in* was lower (77.8%). Second, her target-like uses of *in* were concentrated primarily in relatively concrete functions, whereas Felipe's uses extended across all seven functional categories. Third, functional density fluctuated across Peko's emails, with greater variation than was observed in Felipe's correspondence.

Taken together, the results indicate that the characterization of learner performance depended partly on the level and measure examined: relatively high aggregate prepositional accuracy coexisted with lower accuracy for a particular form, a more restricted distribution of form–function mappings, and fluctuations in discourse-level functional density.

5. Discussion

The present study examined variability in a university EFL learner's written production across approximately six weeks of sustained email interaction. Drawing on a CDST-informed perspective, three complementary analyses were used to examine different dimensions of

performance: target-like use of prepositions, form–function mappings of *in*, and functional density. Across these analyses, relatively high aggregate performance coexisted with fluctuations across individual messages. This contrast highlights the value of examining repeated performances rather than relying exclusively on aggregate measures of learner language.

Importantly, the three dimensions examined did not necessarily exhibit identical patterns of stability and variation. From a CDST-informed perspective, this finding is consistent with the view that different dimensions of learner language may vary across repeated production (Larsen-Freeman & Cameron, 2008; Verspoor et al., 2008). However, the observed fluctuations should not be interpreted as direct evidence of dynamic restructuring or grammatical development. Changes in email topics, differences in the number and types of obligatory contexts, and variation in message length may also have contributed to the patterns observed. The contribution of the present analysis is therefore not to establish developmental causality, but to illustrate how examining multiple linguistic dimensions across repeated writing samples can reveal differences that may be obscured by aggregate accuracy measures.

5.1 Variability in Prepositional Accuracy

The first research question examined variability in the learner's target-like use of English prepositions. Although Peko demonstrated relatively high aggregate prepositional accuracy (89.9%), her performance was less consistent across individual emails, and her accuracy for *in* was lower (77.8%). This contrast illustrates an important methodological distinction: accuracy at the level of a broad grammatical category does not necessarily reflect performance on individual forms. An aggregate measure may therefore provide a useful summary of grammatical performance while concealing differences that become visible through more focused, repeated analyses.

Previous longitudinal studies have documented fluctuations in L2 linguistic performance rather than uniformly increasing trajectories (Polat & Kim, 2014; Spoelman & Verspoor, 2010; Yu & Lowie, 2020). The present findings are consistent with these observations but extend the discussion to the relationship between overall prepositional accuracy and form-specific performance during asynchronous written interaction. Research on L2 preposition use has also identified the influence of linguistic context, prepositional selection, and semantic knowledge on learner performance (Jiménez Catalán, 1996; Mueller, 2011). Viewed alongside these studies, the present results suggest that examining accuracy at multiple levels may be particularly informative when a grammatical category contains forms with different semantic and contextual requirements.

Nevertheless, the observed fluctuations require cautious interpretation. The number of obligatory contexts for *in* was relatively small, meaning that a single non-target-like occurrence could substantially affect the accuracy percentage for an individual email. Differences in topics and communicative demands may also have created unequal opportunities for particular prepositions to occur. Furthermore, the distinction between category-level and form-specific oversuppliance reflects the operational coding decisions adopted in this study. Consequently, the variation observed here cannot establish changes in the learner's underlying grammatical knowledge. Rather, it illustrates how conclusions about learner performance may depend on the linguistic unit examined, the available opportunities for use, and the measurement procedures employed.

5.2 Form–Function Range Beyond Accuracy

The second research question examined the form–function mappings associated with *in*. Although both participants used the preposition predominantly for spatial enclosure and time-span, their observed functional distributions differed. Peko produced target-like instances across five of the seven functional categories, whereas Felipe produced instances across all seven. This contrast

provides information beyond grammatical accuracy by illustrating how the same linguistic form can be used to express different ranges of meanings within a particular set of written interactions. Rather than treating target-like use as a complete representation of grammatical performance, the findings highlight the value of examining the semantic functions associated with individual forms.

This interpretation aligns with cognitive-semantic approaches to English prepositions, which emphasize systematic relationships among spatial and more abstract meanings (Boers & Demecheleer, 1998; Tyler & Evans, 2003; Lindstromberg, 2010). From this perspective, examining whether a preposition is used accurately provides only one dimension of its observed use; considering the meanings it expresses offers additional information about how that form functions in communication. The present analysis contributes to this discussion by illustrating how form–function distributions can be examined within repeated, naturally occurring written exchanges rather than solely through aggregate measures of prepositional accuracy.

Nevertheless, the differences between Peko and Felipe should not be interpreted as evidence that Peko had not acquired the functions absent from her emails or that the participants followed different developmental stages. The analysis included only 14 target-like instances of *in* for Peko and 31 for Felipe, and the topics and communicative purposes of the messages were not controlled. Consequently, the absence of circumstance and cause uses in Peko's writing may reflect limited opportunities or communicative need rather than gaps in her linguistic knowledge. Moreover, assigning instances of polysemous prepositions to functional categories involves interpretive coding decisions, particularly where meanings overlap. The observed distributions should therefore be understood as descriptions of the functions represented in this dataset, not as comprehensive assessments of either participant's semantic knowledge.

The correspondence also contained potentially relevant similarities in the participants' language use. For example, Peko produced a manner/means use of *in* after a related use appeared in Felipe's writing, and constructions involving *succeed in* followed by an *-ing* form occurred in both participants' messages. Such correspondences suggest that the interlocutor's language may be relevant to understanding the communicative context in which particular forms appear. However, temporal proximity and structural similarity alone cannot establish that Felipe's usage influenced Peko's subsequent production. Without more systematic evidence of interactional influence, these instances are best treated as descriptive observations rather than evidence of coadaptation or dynamic restructuring.

5.3 Variability in Functional Density

The third research question examined variation in functional density across the email exchange. Peko's functional-density values fluctuated across messages, including both the highest and lowest values observed in the dataset, whereas Felipe's values varied within a comparatively narrower range. These patterns provide another example of how written performance can differ across successive messages. However, the descriptive contrast between the participants should be interpreted cautiously, given the small dataset and the different communicative purposes of their emails.

The variation in Peko's functional density also appeared to coincide with differences in message content. Email 8 referred back to information in Felipe's preceding message, whereas Email 10 primarily introduced new details about Peko's life. This contrast raises the possibility that whether a message develops previously introduced information or introduces new content may be relevant to the distribution of linguistic features captured by functional density. Nevertheless, the present analysis did not systematically code discourse orientation or control for topic, message length, and communicative purpose. It therefore cannot establish that these differences in content

account for the observed fluctuations. The examples are best treated as contextual observations that may inform future research rather than as evidence of a direct relationship between discourse orientation and functional density.

The interpretation of functional density as an indicator of thought complexity also requires caution. Han and Kang (2018) discuss the potentially nonlinear relationship between conceptual complexity and linguistic performance, noting that learners' language resources may constrain how they express complex ideas. Accordingly, changes in functional density should not be taken as direct evidence that a learner's thinking became deeper or broader from one email to another. In this study, functional density is more appropriately treated as a descriptive measure of variation in written production. The findings demonstrate that this measure varied across messages, but they do not establish changes in underlying cognitive complexity or a developmental trajectory over the six-week period.

5.4 Looking Across Multiple Dimensions of Performance

Considering the three analyses together highlights the value of examining L2 written performance from multiple perspectives. Overall prepositional accuracy provided a broad measure of target-like use, while the analysis of *in* revealed the distribution of functions associated with an individual form. Functional density, in turn, captured a separate dimension of variation across messages. These measures therefore offered complementary descriptions of the same written interaction, none of which alone provided a complete account of the observed performance.

This finding is consistent with a CDST-informed view of language performance, in which different dimensions may exhibit different patterns of variability rather than changing uniformly over time (Larsen-Freeman, 2006; Larsen-Freeman & Cameron, 2008). The contribution of the present study is to illustrate how combining accuracy-based, form–function, and discourse-level analyses can reveal contrasts that may be obscured when performance is summarized using a single measure. However, the study does not establish whether these dimensions influence one another or reflect changes in an underlying linguistic system.

More broadly, the findings underscore the distinction between observed variability and demonstrated development. Although repeated email samples revealed fluctuations across the measures, the six-week dataset does not establish that these fluctuations represented acquisition, dynamic restructuring, or the emergence of a new developmental pattern. Differences in topics, communicative purposes, message length, opportunities for particular prepositions to occur, and coding decisions remain plausible explanations for some of the observed variation. Longer-term research with more densely sampled data, additional learners, and independent measures of proficiency would be needed to investigate developmental processes more directly. Within these limitations, the present case study demonstrates the descriptive value of tracking multiple dimensions of written performance across successive messages without treating every fluctuation as evidence of development.

5.5 Pedagogical Implications

Although this study is exploratory and based on a single EFL learner, it offers several tentative implications for L2 writing instruction and assessment. First, the findings suggest that teachers should be cautious about drawing conclusions about learners' grammatical abilities from a single writing sample. Peko's prepositional accuracy varied across emails despite a relatively high aggregate score. Where feasible, examining multiple samples produced on different occasions and for different communicative purposes may provide a more comprehensive description of learners' written performance than relying on a single assessment.

Second, the contrast between overall prepositional accuracy and the functional use of *in* highlights the potential value of combining broad accuracy measures with more focused analyses of particular linguistic forms. For polysemous prepositions, instruction may address not only whether a form is used appropriately but also the range of meanings and functions it can express. For example, learners could compare spatial uses of *in* with temporal and more abstract uses, examining how meaning varies across linguistic contexts. The present study does not establish that such activities improve learning outcomes, but its findings illustrate why form–meaning relationships may be worth considering alongside grammatical accuracy.

Finally, sustained email exchanges and other asynchronous writing activities may offer opportunities to collect repeated samples of learner language in meaningful communicative contexts. When examined over time, these samples can help teachers identify recurring patterns and variation across writing tasks. Such observations may complement conventional writing assessments by providing a broader picture of performance across occasions. However, the fluctuations observed in the present case study should not be treated as a diagnostic indicator of acquisition or as evidence that a particular instructional intervention is effective. Further research involving more learners and longer observation periods is needed to establish how repeated writing samples can best inform instructional decisions.

5.6 Limitations

Several limitations should be considered when interpreting the findings of this study. First, the study examined the written production of a single EFL learner interacting with one native English-speaking interlocutor over approximately six weeks. Although the 21 emails provided repeated observations of written performance, the small number of participants and relatively short observation period limit the generalizability of the findings. The study is therefore intended as an exploratory case analysis of variability across repeated written performances, rather than as evidence of general developmental trajectories.

Second, the dataset did not include an independent baseline measure of the learner's linguistic knowledge before the correspondence began. Although information about Peko's educational background and English-learning history provides context for interpreting her performance, it cannot establish her precise proficiency level at the time of the exchange. Consequently, the fluctuations observed during the six-week period cannot be interpreted as direct evidence of acquisition or changes in underlying grammatical knowledge. Longer-term studies incorporating independent proficiency measures and more densely sampled writing data would be needed to investigate developmental change more directly.

Third, some analyses were based on relatively small numbers of linguistic tokens. In particular, Peko produced only 16 obligatory contexts for *in* across the correspondence. With such a limited number of observations, individual instances could substantially affect message-level accuracy estimates, and the absence of a particular form–function category cannot establish that the learner lacked the corresponding knowledge. Furthermore, the topics and communicative purposes of the emails were not experimentally controlled, resulting in potentially unequal opportunities for particular prepositions and functions to occur. Differences in message length and content may therefore have contributed to the observed fluctuations.

Fourth, the findings are subject to limitations associated with coding and measurement. Identifying obligatory contexts, distinguishing incorrect preposition selection from oversuppliance, and assigning polysemous uses of *in* to functional categories require contextual judgments. Although the study employed coding procedures and agreement checks, these analytical decisions may still have influenced the resulting distributions. In addition, functional density provides a

descriptive measure of linguistic production rather than a direct measure of thought complexity. As Han and Kang (2018) discuss, the relationship between conceptual complexity and linguistic performance may be nonlinear. Accordingly, the observed fluctuations should not be interpreted as evidence of changes in cognitive complexity, dynamic restructuring, or the emergence of a new developmental pattern. Future research could address these limitations by including more learners, longer observation periods, more systematic control or documentation of communicative contexts, and more detailed reporting of coding and measurement procedures.

6. Conclusion

This study examined variability in L2 written performance across approximately six weeks of sustained email interaction, focusing on overall prepositional accuracy, the form–function mappings of *in*, and functional density. The findings showed that these dimensions provided complementary perspectives on the participants' written production. Relatively high overall prepositional accuracy coexisted with lower accuracy for the individual form *in*, while the distribution of *in* functions and functional density varied across successive messages. These observations illustrate how a single aggregate measure may not fully represent the range of patterns present in repeated writing samples.

The study contributes to research on L2 writing variability by bringing together accuracy-based, form–function, and discourse-level analyses within a longitudinal case study of asynchronous email interaction. A CDST-informed perspective provided a framework for examining variation across these dimensions without assuming that performance develops in a uniform or linear manner. However, the observed fluctuations do not establish that acquisition, dynamic restructuring, or changes in underlying linguistic knowledge occurred during the correspondence. Topic differences, communicative demands, limited opportunities for particular forms to occur, and coding decisions remain plausible influences on the patterns observed.

Future research could build on this exploratory analysis by examining more learners over longer periods, documenting communicative contexts more systematically, and combining repeated writing samples with independent measures of language proficiency. Such studies could investigate whether the relationships among grammatical accuracy, form–function use, and discourse-level measures recur across learners and contexts. Ultimately, examining multiple dimensions of performance across repeated observations offers a useful approach to describing L2 written language while maintaining a clear distinction between observed variability and demonstrated development.

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