

Intra-individual Writing Progression Patterns of Maximal Variation Learners Writing in Different Modes

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Abstract

Applying dynamic systems theory (Thelen & Smith, 1994) and sociocultural theory (Vygotsky, 1978) as the frameworks of the study, the present study used a time-series design to track the intra-individual writing development of EFL learners. Forty writing samples were collected from one low-achieving individual and one high-achieving individual who wrote tasks individually and one low-achieving pair and one high-achieving pair who wrote tasks in collaboration over one semester. More specifically, each of the groups wrote on ten tasks over time. The data were coded for complexity (two measures), accuracy (two measures), and fluency (three measures; CAF) features. Following Norris and Ortega (2009), to offer a more comprehensive and detailed picture of the data, each of the CAF features was estimated through more than one indicator. The data showed progressions and regressions in the developmental process of both learners writing independently and those collaborating in writing over time. In addition, even the high-proficiency individual and pair experienced moments of regression in terms of CAF features. Furthermore, it was shown that learners engaging in collaborative writing produced more accurate texts than those engaging in individual writing tasks.

1. INTRODUCTION

Writing is a highly complex skill which should be acquired in an academic context (Wingate & Harper, 2021). It includes several linguistic and cognitive processes, entailing planning, formulating, and reviewing (Flower & Hayes, 1981). Interestingly, writers in their first language also need to develop writing skills, particularly in academic contexts. As Ball et al. (2015) argued, all students are L2 learners when it comes to mastering the academic register of their first language (Ball et al., 2015). Previously, writing tasks were performed individually (Lopez-Serrano et al., 2019). However, following sociocultural theory (Vygotsky, 1978), collaborative writing performance is emphasized. Research studies have shown that collaborative tasks provide learners with possibilities such as mediation, interactions, and scaffolding that facilitate solving language-

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related problems, noticing gaps, and receiving feedback (Kim, 2008; Wigglesworth & Storch, 2009); during collaborative interactions, although learners focus on meaning, they can discuss the form and solve language-related problems (Elabdali, 2021).

On the other hand, development in terms of language performance can be investigated through two approaches (i.e. cross-sectional and longitudinal studies). Cross-sectional studies provide a somehow context-free detailed quantitative description of the development of linguistic features. However, longitudinal studies track the development based on the conceptualization of the dynamic systems theory (Thelen & Smith, 1994). Accordingly, since the developmental process is dynamic and complex, relying on the local changes in language performance is not sufficient, and there is a need for more precise information about language development when learners perform a task (Lambert & Kormos, 2014).

DST deals with variability (both within individual and between individual variability) in the performance of individuals during development (De Bot et al., 2007; Verspoor et al., 2008). It considers language as a dynamic and organic system which changes, language learning as learners' transformation of their linguistic world, learners' use of language as variant and discontinuous performance, development in language as iterative, individual, unpredictable, and self-organizing, and individuals' use of language as variant at a point in time and over time (Larsen-Freeman, 2006). Most of the studies conducted on the collaborative performance of learners are cross-sectional, in which small sample sizes and unbalanced samples spoil the truth (Elabdali, 2021). In other words, few studies took the dynamic systems theory (Thelen & Smith, 1994) as a framework to investigate learners' performance, particularly writing performance (Bashori, 2021; Fogal, 2020; Polat & Kim, 2014; Verspoor et al., 2011; Zhang et al., 2022). In addition, no study examined the intra-individual developmental paths of both low and high-achieving learners who write individually and in pairs. The microanalysis of intra-individual variations of high and low-achieving learners makes teachers aware of the possible unique paths in the progression of different proficiency-level learners. It helps them to behave more flexibly in the class to provide the assistance consistent with each learner's specific needs. This awareness also prevents learners from comparing themselves with their peers and being demotivated in the learning process. Thus, applying sociocultural theory and dynamic systems theory as the frameworks of the study, the current study inspected intra-individual variability in longitudinal data to provide a vivid picture of language development.

2. LITERATURE REVIEW

Theoretical framework of the study

This study is grounded in two complementary theoretical perspectives that provide a robust foundation for understanding complex learning and developmental processes: Sociocultural Theory (SCT) and Dynamic Systems Theory (DST). These frameworks offer interconnected lenses through which to examine how individuals develop and interact within their environments. While SCT emphasizes the role of social interaction, cultural tools, and mediated learning in cognitive development, DST focuses on the complex, non-linear, and emergent nature of developmental processes. Together, these theories provide a comprehensive lens to understand human development as both socially constructed and dynamically evolving.

Sociocultural theory

SCT, developed by [Vygotsky \(1978\)](#), posits that human cognitive development is fundamentally shaped by social interaction and cultural context. This theoretical framework challenges individualistic perspectives on learning by asserting that higher mental functions originate in social relationships and are mediated through cultural tools, particularly language.

[Vygotsky \(1978\)](#) argued that all higher psychological processes first appear on the social plane (inter-psychological plane) before being internalized by the individual (intra-psychological plane). This process, known as internalization, suggests that cognitive development is not merely a matter of individual maturation but is fundamentally dependent on social engagement and cultural participation. Through collaborative activities and guided participation, individuals transform external social processes into internal cognitive functions.

This transformation process is mediated by tools and signs (e.g., language and symbols) in Zone of Proximal Development (ZPD), which is “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” ([Vygotsky, 1978](#)). In fact, optimal learning occurs when instruction is pitched slightly above the learner’s current independent level, within the zone where they can succeed with the help of a source of support.

Regarding the present study, SCT provides a critical lens for understanding how intra-individual writing progression patterns are shaped by the cultural tools and social contexts inherent in different writing modes. In the context of this study, Vygotsky’s emphasis on mediation through cultural tools becomes particularly salient when examining how different writing modes offer distinct mediational means that differentially support writing development.

Dynamic systems theory

DST, emerging from mathematics and physics and applied to developmental psychology by [Thelen and Smith \(1994\)](#), provides a framework for understanding development as a complex, non-linear, and self-organizing process. DST challenges linear cause-and-effect models of development, proposing instead that developmental outcomes emerge from the complex interaction of multiple variables operating at different timescales. Small changes in initial conditions can lead to dramatically different developmental trajectories (sensitivity to initial conditions), while large changes may sometimes produce minimal effects. This non-linear perspective acknowledges the inherent unpredictability and variability in developmental processes, recognizing that development does not follow a predetermined path but rather emerges from ongoing interactions between organism and environment.

Another central tenet of DST is that developmental patterns are self-organizing; they emerge from the interaction of components within the system without requiring a predetermined controller. Patterns of behavior are not pre-programmed but emerge spontaneously when multiple constraints align in particular ways. This perspective facilitates understanding how stable patterns emerge from dynamic interactions.

Regarding the present study, periods of increased intra-individual variability in writing performance, which might appear as regression or inconsistency in traditional developmental models, can be interpreted through DST as indicators of reorganization and potential breakthrough to new levels of competence ([Fischer & Bidell, 2006](#)). Moreover, the multi-timescale perspective enables examination of how writing processes and developmental patterns (long-term writing development) interact to produce the intra-individual variation in maximal variation cases.

Studies on collaboration

Substantial research studies have focused on collaborative writing over the last 20 years (Chen, 2019; Wang et al., 2025). The literature on collaborative writing can be classified into four different research paths. One group of studies has focused on the interaction of learners during collaboration. For instance, some studies examined the strategies learners use during collaborative performance (Teng et al., 2022; Wang et al., 2025). The second group of studies focused on the overall quality of learners' collaborative productions (Ajideh et al., 2016; Mazdayasna & Zaini, 2015; Pham, 2023; Qiu & Lee, 2020). The third group explored the mediating effect of collaborative writing endeavors on the acquisition of language sub-skills (Kim, 2008; Nassaji & Tian, 2010). The fourth group of studies attempted to examine the effect of computer-mediated collaboration (Su et al., 2023; Thiemann et al., 2019).

As pertinent to the present research study which investigated the quality of the final product of collaboratively written texts, almost all cross-sectional experimental studies on the effect of collaborative writing on the quality of the learners' texts showed that learners in collaborative writing group produced more accurate texts than learners writing individually (Chen, 2019; Elabdali, 2021; McDonough & De Vleeschauwer, 2019; McDonough et al., 2018; Pham, 2023; Sang & Zou, 2023; Wigglesworth & Storch, 2009). However, regarding the fluency and complexity of the texts, the results are contradictory. One reason of this discrepancy in findings is neglecting the differences in learners' proficiency levels (Chen, 2019). Another reason can be attributed to considering subordination as the unit of analysis for any proficiency level of learner. More specifically, subordination indices are beneficial with intermediate proficiency levels; it is not fruitful for beginners and advanced learners (Elabdali, 2021). The contradictory results may also be due to conducting collaboration in different phases of writing. Some studies focused on collaborative writing in the planning phase (McDonough & De Vleeschauwer, 2019; McDonough et al., 2018; Mohammadi et al., 2023) while other studies investigated collaboration through all writing stages (Bai & Chen, 2024; Qiu & Lee, 2020; Wigglesworth & Storch, 2009). Furthermore, different studies operationalized different measures of writing proficiency (complexity, accuracy, and fluency) differently, which may have resulted in discrepant findings.

Unlike these studies, which typically adopt cross-sectional designs and group-level comparisons, the present study employs a within-writer, maximal variation case approach to trace how individual writers' texts evolve across writing modes over time. By focusing on intra-individual developmental patterns, this study addresses an underexplored dimension of collaborative writing research and offers a more fine-grained account of how writing quality changes as the writers engage in different modes of writing.

Studies on learners' development in L2 performance

This part reviews a report of some studies focusing on individuals' development in L2 performance. Zhang et al. (2022) examined CAF measures in the productions of three learners through DST. They found three prototypes in the data; one learner's performance was stable. Another learner first had variable then stable performance. The other learner had a continuously variable performance. They showed that the variable prototype learner improved in CAF more than the others.

Bashori (2021) tried to examine intra-individual variability of vocabulary diversity and vocabulary sophistication (defined by average word length in morphemes) in writing from DST. She examined 12 written performances of one Indonesian English learner over five years. She

visually showed the variability in the performance of the participant in terms of the measures of writing.

Fogal (2020) examined the L2 developmental path of a Thai undergraduate student in terms of authorial voice, which was scored based on the Voice-Labeling-Rubric. He revealed the role of variability in constructing authorial voice over time through the visualization technique of graphs.

Verspoor et al. (2011) explored L2 learners' written products through DST. The compositions collected from Dutch learners of English were coded at sentence, phrase, and word levels across five different proficiency levels. They asserted that the use of a common yardstick to measure writing proficiency was difficult; instead of just focusing on the length of compositions, one should consider development in all directions. Furthermore, the analysis of the compositions through DST highlighted the variation in the development of the investigated variables. Concerning the development of learners with different proficiency levels, learners who moved from the first levels of proficiency dealt with learning words and lexical changes, while learners at higher proficiency levels experienced both lexical and syntactic development.

While earlier studies have provided valuable insights into intra-individual variability and developmental trajectories in L2 writing, they have largely focused on single writing modes, isolated linguistic dimensions, or broad proficiency contrasts. The present study addresses an underexplored area by examining intra-individual writing progression across different writing modes using a maximal variation case design.

Thus, examining the how and when of variability and writing development requires investigating developmental details. Thus, the present study attempted to examine the intra-individual developmental paths of learners with different proficiency levels in distinct writing contexts (i.e., independent and pair writing). The following research questions were asked:

1. How do low and high-achieving cases writing individually perform in terms of writing measures over time?
2. How do low and high-achieving cases writing collaboratively perform in terms of writing measures over time?

3. METHODOLOGY AND DESIGN

Participants

Six Iranian EFL MA participants (i.e., 4 men and 2 women) were selected purposively from among their 14 classmates. More specifically, based on a pretest given to all 20 members of the class, those who gained the highest and the lowest scores in terms of CAF measures were selected to be assigned to the individual and collaborative writing groups. Following the literature advocating that collaboration is mainly possible in parallel-level pairs (Storch & Aldosari, 2013), two learners with the lowest score in CAF (two men; Low Achieving Pair; LAP) and two learners with the highest score in CAF (two women; High Achieving Pair; HAP) were assigned to the collaborative writing group. Furthermore, one learner with the lowest score in CAF (a man; Low Achieving Individual; LAI) and one learner with the highest score in CAF (a man; High Achieving Individual; HAI) were assigned to the individual writing group.

The age range of the participants was 25-32 years, and they were at the intermediate level based on the Oxford Placement Test. They enrolled in a two-credit writing course that was required for their MA degree. The class targeted writing skills, including paragraph-level writing (i.e., topic sentence, conclusion, supporting details, and types of paragraphs) and essay-level writing (i.e., writing different parts of an article). It should be noted that the instructor holds a PhD in the field of TEFL. In addition, she had 15 years of experience teaching English courses at the university.

Materials

The materials included the Oxford Placement Test (Cronbach's Alpha = .89) which informed the appropriate syntactic complexity measure (Norris & Ortega, 2009), 20 paragraphs written by the 20-member class as a pretest, and 40 paragraphs written by the study groups. Each of LAP and HAP was requested to compose 10 paragraphs throughout a semester collaboratively, and each of LAI and HAI was requested to compose 10 paragraphs throughout a semester individually. The topics of the tasks (300-word paragraphs) are presented in Table 1.

Table 1: Task Topics

Tasks	Topics
Task 1	Describe a memorable day in your life and explain why it was important to you.
Task 2	Describe your typical day from morning to night.
Task 3	Describe a place you like (e.g., your hometown, a park, or a room) and explain why you like it
Task 4	Do you think students should use mobile phones in class? Give reasons and examples.
Task 5	Many students feel stressed at university. Describe the problem and suggest solutions.
Task 6	Compare studying alone with studying in groups. Which do you prefer and why?
Task 7	What are the effects of using social media on students' learning?
Task 8	Do the advantages of online learning outweigh the disadvantages? Support your opinion.
Task 9	What challenges have you faced in learning English, and how have you tried to overcome them?
Task 10	Define and classify natural resources.

Data collection procedures

Initially, the 20-member class took the Oxford Placement Test. Then, a pretest (i.e., a 300-word individual writing) was administered, which served as the ground for the selection of the participants. Based on the mean of CAF features in this pretest, the students were assigned to two collaborative writing groups and two individual writing groups. They received the same instructions from the same teacher. During the first 10 sessions, the students were instructed on the features and components of a well-written paragraph and types of paragraphs. From sessions 11 to 16, they were given some articles to review different paragraphs in different parts of the articles. To track the developmental paths of the participants over time, the students in collaborative writing groups were asked to collaborate in all phases of writing (i.e., prewriting, drafting, and revising) to write on 10 tasks (300-word paragraphs) during the semester collaboratively. Moreover, the students writing individually were requested to perform on the same 10 tasks (300-word paragraphs) individually. The data were collected during the semester (from session 4 to session 13, one task in each week). The students in the collaborative writing group had 45 minutes, and the students in the individual writing group had 35 minutes to brainstorm, write, and revise the tasks. Moreover, they were not allowed to check dictionaries. The teacher was present during the data collection period and monitored the way they accomplished the tasks. It is noteworthy that the feedback on the 10 tasks was offered after the data collection period to control the possible effect of feedback.

It should be highlighted that the participants were informed about the purpose of the study. Written consent was obtained, and specific attention was paid to the collaborative tasks to ensure peer interaction remained respectful. Student writings were de-identified using participant codes

by a colleague (e.g., P01–P20), and all potentially identifying content was removed before analysis.

Data analysis procedures

The writing proficiency of the students was estimated through CAF features. Syntactic complexity was examined through subordination measures since the students were at intermediate proficiency level (Norris & Ortega, 2009); the proportion of clauses to T-units (the independent clause accompanied by any subordinate clauses, and the imperatives) and the proportion of dependent clauses to all clauses indicated syntactic complexity. Furthermore, the ratio of error-free clauses (clauses with no grammatical errors) to all clauses (Wigglesworth & Storch, 2009) and the ratio of error-free T-units to all T-units estimated accuracy feature. It is worth noting that errors in syntactic level (e.g., missing the subject) and morphological level (e.g., third person-s -s) were considered for analysis while errors on spelling and punctuation were not considered. Finally, the average number of words, T-units, and clauses in the text showed fluency (Wigglesworth & Storch, 2009). It should be noted that *Microsoft Word* displayed the number of words automatically.

The researcher examined the intra-rater reliability after six weeks. The required units for analysis of CAF measures included the number of T-units, dependent clauses, clauses per text, error-free clauses, and error-free T-units. Kappa agreement indices turned out to be .94, .92, .90, .90, and .91, respectively. Furthermore, inter-rater reliability was examined by a faculty member with a Ph.D. degree in TEFL. He was asked to code the mentioned units in the 20 paragraphs written individually and the 20 paragraphs written collaboratively. The agreement indices were .92, .90, .90, .86, and .89, respectively.

To track the intra-individual developmental paths of the participants at different data collection points, their performance in terms of each of the CAF measures was transformed to z-scores to ensure comparability (Larsen-Freeman, 2006). On the other hand, another way to investigate the developmental process and the intra-individual developmental variability in the students' time serial performance was to draw a min-max graph. This method allows researchers to detect the extent and the general pattern of variability in the data while showing the raw data. Different phases encompassing different bandwidths of variability would appear through this method.

4. RESULTS

Following DST, this case study visually showed intra-individual variability through graphs. Following Larsen-Freeman (2006), the CAF measures in each learner/pair's performance on 10 writing tasks were transformed to z-scores to ensure the comparability across different CAF measures. Figure 1 illustrates the intra-individual variability of each participant/pair from one task to the next. As can be seen, development was nonlinear for each measure in each participant's observation. It is interesting to note that sometimes a participant exhibited a fluctuating development for even some relevant measures. For instance, although the number of words, T-units, and clauses show the fluency of the productions, each participant showed different developmental patterns in terms of these related measures at some points during the time. As an example, in the case of LAI, although the number of T-units and clauses did not change in the second task, the number of words increased at that period.

In addition, some learners showed variable development in complexity measures at some points during the writing performance. For instance, in HAI's performance, although the ratio of clauses to T-units increased in the second task, the ratio of dependent clauses to all clauses decreased.

Moreover, each participant also showed variable development in the accuracy measures at some points during the writing performance. For instance, in LAI's performance on the seventh task, the number of error-free T-units decreased; however, the number of error-free clauses increased.

Figure 1: Intra-individual variation in the performance of the learners on measures of CAF

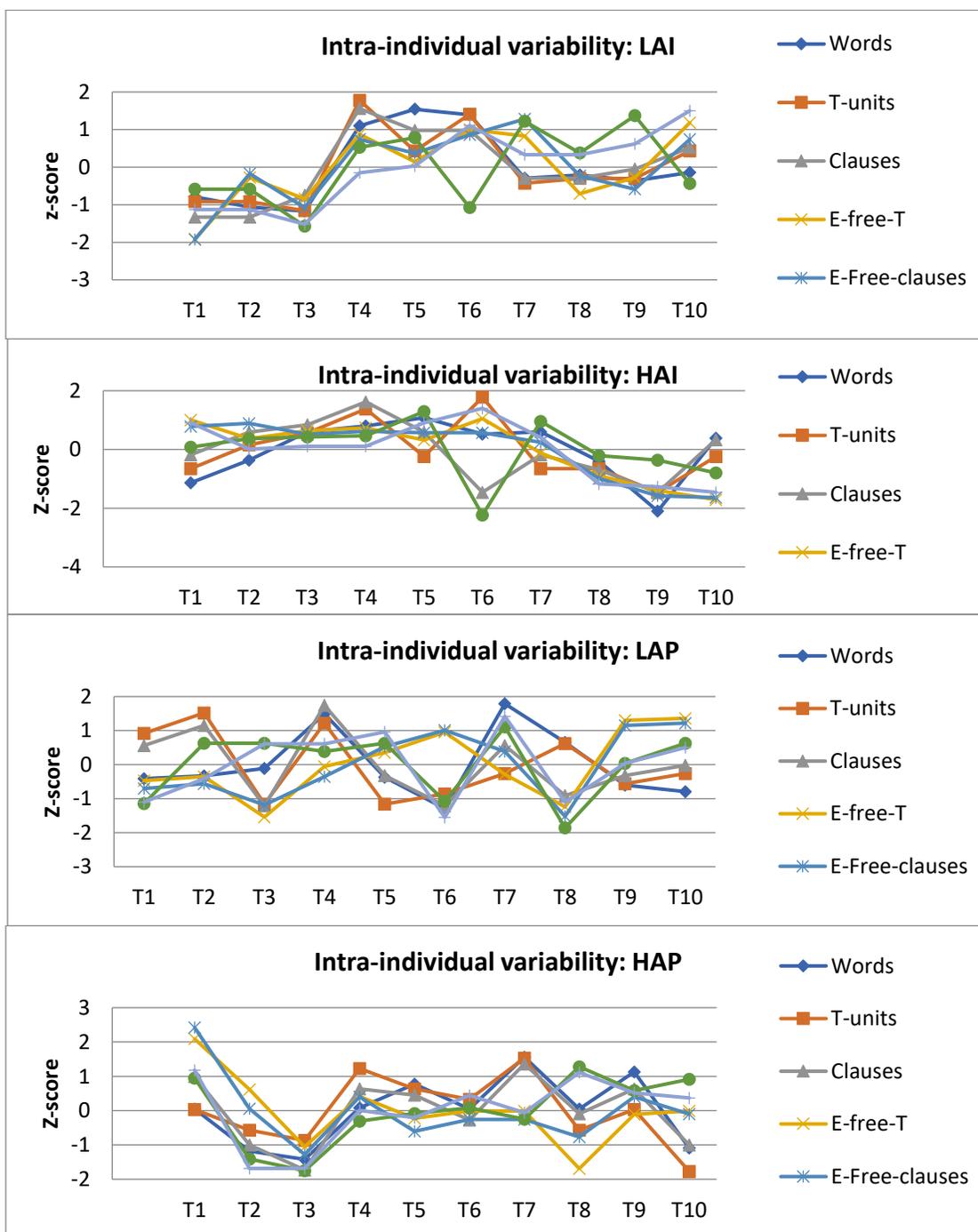


Figure 2 represents seven min-max graphs related to the CAF measures estimated based on LAI's performance over time. The graph showing his performance in terms of the number of words contains three main phases of variability (tasks 1-5), random use of words (tasks 6-8), and a more regular pattern (tasks 9-10).

In terms of the number of T-units, there was variability (tasks 1-5). Then, he used the T-units rather randomly (tasks 6-8). Finally, he used T-units in a more regular pattern (tasks 9-10).

As for the number of clauses, there are three phases of variability (tasks 1-4), random use of clauses (tasks 5-6), and a more regular pattern (tasks 9-10).

Concerning error-free T-units, three phases emerged: A period of significant variability (tasks 1-3), a more regular pattern (tasks 4-7), and a more variability (tasks 8-10).

As far as the error-free clauses are concerned, three main phases emerged: a period of variability (tasks 1-3), a decrease in the amount of variability (tasks 4-6), and more variability (tasks 7-10).

The proportions of clauses to T-units in the performance of LAI showed that there was not a strong difference in the bandwidth over time, even though the band itself moved up in tasks 9-10.

Finally, regarding the proportion of dependent clauses to all clauses, three main phases appeared; the graph shows a step-wise progression, with a period of variability (tasks 4-5) between the two periods of somehow more stability (tasks 1-3 and tasks 6-10).

Figure 2: Min-max graphs showing variability in CAF features estimated for LAI's performance over time

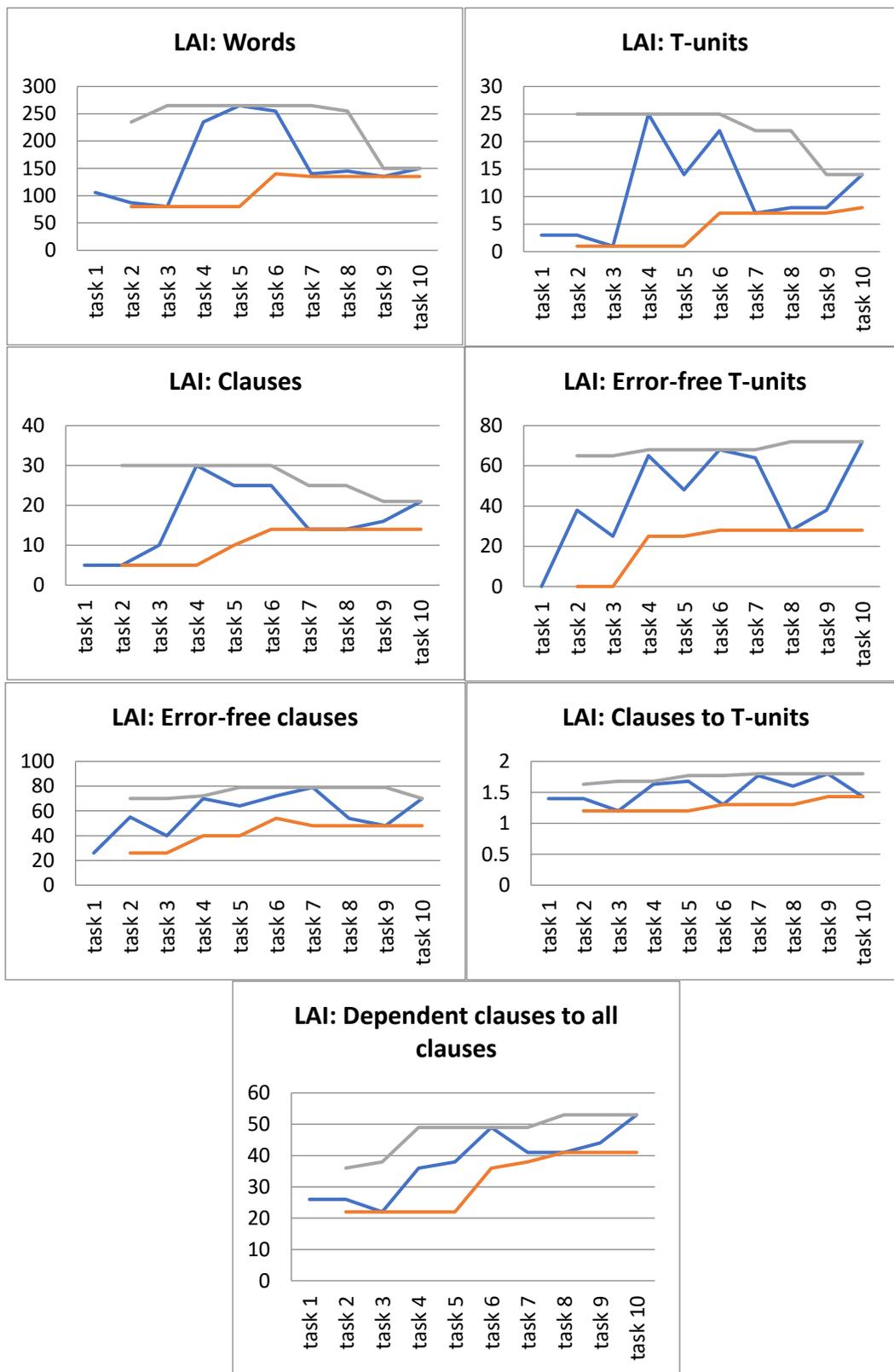


Figure 3 illustrates seven min-max graphs related to the CAF measures estimated based on HAI's performance over time. The graph showing his performance in terms of the number of words contains three main phases. Although at first, HAI used words variably (tasks 1-3), the range of variability in the use of words was higher in the final points of observation (tasks 7-10).

As for the number of T-units, the graphs suggest a step-wise progression, with a period of variability (tasks 7-8) between the two periods of somehow more stability (tasks 1-6 and tasks 9-10).

As far as the number of clauses is concerned, the graph suggests a period of more variability (tasks 4-6) between two periods with less variability (tasks 1-3 and tasks 7-10).

With respect to error-free T-units, graph contains three phases of a rather narrow bandwidth of variability (tasks 1-3), a widening bandwidth of variability (tasks 4-7), a narrower bandwidth of variability (tasks 8-10).

Regarding the error-free clauses, the graph suggests that although the band itself moves down, there is a period of more variability (tasks 6-8) between a period of rather stability (tasks 1-5) and a period of less variability (tasks 9-10).

As for the proportion of clauses to T-units, the graph shows three main phases of a narrow bandwidth of variability (tasks 1-2), a wide bandwidth of variability (tasks 3-7), and a narrower bandwidth of variability (tasks 8-10).

Concerning the proportion of dependent clauses to all clauses, there are three phases of a rather narrow bandwidth of variability (tasks 1-3), a widening bandwidth of variability (tasks 4-6), and a wider bandwidth of variability (tasks 7-10).

Figure 3: Min-max graphs showing variability in CAF features estimated for HAI's performance over time

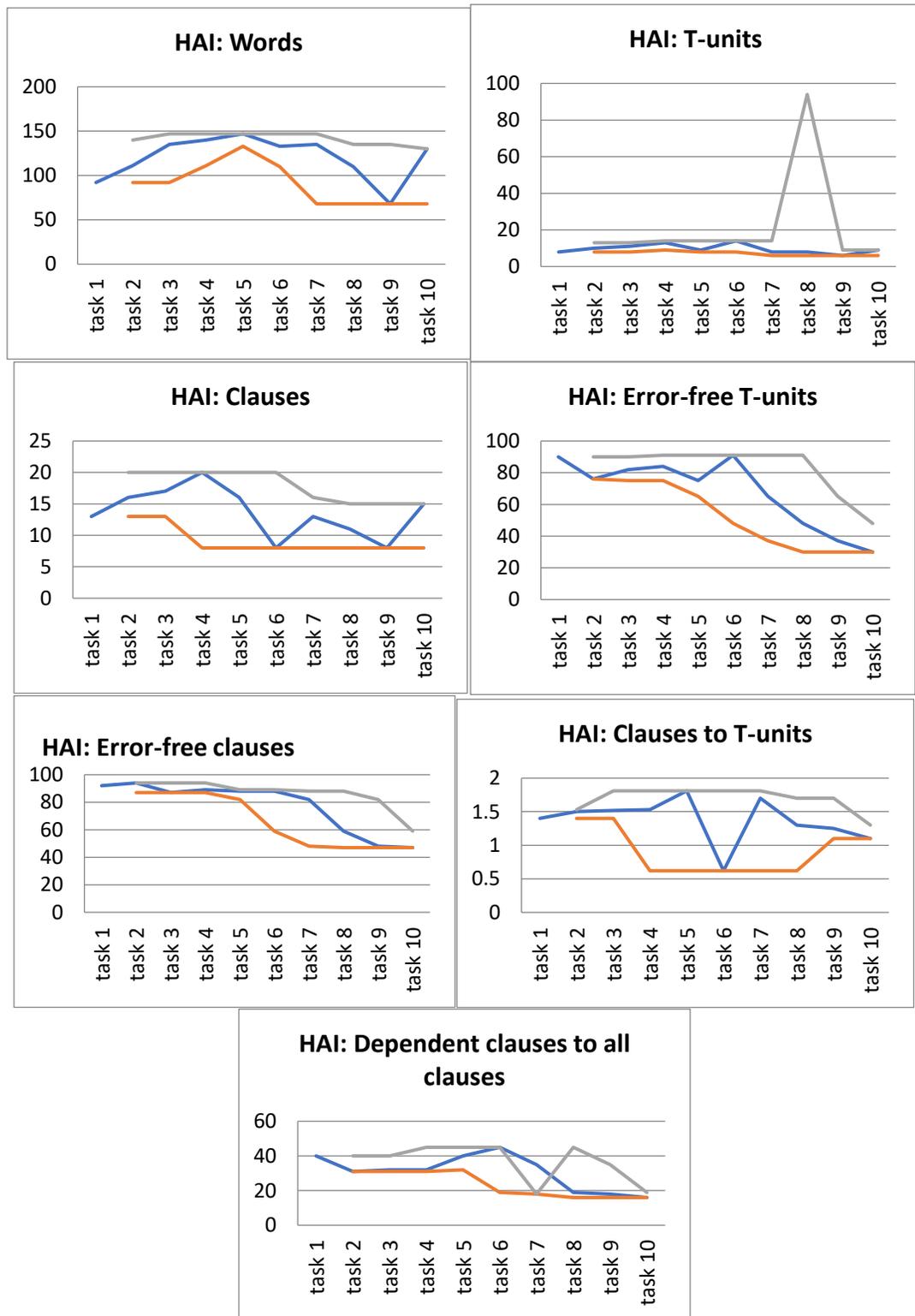


Figure 4 represents seven min-max graphs related to the CAF measures estimated based on LAP's performances over time. The graph showing their performance in terms of the number of words contains four main phases of a rather wide bandwidth of variability (tasks 1-3), a less wide bandwidth of variability (tasks 4-5), a much wider bandwidth (tasks 4-6), and a narrower range (tasks 9-10).

As for the number of T-units, there is a wide bandwidth of variability (tasks 1-4), decreased range of variability (tasks 5-6), and the narrowest bandwidth in tasks 7-10.

With respect to the number of clauses, there is a wide bandwidth of variability (tasks 1-6), decreased variability (tasks 7-8), the narrowest bandwidth of variability (tasks 9-10).

The graph concerning the error-free T-units shows that although the bandwidth moves rather up, there is no obvious widening or narrowing in the range. However, there are several mild oscillations.

Considering the error-free clauses, the graph shows three main phases of a rather narrow bandwidth of variability (tasks 1-3), a wide bandwidth of variability (tasks 4-5), and a wider bandwidth of variability (tasks 6-10).

As for the proportion of clauses to T-units, the graph shows three phases of a rather narrow bandwidth of variability (tasks 1-4), a wide bandwidth of variability (tasks 5-9), and a narrow bandwidth (tasks 9-10). Thus, the graph may show a step-wise progression, with a period of greater variability between the two periods of somehow less variability.

Finally, concerning the proportion of dependent clauses to all clauses in the performance of LAP, the graph may show a step-wise progression, with a period of greater variability (tasks 4-8) between the two periods of somehow less variability (tasks 1-3 and tasks 9-10).

Figure 4: Min-max graphs showing variability in CAF features estimated for LAP's performance over time

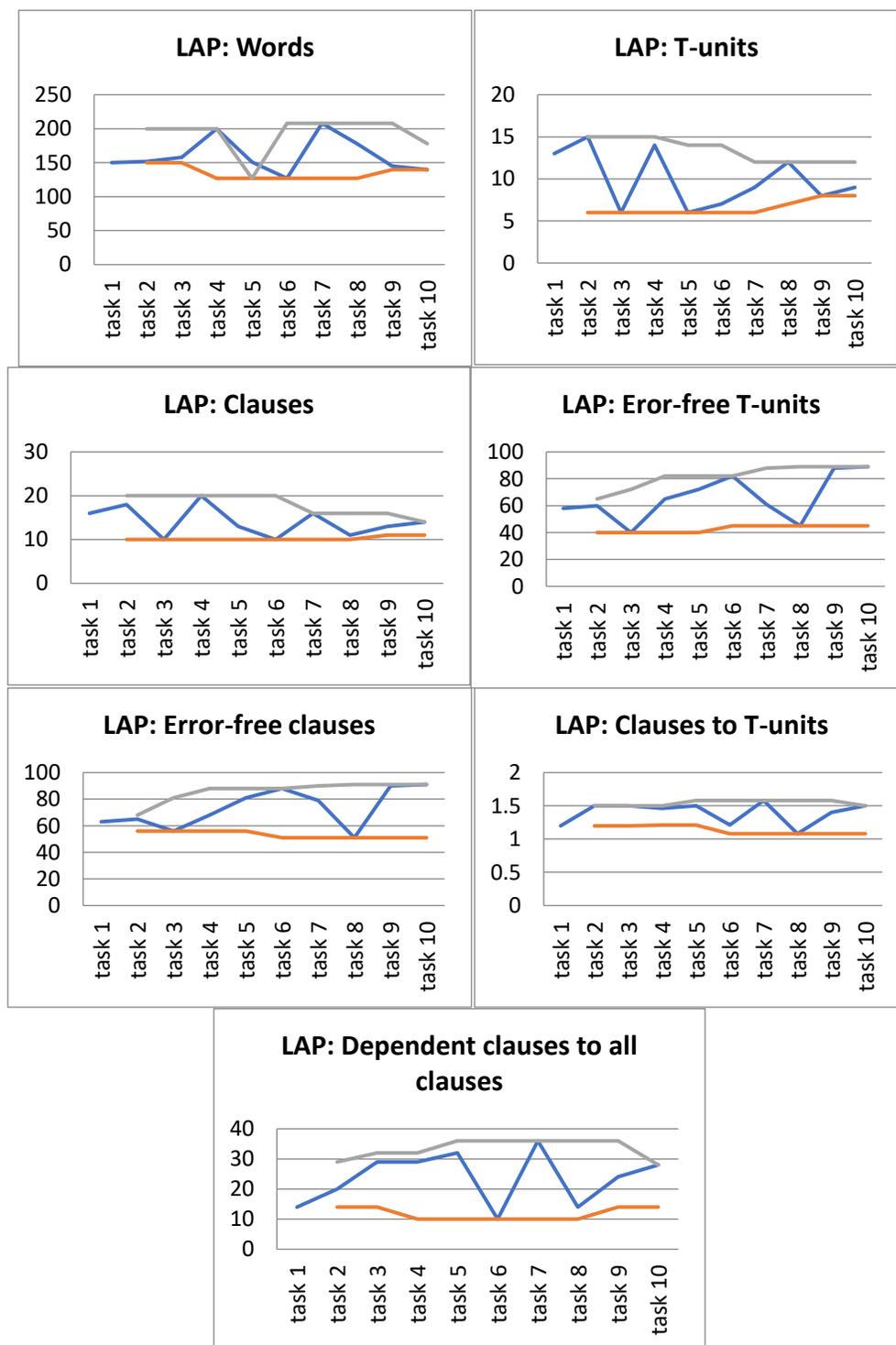


Figure 5 illustrates seven min-max graphs related to the CAF measures estimated based on HAP's performance over time. The graph showing their performance in terms of the number of words contains three main phases of a rather wide bandwidth of variability (tasks 1-5), a narrowing bandwidth of variability (tasks 6-7), and a much wider variability (tasks 8-10).

With respect to the number of T-units, there was a narrow bandwidth of variability (tasks 1-2). Then, although the band itself moves upward till task 8, there is not as strong a difference in the bandwidth range in this period. Third, from task 9 to task 10, the bandwidth of variability widens.

Regarding the number of clauses, there are a rather wide bandwidth of variability (tasks 1-5), a wider band (tasks 6-7), and a narrower bandwidth of variability. Finally, even though the band itself moves down from tasks 8-10, the bandwidth of variability becomes wider in this period.

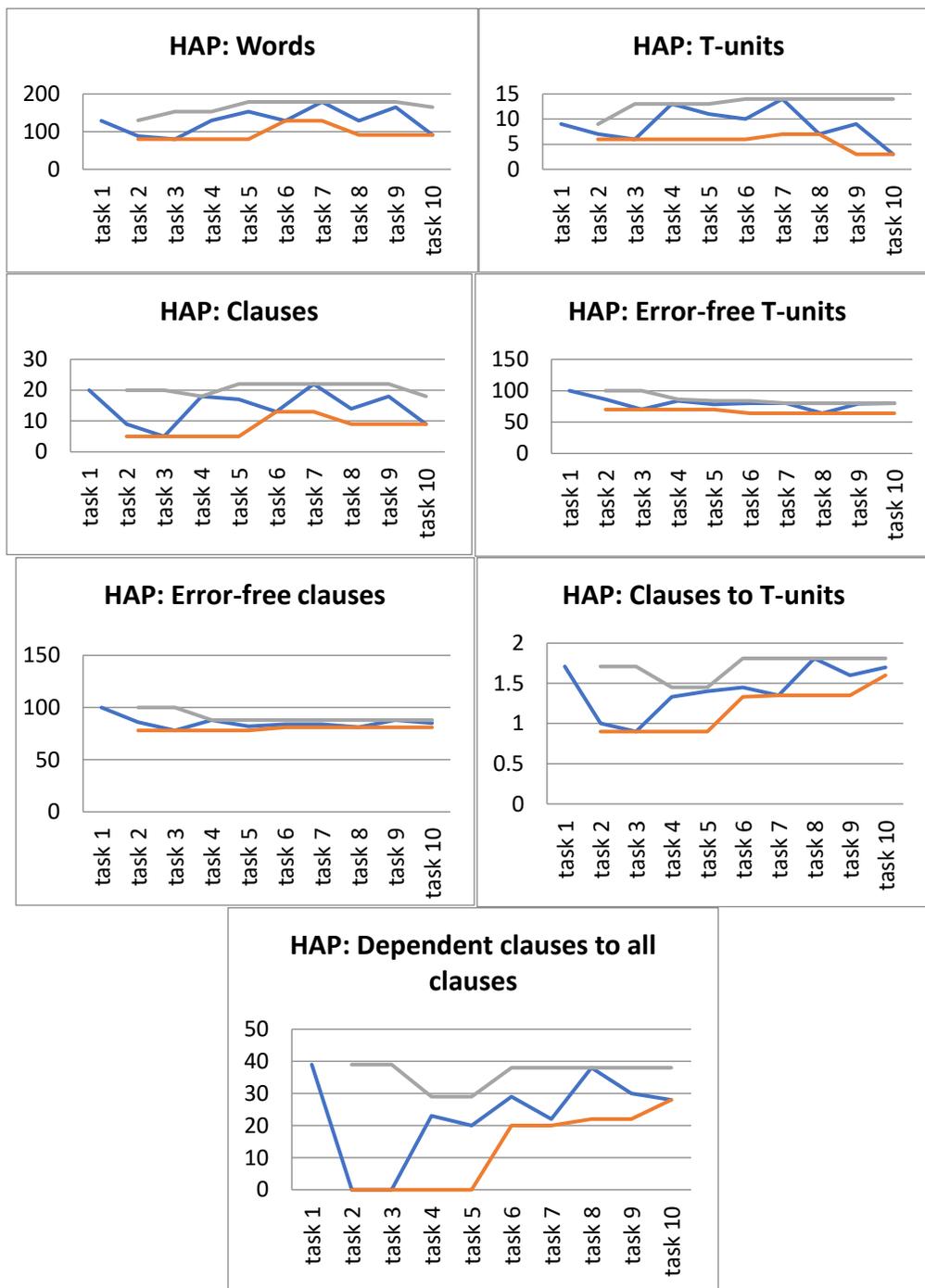
As far as the error-free T-units, there are a rather narrow bandwidth of variability (tasks 1-3) and a narrower bandwidth of variability (tasks 4-10). In other words, more stability is evident in the use of error-free T-units over time.

Moreover, the graph showing the error-free clauses is similar to that of error-free T-units in their performance. In other words, more stability is evident in the use of error-free clauses over time.

As for the proportion of clauses to T-units, there are a rather wide bandwidth of variability (tasks 1-3), a narrower bandwidth of variability (tasks 4-5), and a much wider variability range (tasks 6-8). Finally, the variability narrows in tasks 9-10.

Finally, the graph concerning the proportion of dependent clauses to all clauses shows a wide bandwidth of variability (tasks 1-3) and a decreased variability (tasks 4-5). Then, the bandwidth in tasks 6-8 is narrower than the previous one. Finally, the bandwidth of variability is the narrowest one in the graph in tasks 9-10.

Figure 5: Min-max graphs showing variability in CAF features estimated for HAP's performance over time



To sum up, this section tracked how different proficiency-level individuals and pairs developed over ten writing tasks. It showed periods of both progressions and regressions in the developmental process.

5. DISCUSSION

The examination of the learners' performance showed their distinctive progression paths over time. This finding is in line with the arguments of DST advocating that complex systems are sensitive to their initial conditions (De Bot, 2008). Thus, since learners had distinctive initial conditions in terms of pair/individual writing or proficiency level, they showed distinctive progression paths.

Moreover, in learners' performance (based on Figure 1), there were instances of regressions and progressions in terms of writing measures which is consistent with the arguments of DST. As Verspoor et al. (2008, p.229) indicated, in the language learning process, "there can be no development without variability, and the amount and type of variability can reveal the actual developmental process". Moreover, different variability patterns in each learner/pair's subsystems (CAF) suggest that a learner has access to some limited resources, which should be devoted to different developing subsystems (Skehan, 2009). In this vein trade-off hypothesis (Skehan, 2009) is supported; learners cannot consider all aspects of the language simultaneously. At one point, they may focus on one aspect and ignore the rest.

As evidenced in Figures 5, each learner/pair presented unique bandwidths of variability in each of the CAF measures. The comparison of the learners' graphs in terms of the number of words shows that HAI and HAP showed more variability in the frequency of words used during the final tasks. Regarding the number of T-units, the comparison of the learners' graphs shows that LAI generally had the greatest variability during the 10 data points; LAI, HAI, and LAP somehow reached stability during the final data points. The comparison of the learners' graphs concerning the number of clauses shows that LAI had the greatest variability during the first half of the data points whereas HAI and LAP showed the highest stability level during the final data points. With respect to the error-free T-units, the comparison of the learners' graphs shows that LAP and HAP illustrated no significant difference in the range of variability during the 10 points; of all the learners, HAP generally showed the most stable performance during the 10 data points. With respect to the error-free clauses, HAP generally had the most stable performance during the 10 data points. As for the number of clauses to T-units, the comparison of the learners' graphs shows a period of variability between the two periods of somehow more stability in the HAI's graph. In addition, LAI and LAP's graphs were somehow stable during the 10 tasks. Finally, the comparison of the learners' graphs in terms of dependent clauses to all clauses shows that LAI and HAI's graphs were similar to what is expected in the developmental process, and finally, HAI showed the most stable level of performance during the 10 data points.

Thus, the bandwidths of CAF measures (based on Figures 5) were not stable over time. However, although the performance of each learner was accompanied by many occasions of regressions and progressions, there were moments of attractor states (i.e., occasions with little oscillations indicating stability) during their progression. This is in line with the findings of Zhang et al. (2022), Bashori (2021), Fogal (2020), and Verspoor et al. (2008) studies which showed that periods of low variability indicate stability while high variability signals the beginning of changes and emergent behaviors in the development process.

In addition, although learners performed consistently in different measures of a writing proficiency feature (CAF), at some data points, variations were observed. This finding is in line with Verspoor et al. (2008) study which showed learners' use of a variable progression pattern for some related measures over time. In fact, variability is not unexpected since it is a feature of the self-organizing system (Verspoor et al., 2008). Furthermore, although individuals' limited resources should attend to different subsystems, equal resources are not required by all subsystems; two connected growers require fewer amounts of resources than two competitive resources.

Concerning the role of proficiency, even in the performance of learners with the higher proficiency level, there were constant instances of regressions and progressions. Similar to [Verspoor et al. \(2008\)](#) finding, language development, even for an advanced learner, is far from stable. More specifically, learners' progression is non-linear and unexpected. When a learner is at a higher proficiency level, his writing proficiency does not necessarily reveal improvement since many internal and external factors affect his performance ([Bashori, 2021](#)). However, both high proficiency-level individual and pair reached stability in terms of all CAF performance during final tasks; however low proficiency-level individual and pair reached stability just in terms of fluency and complexity during final tasks. This finding is consistent with [Verspoor et al. \(2011\)](#) study showing that less proficient learners focused on lexical changes while more proficient learners engaged in syntactic progression.

Regarding the comparison of individual and pair writing groups (based on [Figure 1](#)), learners who wrote collaboratively (i.e. LAP and HAP) produced more accurate texts in most tasks. This finding is in line with [Elabdali \(2021\)](#), [McDonough and De Vleeschauwer \(2019\)](#), [Chen \(2019\)](#), [McDonough et al. \(2018\)](#), and [Wigglesworth and Storch \(2009\)](#) studies which showed that collaborative groups produced shorter but more accurate texts. It can be explained by referring to the resources available to the learners while engaging in collaborative activities; learners can benefit from the feedback, motivation, negotiation of language forms, mediation, assistance, and scaffolding of their peers during collaboration which may improve their performance in terms of accuracy ([De Bot, 2008](#); [Kim, 2008](#); [Qiu & Lee, 2020](#); [Wigglesworth & Storch, 2009](#)).

6. CONCLUSION

In this study, DST assisted in detecting progression patterns which otherwise would not have been possible. The micro-genetic analyses revealed the intra-individual variability in the performance of the selected learners in terms of CAF. The examination of the intra-individual differences at different data collection points was conducted through z-score and min-max graphs. They showed that each learner/pair followed distinctive paths in each of the CAF measures. Furthermore, it was observed that progression was nonlinear for each measure in each learner's data. Some learners also showed variable progression for even some related measurements at some points. These different variability patterns in each learner's subsystems show that a learner has access to some limited resources, which should be devoted to different developing subsystems. In addition, the comparison of the graphs showing the progression paths of learners writing individually and learners writing in pairs showed that the latter produced more accurate texts in most tasks over time. Moreover, it was shown that although the high proficiency-level learner/pair experienced periods of regression in their performance, they gained stability in all CAF measures during the final tasks.

This study is not void of limitations. If the study had been conducted over a longer period, it would have offered a deeper understanding of the progression of the learning process. In addition, collaborative writing is affected by individual contributions in the group which were not controlled in this study. The limited number of learners is another limitation of the study. Involving a larger sample of students may result in different findings.

Regarding the implications of the study, both teachers and students would be aware of the unique language learning trajectory and progression path in each mode of writing. As a result of consciousness-raising, they would be more patient in the language learning process, would not compare the learning outcome of one learner with that of another learner at one point in time, and would not be demotivated in the learning process due to weak performance at one point in time. Further research may pair the investigation of progression paths of learners with techniques such

as think-aloud to provide a much deeper understanding of the psychological processes during learners' progression. In addition, some studies may compare the developmental paths of pairs and groups in terms of writing proficiency measures.

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