Asian Journal of Social Science and Management Technology
ISSN: 2313-7410
Volume 4, Issue 2, March-April, 2022
Available at www.ajssmt.com

The Significance of Chaos/Complexity Theory in Maltese as a Second Language Acquisition

Dr Jacqueline Żammit

Department of Languages and Humanities Education Faculty of Education, University of Malta.

Abstract: Despite extensive research in second language acquisition (SLA), we are still a long way from understanding what exactly happens in the adult's mind while learning a second language (L2). This study explores whether a learning pattern could be established over time in 35 adults learning Maltese as a second language (ML2), especially with respect to Maltese verbs. This research is driven by chaos/complexity theory. It focuses on the non-linear learning curve, the origins of the butterfly effect and fractal patterns of learning. It describes how learning is unpredictable, chaotic, dynamic and complex. A longitudinal research system and a mixed-method approach focussed on methodological triangulation were used in this research. Structured Timed Grammaticality Judgment Tests, verb conjugation tasks, reflected journals and interviews were used to investigate the learning curve over a period of 15 months. According to the results, all participants indicated a non-linear learning pattern and confirm the characteristics of Chaos/Complexity Theory.

Keywords: Chaos/Complexity theory (C/CT), non-linear learning curves, butterfly effect, fractal patterns, second language acquisition.

1. Introduction and Background Information

At the time Malta became a European Union (EU) Member State in 2004, the Maltese language was established as one of the EU's official languages. This offers Malta the right to demand communication proficiency in Maltese so that Maltese can be used in ceremonial EU indentures and communication. Thus, it is expected that EU citizens employed in Malta and falling under Directive 2005/36/EU, Article 53 will speak Maltese unless they are citizens of a third country (Camilleri Grima & Żammit, 2020).

This research probes the interlanguage of adults in learning the verbal tense and aspect of Maltese as a second language (ML2). The interlanguage concept refers to a type of language produced by a second language (L2) learner that frequently contains grammatical characteristics not present either in the learner's native language (L1) or the second language (i.e., a person's second, third or fourth language; Nordquist, 2020).

This study is based on grammar tasks which were conducted six times in a timeframe of 15 months. The participants in this research were 35 ML2 learners and 15 Maltese as a native/first language (ML1) speakers. This research is relevant as it attempts to fill the gap due to a lack of research on the teaching and learning of ML2 and explores whether the ML2 learning curve confirms chaos/complexity theory (C/CT) in ML2 learning.

2. Literature Review

Several concepts, theories, and schools of thought have been developed to support SLA. However, there is no single absolute concept that incorporates all the factors that influence learners' interlanguage. The cognitive and sociocultural perceptions of C/CT contribute to a great extent to SLA.

C/CT is an interdisciplinary scientific theory and a branch of mathematics that focuses on underlying patterns and deterministic laws that are extremely sensitive to initial conditions in dynamic systems that were previously thought to have completely random states of disorder and unevenness (Benbya, Nan, Tanriverdi & Yoo, 2020). It has recently attracted the attention of social scientists and educators in the field of SLA, particularly in analysing the pattern of L2 learners' performance (Larsen-Freeman, 2018).

C/CT helps us comprehend the L2 learners' interlanguage from a diverse perspective. Specifically, it analyses the sociocognitive perception and clarifies precisely how an individual's interlanguage establishes, grows and develops with time. C/CT maintains that learning is *non-linear* (Pallotti, 2018) which is in line with existing research which proposes that L2 learners may not necessarily grasp one language element prior to getting back to another aspect. C/CT is developing and gaining more importance in our modern world as a result of increased levels of interlinkage vigour, technical revolutions and adjustments (Pallotti, 2018). C/CT attempts to narrate the connection among a number of factors, components and segments that can lead to an enhanced degree of complexity (Panther & Thornburg, 2018). In its use and application in various fields including SLA, C/CT enables us to comprehend the entire learning procedure and change process (Panther & Thornburg, 2018). It also clarifies how the various factors that are associated with the learner, the teacher and the learning environment interact to facilitate the process of change. C/CT primarily concentrates on the dynamics and complex structures that could be non-linear in acquiring an L2 (Larsen-Freeman, 1997, 2018). As a non-linear system, C/CT seeks to explore the learning pattern through its 12 characteristics, namely: *dynamic, complex, non-linear, chaotic, unpredictable, sensitive to initial conditions/butterfly effect, open, self-organising, feedback sensitive, adaptive, strange attractor and fractal pattern* (Larsen-Freeman, 1997).

This study aims to explore the implications of C/CT in ML2 by linking together the 12 C/CT features and exploring the challenges encountered by foreign adults in learning ML2, especially when learning Maltese verbs. The existing literature proposes that the teacher may not control and influence what learners take into their minds because of the dark and messy nature of what learners may perceive (Żammit, 2019). Learners also might not control the images that they perceive and take into their hearts and brains. C/CT recognises this concept. Consequently, this study intends to show that C/CT is suitable and applicable in the interpretation of learners' interlanguage.

C/CT Characteristics

Although L2 learners could share a similar L1, their interlanguages could be dissimilar and highly differentiated (Matsuda, Chinokul & Sukavatee, 2017). This is due to the fact that an individual's adoption of an L1 might stem from a perspective which is distinct from another learner who has the same L1. At this point, C/CT perfectly serves to comprehend the mastery of an L2 as an L2 has a feature of a *strange attractor* that can appeal to an element of a learner's L1 (Scholz, 2017). However, another L2 learner with a similar L1 may not be attracted to the same element.

C/CT also depicts a significant *butterfly effect* in L2 learning and mastery. The butterfly effect explains the disparities in the SLA of two learners who have a similar L1 but with dissimilar initial conditions (Larsen-Freeman, 1997, 2018). It further explains that there could be varied deviations over time in SLA among such learners and that a small, insignificant change could lead to a drastic change over time (Larsen-Freeman, 1997, 2018; Murphy, Macaro, Alba & Cipolla, 2015; Żammit, 2021). Furthermore, SLA can be significantly affected by other social elements, such as individual learners' cultural backgrounds.

Interlanguage is considered as the point of intersection between L1 and L2 (Mystkowska & Pawlak, 2017). Nonetheless, it is notably vigorous and matches the C/CT *dynamic* element. The use and application of L2 are a critical aspect of transforming learners' interlanguage (Mystkowska & Pawlak, 2017). The frequency with which interlanguage develops and is established is affected by several other interacting elements referred to as *self-organisation* (Norris, Davis & Timpe, 2017). Self-organisation could lead to the *fractal pattern* characteristic in which the chaotic nature of learning can organise itself into a pattern that looks similar but appears on various

scales (Larsen-Freeman, 1997). For example, a person can achieve a higher score in a language task as compared to his or her prior score on the same task as well as a higher score on another task.

The more significant the progress of an L2 learner in comprehending and mastering L2, the better. This is because learners begin to acquire new regulations and purify the initial rules to contemplate competency in L2. The interlanguage rules and regulations are viewed as flexible (Nordquist, 2017). The fresh inputs that learners obtain can amend, erase or develop entirely different language rules and regulations. Such a feature confirms the C/CT characteristic that SLA is *open* (Larsen-Freeman, 1997, 2018). This is due to the fact that learners can obtain new information, but the production/output of the outcomes could vary and become dissimilar from the actual information/input they receive and learn.

C/CT recognises and appreciates the existence of interlanguage variability due to the various possible expressions the interlanguage creates within and across various environments. Variability may be illustrated graphically by comparing learner's expressions (O'Neill, 2015). Learners' pronouncements and articulations may be more precise but less expressive and communicative in one interaction when compared to other interactions in other contexts (Paggio & Gatt, 2018). Hence, a learner can depict a justifiable and admissible variant of an L2 but can express intolerable and unsustainable variants in other contexts/environments. C/CT acknowledges that the learning process is unpredictable and dependent on various elements (Larsen-Freeman, 2018) and anticipates that a learner can depict varying elements from the environment that can be acceptable or unacceptable depending on the specific context. Furthermore, the C/CT *adaptability* characteristic demonstrates that exposing an adult learner to an environment leads to L2 adaptation, while a lack of exposure leads to resistance, and the learner is disinterested in learning the L2 (Saylag, 2014).

C/CT consists of a notable principle of science rather than that of state. A change in L2 learning is viewed to be inevitable with time, especially in a *dynamic* structure like language administration. As such, language is considered to be dynamic irrespective of the form it takes, including synchronic and diachronic perspectives (Pathan, Memon, Memon, Khoso & Bux Gopang, 2018). Additionally, *complexity* is vital because L2 learning involves several aspects that interlink to produce the best possible interpretation of L2 learners' interlanguage (Larsen-Freeman, 2018).

Since SLA is *feedback sensitive* according to C/CT, appropriate feedback from L1 speakers, peers and educators can potentially help L2 learners enhance their SLA (Peters, Grüter & Borovsky, 2018). Tutors are of great help because they provide essential responses based on their knowledge in the interpretation and comprehension of diverse grammatical requirements in the use and application of an L2 across society; feedback not only incorporates the tutor's corrections and concerns but also involves the responses and interpretations that are directly linked to L2 (Peters et al., 2018). This feedback feature relates C/CT to the sociocultural concept.

C/CT is essential for the entire process of obtaining an L2 because it sets up and demonstrates the meaning and significance of learning. Notably, C/CT pinpoints the dissimilarities that could call for improvement for better learning of an L2 (Larsen-Freeman, 2018). It also explains the implications of pedagogy for incorporating the tutors' responses and the learners' noticeable changes. The recognition of the application of C/CT continually proves to be significant. In addition to enabling us to comprehend L2 learners' interlanguage, it enhances and stimulates extensive and comprehensive teaching procedures for L2. The C/CT school of thought makes helpful clarifications and rectifies the presuppositions and hypotheses concerning learning. Such assumptions were drawn from the conception that acquiring an L2 is invariable, linear and fixed.

C/CT emphasises that L2 educators can deploy teaching procedures and techniques that are adjustable, flexible and rational to match a language classroom's dynamic style (Al-Hoorie, Hiver, Larsen-Freeman & Lowie, 2021). An extensive understanding of C/CT enables tutors to effectively plan for unforeseen aspects of language classrooms. Educators, therefore, appreciate and acknowledge that they are required to concentrate not only on definite outcomes and goals but also on deploying techniques, frameworks and structures which

allow students to easily make correlations and connections and that assists them in developing their interlanguage. In most cases, the rules and regulations of interlanguage can be refined to meet SLA requirements (Al-Hoorie et al., 2021). Nonetheless, the interlanguage may not outstretch the terminus of the entire process of mastering L2.

C/CT clarifies that the process of learning is non-linear in two major categories. The two categories are sociocognitive and emergentism (Mirski & Gut, 2020). The SLA emergentism's perception emphasises the complexity, dynamic establishment and dynamic implementation of language. Metaphors as well as compartmentalised and dichotomised acquisition of L2 are considered to be significantly helpful to a researcher (Makhdoumi & Zoghi, 2017). Illustratively, they go a long way in simplifying the complexities that may occur in SLA. The emergentist school of thought on SLA dares the cognitive SLA theorists and scientists who depict the process of SLA as taking place in a structured manner. In the emergentist view, it can be almost impossible for an individual to run down any form of facts in the absence of *chaos*, which is another C/CT characteristic (Makhdoumi & Zoghi, 2017). The conventional perspective states that chaos is classified by a sensitive reliance on original circumstances. Circumstances for minor and inconsequential alterations can result in integrated and fractional learning (Gkiolmas, Stoumpa, Chalkidis & Skordoulis, 2021). Significantly, it involves strange attractors which prove and inform on unpredictable C/CT learning features (Larsen-Freeman, 2016).

3. Methodology

Research Questions

The main goal of this study was to explore how C/CT is applied in ML2 learning. To fully address this aim, two research questions were proposed:

(1) Can a learning pattern be observed with time in ML2 acquisition?

(2) What are the challenges that learners experience in ML2 acquisition, especially with respect to Maltese verbs?

The first question helps in providing a comprehensive review of C/CT features as indicated by the study findings. The second question serves as a guide for the implementation of C/CT since the theory may be simply implemented by analysing the challenges involved with the learning process.

Pragmatic and Longitudinal Research Design

This study adopted a pragmatic epistemology and a longitudinal research design to address the two research questions. The emphasis of pragmatism is that the development of knowledge is through an individual's reflection and the lived experience (Bazeley, 2013). The rationale of selecting the pragmatism epistemology approach was that the study aimed to explore the lived experience of a sample of 35 ML2 learners and to reflect upon the findings in line with C/CT.

Longitudinal research involves the collection of data over a long period of time (Caruana, Roman, Hernández-Sánchez & Solli, 2015). This research was conducted six times over 15 months between March 2016 and May 2017. A longitudinal design was selected to effectively determine the impact of C/CT on ML2 through the data of the ML2 adult learners' scores on the Timed Grammaticality Judgement Test (TGJT) and Verb Conjugation (VC) tasks. In addition, a longitudinal design is appropriate when there is a need to identify a learning pattern (Bardovi-Harlig, 2000). This study was focused on identifying a learning pattern for ML2 verbs.

Mixed Methods Research Design

This study adopted a mixed-method design due to the need to collect both qualitative and quantitative data to answer the two research questions (Shorten & Smith, 2017). The mixed methods research design is effective because it presents several advantages to a researcher in a specific study area. As an example, this research design enables a researcher to successfully address the dynamism in a question, which might otherwise be difficult and demanding to do, especially when employing either a quantitative or a qualitative research

methodology (Shorten & Smith, 2017). Furthermore, the mixed-method research design proves effective in comprehending a research concern or phenomenon with the general view that a single technique may not provide a conclusive understanding (Creswell & Clark, 2017).

In the current study, quantitative data were required to establish if a pattern indeed exists in ML2 learning. The qualitative data were required to explore the issues associated with ML2 learning difficulties. The quantitative data were obtained by administering the Maltese grammar tests of the TGJT and VC, while the qualitative data were obtained by means of reflective journals and interviews.

The setting of the study was three lifelong learning centres. There was a lesser population of ML2 learners, especially at the intermediate level (Levels B1 and B2), and the TGJT and VC tasks were appropriate for the intermediate level of ML2. A larger sample size would usually be preferred to small sample population sizes because the potential to make errors is limited with large samples (Vasileiou, Barnett, Thorpe & Young, 2018).

The present study had a small sample size of 35 ML2 participants. The concern of the small sample size was effectively handled by the application of qualitative techniques of interviews and reflective journals. The use of the mixed technique procedure was essential in enabling the researcher to develop numerous alternative options for the study's structure. Such a benefit is not guaranteed when using and executing a single research method (Creswell & Clark, 2017).

The use of TGJTs and VCs

The researcher's reason for incorporating the TGJTs was to access implicit knowledge (Sorace, 1996; Zhang, 2015). The use and application of TGJTs are critical, especially for psycholinguistic data. Illustratively, this permits the researcher to pinpoint and assess the learner’s comprehension of SLA. The results obtained by TGJTs are, in most cases, consistent and meet the need for reliability (Sorace, 1996). As a result, the researcher can comprehend learners' language development as they become familiarised with the entire process. TGJT is also considered to be adequate for use when the participants have time to use explicit knowledge (Sorace, 1996). If, on the other hand, the participants are expected to make decisions on the grammaticality of a sentence, they will most likely use implicit knowledge to assure effectiveness. For this reason, the participants were only given 20 minutes to judge whether 40 sentences were grammatically correct or not.

In contrast, the VC tasks which allowed the participants more time to think were used to generate explicit knowledge and assess the participants' grammatical expertise (Sorace, 1996). The interviews and reflective journals were used in this study so that the researcher could comprehend the reasons the participants scored lower or higher on TGJT and VC tasks than their previous scores on the same tasks. Generally, the triangulation technique's use and application should be streamlined to provide confidence that the research findings generate practical insight into the type and sort of interlanguage of a specific L2 learner.

The Participants

The 35 participants who were selected for this research were all adults between the ages of 19 to 74 years old who were learning ML2 at the intermediate level (B1 and B2 levels). They were not correspondent with respect to their first language, nationality or degree of competency in English and Maltese. The occupations and marital status of the participants were also not homogenous. The only similarity among the sample was that they all possessed some apprehension of English. Additionally, they had all finished the Maltese as a foreign language Level 1 (MFL1) course (Elementary and Pre-Intermediate Level of Maltese, A1 and A2 Levels). At the time of the study's commencement, they had been learning Maltese as a foreign language second level (MFL2) for two years, and all candidates had been residing in Malta for over a year.

Fifteen adult ML1 speakers were selected for this research to determine whether the data collection tasks were dependable, attested and justifiable. The ML1 speakers were essential in this research to validate the TGJT and VC tasks and their corrections.

All 50 participants in this research signed a consent form to extensively participate in this study. The participants were grouped into four major cohorts, as shown below:

1. All 35 ML2 participants sat for TGJT and VC tasks for six times and once for an interview.
2. Five of the 35 ML2 participants were willing to maintain a reflective journal and jot down thoughts weekly.
4. Fifteen ML1 participants with differentiated careers and marital statuses were selected through individual contacts for reliability and validity purposes of the TGJT and VC tasks.

Ethics Approval

The researcher was provided with an Ethical Review Approval from the University Research Ethics Committee (UREC) and Faculty Research Ethics Committee (FREC) of the University of Malta prior to the collection of data. The participants were appropriately informed, not only of the issue and study procedure but also concerning their rights (Cascio & Racine, 2018). The researcher then requested the participants to append consent forms and information sheets, and they were notified that they were free to decide if and when they should be excluded from the study process, which could be done without providing a justification. Moreover, the researcher made sure that the type of data-collection tasks were suitable to the ML1 participants prior to the entire process of data collection (Resnik, 2018).

Interview transcripts were transcribed after they were conducted. All participants in this research were assured of privacy and anonymity in the entire process and pseudonyms were applied (McKenna & Gray, 2018).

The Data Collection Procedure and Analysis

For the data collection procedure, the participants were either at their learning institutions or outside their learning institutions if they were ML1 speakers or were absent when the data collection took place. Each TGJT and VC task was conducted six times during six different months. Interviews with ML2 participants were conducted only once.

Fifteen ML1 applicants attempted the TGJT and VC tasks only once. Interviews with ML1 speakers were conducted for comparison purposes, authenticity, validity and rationality reasons. To authenticate all the tasks, the researcher used the ML1 applicants to see whether or not they agreed with each other's responses and with the researcher's.

Analysis

A one-way ANOVA test was applied to compare the mean scores of the ML2 participants. It was similarly applied for both the TGJT and VC quantitative tasks. Additionally, the researcher used LSD, which is a post hoc statistical collation, to verify areas of significant differences (Martínez-Adrián & Gallardo, 2017). This is because ANOVA only reveals that there are remarkable dissimilarities, but it does not indicate precisely where the notable variations exist (Martínez-Adrián & Gallardo, 2017). In this manner, the researcher could assess the statistical significance between the mean scores for the quantitative tasks over the six months. The researcher applied the Pearson correlation coefficient, a statistical test, to explore any link between variables (Schweder & Hjort, 2016) to determine if there were any correlations connecting TGJT and VC outcomes.

4. Results and Discussion

The Learning Patterns

Learning patterns represent the rate at which a person can learn over time (Aird, 2017). With respect to the learning patterns shown in Appendix 1, 'progress' means that the learner scored higher than their previous score. A 'plateau' means that the subsequent score was similar to the previous score. A 'decline' is an indication that the subsequent score was lower than the previous score.

Non-Linear Characteristic

It is evident in this study that the learning patterns were non-linear because most participants experienced progress, decline and a plateau in the grammar tasks of the TGJT and the VC tasks during the 15-month period in which learning of Maltese was assessed (see Appendix 1). As shown in Appendix 1, although the participants' marks were categorised into six groups, there were even differences within the same group. For example, for learning curve 1 (see Appendices 1 and 2), in January–March 2017, there were some participants who experienced progress in their TGJT scores and others in the same group who experienced a plateau or a decline. This observed learning pattern is evidence of C/CT, which states that SLA is not only non-linear but also unpredictable (Larsen-Freeman, 1997, 2011, 2018).

It was challenging to group participants based on their learning curves since progress, declines and plateau patterns varied from time to time (see Appendix 1). The participants' scores were grouped into six different learning curves, and there was variation for learning curves 1 and 6 as shown in Appendix 1 and the general learning curves drawn by GeoGebra software in Appendices 2 to 7.

Although a little progress or decline in raw scores was recorded for some participants, such variation is usually not considered statistically significant, but in this research, every kind of observed decline or progress of the non-linear learning curve was considered to be significant as evidence of one of the C/CT characteristics. Moreover, the statistically significant mean scores showed small insignificant differences in the mean scores in the first four months (i.e., March, May and October 2016 and January 2017) in which the data were collected on the TGJT and VC tasks, resulting in significant differences in the mean scores in the last two months (that is, March and May 2017; see Figures 1 and 2). This provided evidence of C/CT's butterfly effect. According to the butterfly effect, any change that is small and termed as not being statistically significant is likely to result in a dramatic change, as shown in Figures 1 and 2. The facts show that there was a dramatic change as the participants continued to learn Maltese, as indicated by each participant experiencing either a decline, a plateau or progress during the learning phases.

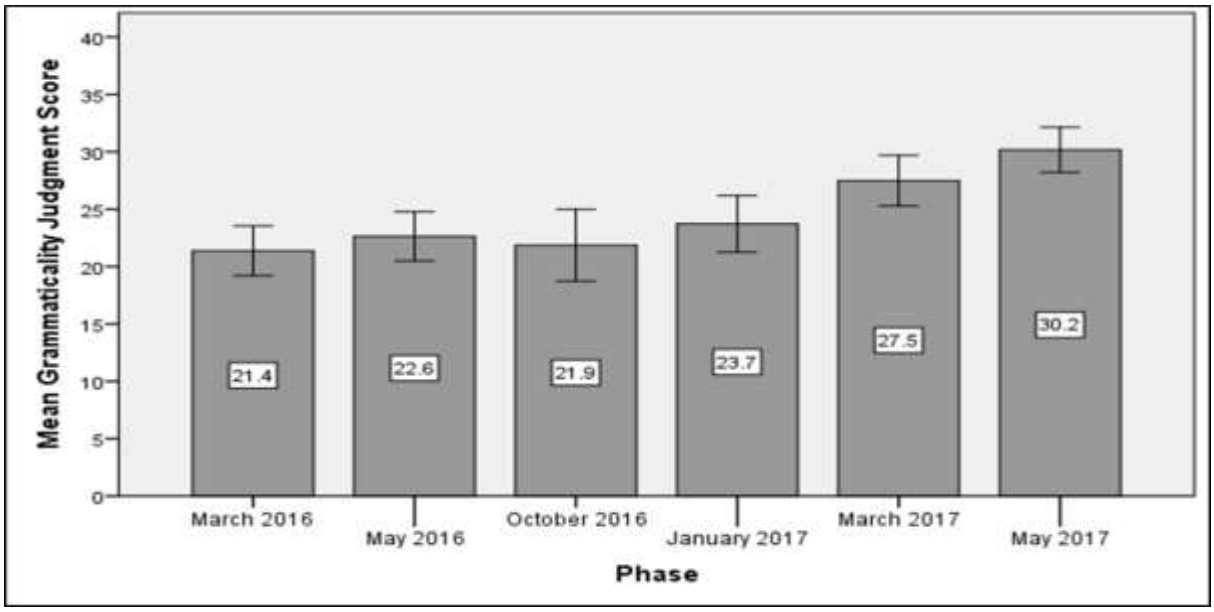


Figure 1: The Mean Scores of Timed Grammaticality Judgment Tests

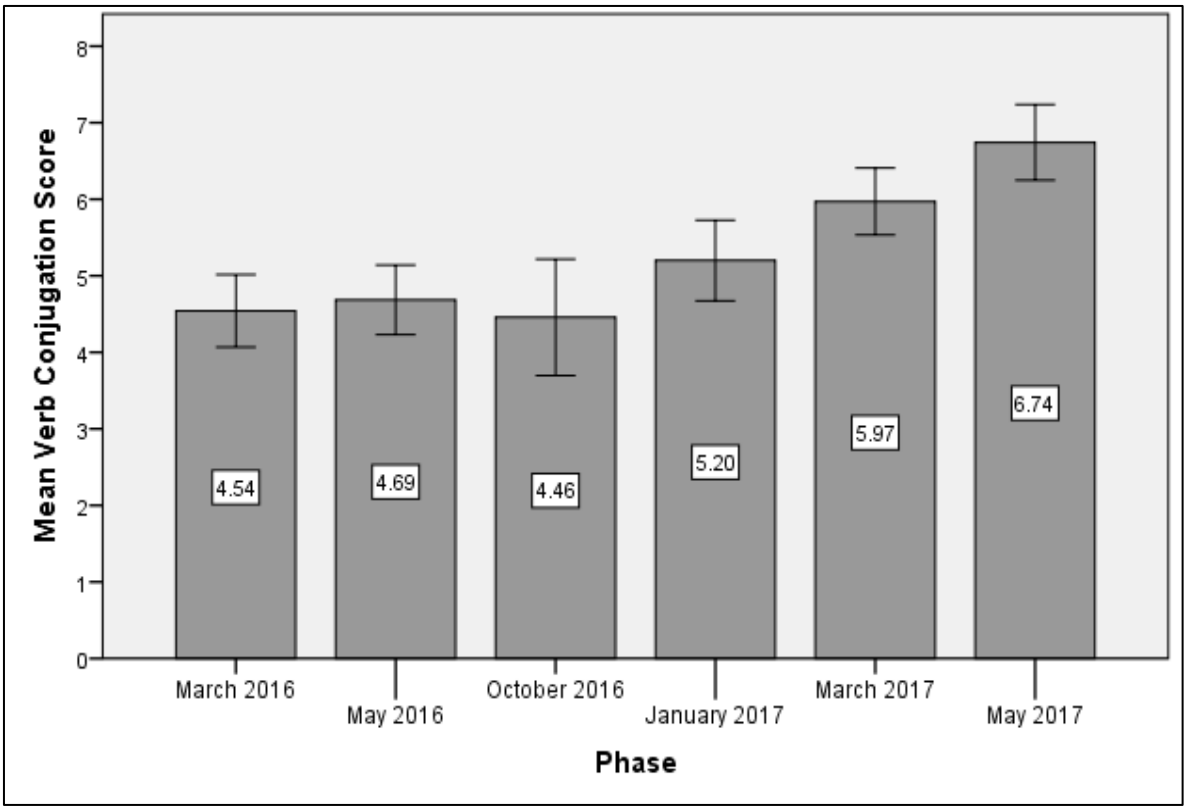


Figure 2: The Mean Scores of Verb Conjugation Tasks

An analysis of learners' performances indicates that the teacher cannot predict the performance because a student who has performed well may either improve or decline in performance and vice versa. In light of the foregoing, the findings of this study are contrary to those reported by traditional studies, such as the results of De Bot and Verspoor (2005) who avowed that SLA has a clear starting and ending point, is linear and can be displayed in a cause–effect graph. If learning is linear, it means that the learner's performance continues to improve with time and cannot decline or hit a plateau; an aspect that is not evident in the current study or in Safari and Rashidi's (2015) results; it is also not supported by C/CT.

This study's findings are supported by most researchers who acknowledge that SLA is non-linear (Larsen-Freeman, 1997, 2016, 2018; Safari & Rashidi, 2015). SLA is a complicated process that cannot be predicted, as evidenced by the varied performance of the participants over time. The unpredictability of a learner's performance is influenced by several factors as demonstrated in some learning theories, such as the completion model which emphasises that within a person's language system, SLA is influenced by social, cultural, environmental and psychological variables which work together to determine how a person learns a language (Larsen-Freeman, 2016). Other theories that form the basis for this study and that can be used to explain the complex nature of SLA include C/CT and cognitive, sociocognitive and sociocultural theories.

According to Larsen-Freeman (1997), a complex system is usually non-linear and, therefore, the effect does not depend on the cause. Since the present study has revealed that SLA is non-linear, the effect – in this case, the learners' score on the Maltese grammar tests – does not depend on the cause – in this case, the learners being taught Maltese. It is thus evident that the performance of the ML2 learners on the grammar tests does not completely depend on the instructors' teaching methods or the learner's amount of time or effort.

The non-linear pattern of SLA cannot be entirely linked to the instructor's teaching approach, but rather to the learner's internal and external environment. SLA is termed as complex in C/CT since the learning process is influenced by factors such as feedback from native speakers, peers and teachers as well as the learner's age, motivation, attitude and strategies of learning (Larsen-Freeman, 2011). It is expected that learners will always

present their subjective reasons for their poor performance on L2 tests. To comprehend how C/CT applies to SLA, the difficulties experienced and mentioned by the 35 ML2 learners will be explored and linked to C/CT.

Difficulties in learning ML2

All of the 35 participants were faced with a variety of problems ranging from personal to environmental that led to either a decline, progress or plateau in TGJT and VC task performance. The existence of these problems associated with ML2 learning gave rise to evidence that C/CT truly prevails. The learning difficulties will be discussed according to the identified themes and then linked with C/CT. The findings are arranged into the common emerging themes in relation to the theories that form the basis for this research.

Lack of both implicit and explicit knowledge

Several participants reported that their low scores were due to not being exposed to the Maltese language during their four-month summer vacation period (i.e., June–October 2016), Christmas vacation for three weeks and Easter vacation for two weeks. Thirty-one participants acknowledged that while they visited other countries, they neither spoke nor listened to Maltese and thus, implicit knowledge could not occur. As evening classes were not provided during the holidays, most participants lacked explicit knowledge. For example, a participant who was a doctor said:

I went back to Macedonia during summer to visit my family and for an important medical course as I need to continuously update my knowledge in my work. I didn't have time to study or to talk to anyone in Maltese.

(Interview, 24/05/17, Danijela)

The underlying issue of lack of implicit and explicit knowledge is not a lack of L2 exposure but rather the break in exposure during the vacation period. Saylag (2014) asserted that exposure of an adult learner to an environment will lead to adaptation of L2, while a lack of exposure can lead to resistance, and a learner might not be interested in learning L2. Extended breaks in exposure to the Maltese language could have led participants to a decreased knowledge in ML2.

Lack of feedback

The majority of the participants who were married to partners that were Maltese reported that their partners were not willing to speak in Maltese, and if the ML2 participants spoke in Maltese to their partners or ML1 speakers, the latter were not willing to correct their mistakes in Maltese and even answered them in English instead. Furthermore, one of the participants who was an English maid stated that her husband informed her that she did not even need to learn Maltese:

My husband keeps on asking me: Why are you learning Maltese when we talk in English, and everyone here understands English? It is not an important language at all. You can speak it only in Malta. It's just a waste of time so that you won't do household chores!

(Interview, 25/05/17, Gabby)

According to C/CT, learning is also feedback sensitive (Larsen-Freeman, 1997); hence, learning might not have taken place when ML1 speakers were too polite to correct ML2 learners during their interactions. A participant who was a Russian writer stated that writing was important and that it has helped him in his ML2 learning more than ML1 speakers:

Many people are so wrong when thinking that you will know the foreign language better if you live in that country where this foreign language is being spoken there. For instance, Maltese are so kind and polite that they always reply to me in English even if I talk to them in Maltese. So, it's not living in Malta which made me learn Maltese but my motivation and my ability to learn. I used to also have fun writing dialogues in Maltese; some of the dialogues were actual conversations that I have heard on the bus or at a shop or by the beach.

During evening classes, we should be allowed to write dialogues to each other or to fictional characters and then recite it in class.

(Interview, 26/05/17, Vladimir)

Culture shock

Some participants blamed a difference in culture between Malta and their home country as a barrier to ML2 learning. Twenty-three participants reported that they were influenced by culture shock and needed to adapt themselves to the Maltese culture.

Over time, Martina, a Czech ICT assistant, started to feel a sense of belonging in Malta and felt more comfortable with the Maltese culture, the Maltese people, their food and the Maltese language. In fact, she claimed:

I have accepted the side that the Maltese people drive. Now for me, driving on the left is fine and I got used to it. Even the hot climate in Malta especially in July and August, the lack of greenery and trees especially during summer when everything looks so dry, the Maltese food, its political system, the fireworks' noise during the morning, the fact that we cannot drink tap water, the Maltese language ... all of this is sounding familiar to me now. Now I am finding it difficult when I return to my home country for the holidays because I feel that I am getting used to the Maltese culture.

(Interview, 24/05/17, Martina)

Adaptability to the environment (and hence to the L2 environment) is also a characteristic of C/CT (Larsen-Freeman, 1997). Culture differences between Malta and the ML2 learners' original cultures imply there are difficulties in learning ML2. Culture shock can be countered by cultural intelligence in which the learner becomes flexible enough to understand, listen, analyse and reflect on the L2 culture (Aravind & Dhar Dwivedi, 2015). Learners need to unlearn and challenge their own cultural beliefs and practices as otherwise these could impede ML2 acquisition in this context. Nonetheless, C/CT states that SLA is unpredictable (Larsen-Freeman, 2016), and the ML2 learner who adapts to the Maltese culture is not guaranteed to learn ML2 without experiencing any problems. Besides, it is difficult for a teacher to declare that all ML2 learners will similarly resolve the problem of culture shock.

Adult learners' commitments

Thirty-two participants reported that they required more time to learn ML2. These participants reported that learning Maltese requires commitment in terms of time; yet it is difficult to find the time to learn ML2 due to obligations, such as a family, children, a garden, pets, hobbies or the need to keep the house clean. Some participants perceived being older and other such external factors (in this case, having adult duties) as a reason for their poor performance in ML2 learning.

C/CT's characteristic of openness requires that external factors which influence SLA should be considered in the learning process (Gonsior, Domzalski & Gątarek, 2014). The problem of poor performance is further enhanced by the fact that C/CT is sensitive to the initial conditions (Larsen-Freeman, 2016). There is an increased probability that the commitments of the adult learners as well as L1 transfer affected the initial conditions, and thus, the learners could not grasp the important aspects in ML2 leading to a decline in ML2 test performance.

Learner's memory issues due to ageing

Seventeen participants declared that they were ready to give up learning ML2 as they were experiencing memory problems. Growing older and experiencing memory loss was cited as the reason for the participants' declining performance, especially in VC tasks from October 2016 to the period of January 2017. Memory loss was also found not only to affect ML2 learning but also the participants' L1. Consequently, the participants were very frustrated when they tried very hard to remember a word, even in their L1.

An English teacher admitted that his memory is failing him due to the ageing process as he had a good memory when he was a child.

Sometimes I just cannot remember the word or the conjugation of the verb. I know that we did it in class or that I have seen it somewhere. I also know that I know it, and then, I just cannot remember it. It is so frustrating! What's worse is that sometimes I realise that I am remembering a word in Maltese but I forgot the same word in English. Then after some time, I remember how to say that word in English. This is quite impressive considering that I have been learning Maltese for only three years! It shows that I am getting old. This never happened to me when I was younger.

(Interview, 24/05/17, Robert)

This highlights the critical period hypothesis, in that SLA processes in adults are slower and less successful than in children younger than the age of puberty (Muñoz, 2017). The maturation mechanism has been proposed as a synchronous constraint on both the ability to lose a language, as L1 attrition shows, and the ability to acquire L2 (Muñoz, 2017). This implies that the brain plasticity for both L1 attrition and SLA are age dependent and will correspond to a qualitative change in individual learning ability (Gathercole & Baddeley, 2014).

However, some learners performed well in ML2 tests despite having advanced ages, and it can thus be said that other factors interfere with learning apart from memory loss. In a situation in which SLA presents with a progressive curve, which is declining as well as plateauing in nature, the fractal concept as a characteristic of C/CT is shown (Larsen-Freeman, 1997, 2016). This creates a need to examine all the possible factors associated with the decline in the performance on an L2 test before settling on the fact that poor performance is associated with age.

As Table 1 and Figure 3 show, most participants experienced the same pattern in their learning curve on the TGJT and VC tasks and this is evidence of the C/CT fractal pattern characteristic, which is a pattern that looks similar but appears on various scales (Larsen-Freeman, 1997). Figure 3 shows the positive correlation between the TGJT and VC scores. As Table 1 shows, the correlation coefficient between TGJT and VC scores was 0.676 which is close to one, and it shows a positive correlation. The P-value is 0.000 which is less than a 0.05 level of significance, and thus, the correlation is statistically significant.

Table 1: The Correlation between TGJT and VC scores

	Pearson Correlation	VC score
TGJT score	Correlation Coefficient	0.676
	P-value	0.000
	Sample size	35

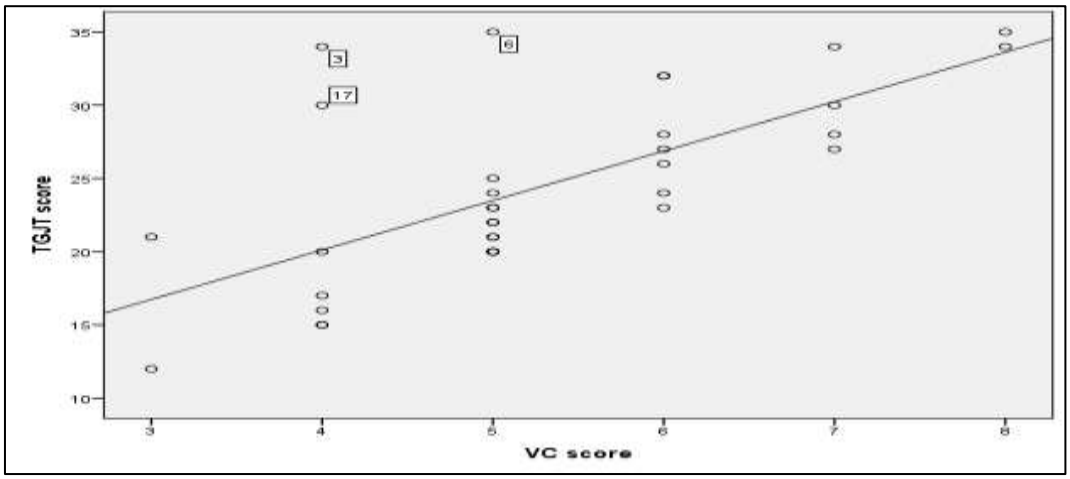


Figure 3: The Pearson Correlation between TGJT and VC scores

Frustrations associated with either stagnation or slow progress in ML2 learning

Twenty-nine participants reported being frustrated due to the absence of progress in ML2 learning. The experience of frustration was further aggravated as these participants were attending evening classes and tried hard to interact with ML1 speakers, and yet their ML2 performance was stagnating. A Serbian team leader of a cruise liner commented:

Even though I am an intermediate student of Maltese, I am aware that I have not achieved perfect mastery of Maltese. I feel that I am not that very competent in Maltese when I talk to Maltese in Maltese. I might know the verbs, as I have studied them by heart like a parrot, but that doesn't mean that I can use the verbs suitably when I am talking in Maltese. My nine-year-old daughter is better than me. We started learning Maltese together, but at least she is able to talk and play with the other Maltese children, and many times when we read a book or watch a Maltese drama on TV, she is translating from Maltese to Serbian and not the other way round.

(Interview, 24/05/17, Jasmina)

Jasmina's comment supports C/CT's strange attractor characteristic (Larsen-Freeman, 1997), implying that no matter how much time and effort a learner dedicates to learning a language, s/he still can obtain unpredictable results; in this case, lower scores than previously on the same grammar tasks. The period during which the L2 learner is experiencing a plateau is termed as chaotic because the new content being taught results in a collapse of the content that was taught earlier (Safari & Rashidi, 2015). The stagnation in the learning process usually continues until the learner understands how to incorporate the new concept that has been taught into the already existing concepts which were previously taught. It can thus be said that ML2 learners were not making progress because they were in the SLA chaotic phase.

Difficulties in making effective utilisation of language transfer

All of the 35 ML2 participants acknowledged that the Maltese language was either similar or different from their L1, and this either positively or negatively influenced ML2 learning. It was acknowledged by most learners that if they were familiar with Arabic, then they would perform well in learning Maltese, especially Maltese grammar. Knowledge of Italian was associated with easier learning of Maltese vocabulary. In fact, the existence of positive language transfer (Shatz, 2016) was reported in cases in which the participants' L1 was Arabic or Italian. In other cases, negative consequences of language transfer were reported. Positive transfer from a source language might be attained due to the facilitating effects of the L1 in SLA (Alonso, 2016; August & Shanahan, 2017). Most learners reported that they experienced a negative transfer due to the differences between their L1 and Maltese.

The issue of language transfer could confirm the C/CT characteristics of adaptability, self-organisation and feedback sensitivity. This means that for SLA to be effective, the ML2 learner needs to not only adapt to the new environment but also, for example, accept and use feedback from ML1 speakers or peers. Furthermore, a learner's interlanguage is impacted by interacting factors referred to as self-organisation (Norris, Davis & Timpe, 2017).

Limitations associated with personality, especially extroversion and introversion

Some participants reported that their improved performance could be attributed to the fact that they have an extroverted personality, were not afraid of making mistakes and, thus, kept on speaking Maltese with their peers and teacher in class and when meeting ML1 speakers. Studies have suggested that extroverts are inclined to learn more aspects of an L2 than introverts (Lightbrown & Spada, 2013). On the other hand, several participants reported that their performance improved even though they have an introverted personality, contrary to what many studies have claimed.

Jasmina stated that she was an introvert and admitted that she felt shy in talking to ML1 speakers:

I come across as a very introverted person, and this could have been the reason my husband left me five years ago. I am really shy to speak in class and I do not dare speak in Maltese with a Maltese person. First of all, Maltese people are very fast when they talk to each other in Maltese, and I can barely understand them, even though I have been attending private lessons and evening classes in Maltese for three years.

(Interview, 24/05/17, Jasmina)

As observed by Ratner (2010), connections with other people are not natural among introverts since they prefer to cautiously choose with whom they interact. Moreover, this participant recorded an improvement in her performance on the Maltese grammar tests and she attributed this to the fact that she liked reading Maltese books and listening to the radio and podcasts in Maltese. At the beginning of the ML2 learning process, the difference in personality can be linked to C/CT's butterfly effect since being either an introvert or an extrovert will influence ML2 learning and is termed as the learner's initial condition.

The fact that personality may have had a positive influence in SLA gives further credence to C/CT's unpredictable and complex characteristics, and it is not pegged on personality, particularly introversion and extroversion among adult learners. An extroverted personality facilitates more learning since these individuals are not afraid to interact with L1 speakers, and they have been found to learn L2 faster than introverts (Lightbrown & Spada, 2013). However, in a contrary finding, Zafar (2017) reported that introverts learn faster and are better at L2 in comparison to extroverts because they listen better, thereby enhancing their L2 implicit knowledge. Hence, it is difficult to predict the learner's performance depending on the learner's personality, and this further portrays the fact that SLA is a complex process as indicated by one of the C/CT characteristics.

The teacher's overdependence on using traditional teaching methods

Thirty-three participants reported that their ML2 learning went through a plateau period or that they even obtained lower scores due to their teacher's traditional methods, such as sitting down during the whole lesson; distributing long lists of verb conjugations and vocabulary translated to English; writing on the board and expecting the learners to just passively sit; lack of engagement in classes; failure to listen; and lack of positive feedback. Such traditional methods were very boring and ineffective for 95% of the participants. Other reasons mentioned by the participants were that the teacher did not link previous knowledge with current knowledge, the teacher insisted that everything should be learnt by heart and that there was a lack of engagement during lessons through role play and group work. The participants preferred learning methods which included visual, auditory, reading and kinaesthetic learning styles.

C/CT is characterised by sensitivity to feedback which is an important aspect in SLA (Larsen-Freeman, 1997, 2018). The teaching method needs to be one in which ML2 learners are given feedback and are engaged in lessons so that they can consider the areas in which they need improvement.

5. Limitations of the Study

Sample Size

Several limitations arose in the course of conducting the research. Among the limitations was that some participants were withdrawn from the research. The sample size in the academic year 2015/2016 was that of 39 ML2 learners who were taking part in the MFL2 intermediate level course at three differentiated lifelong learning institutions in Malta. In the subsequent academic year of 2016/17, the sample size fell to 37 ML2 learners as two learners failed to pursue the MFL2 course. This research population size further fell to 35 participants as a learner was not ready to be a subject in this research and another participant left Malta indefinitely. Due to the small participant size, the outcomes cannot be generalised to the entire foreign learner populace in Malta, which is, in any case, undisclosed.

Data Collection Instruments

The other limitation was that the researcher wanted the five reflective journal contributors to perceive that they could interact candidly and overtly with the researcher. The researcher did not want to be entirely

authoritarian in imposing restraints on what they could note in their reflective journals. However, this influenced the reflective journal outcomes since these participants at times noted other elements which impacted their ML2 learning that contradicted what the researcher perceived to be helpful for the research questions. Furthermore, the researcher had to extensively depend on the information the participants gave her in their interview or jotted in their reflective journals. Hence, the researcher was compelled to note down their viewpoints without being able to authenticate their responses.

6. Recommendations for Further Research

Further study could determine the best teaching techniques for ML2 learners to absorb Maltese verbs, for instance, via action research. An assessment could also be made subsequent to various learning techniques related to Maltese verbal tense and elements for diverse ML2 groups in order to evaluate the pertinence of the teaching techniques.

There could also be research concentrating on the discerned language distance concept, one of the elements of Crosslinguistic Influence theory. Language distance is contemplated to be an element affecting the simplicity or difficulty with which learners obtain and master an L2.

7. Conclusion

The findings of this research support C/CT, as SLA is depicted as a complex, dynamic, chaotic, unpredictable, adaptive, open, self-organising and non-linear procedure. Additionally, this study confirms that SLA is in correspondence with the butterfly effect, is feedback sensitive, is a strange attractor and has a fractal pattern. The research outlined various cognitive and sociocultural provocations that impact the accomplishment, proficiency and achievement of ML2 learners. The valuable areas include but are not limited to similarities and distinctions in ML2 and the learner's L1, lack of both implicit and explicit knowledge; culture shock; the commitments of adult learners; loss of learners' memory due to ageing; problems encountered during the initial stages of learning ML2; limitations associated with personality, especially extroversion and introversion; difficulties interacting with Maltese people; insufficient language-related support from Maltese partners; and the teacher's overdependence on traditional teaching methods. The absence of exposure to Maltese while on vacation, social interlinkage and memory concerns were of vital importance. According to this research, despite learning challenges, SLA occurs with time.

8. Abbreviations

C/CT - Chaos/Complexity theory
EU - European Union
L1 - first/native language
ML1 - Maltese as a first language
ML2 - Maltese as a second language
L2 - Second language
SLA - Second language acquisition
TGJT - Timed Grammaticality Judgement Test
VC - Verb Conjugation

9. Declarations

Ethics approval and consent to participate
The study was approved by the University of Malta's University Research Ethics Committee (UREC).

Availability of data and material
Please contact the author for data requests.

Funding
The author did not receive any financial support for the authorship and publication of this article.

Competing Interests
The author declares that she has no competing interests.

Author's contributions
JŻ conceived and designed the study. JŻ recruited the participants, conducted the interviews, collected data and used the analysis tools. JŻ performed the analysis. JŻ wrote the paper.

Acknowledgements
The author wishes to thank Prof Antoinette Camilleri Grima and Dr Cathy Benson for their inspiration and support during this study.

10. References

1. Aird, C. (2017). *Learning Curve*. UK: Allison & Busby.
2. Al-Hoorie, A., Hiver, P., Larsen-Freeman, D. & Lowie, W. (2021). From replication to substantiation: A complexity theory perspective. *Language Teaching*, 1-16. https://doi.org/10.1017/S0261444821000409
3. Alonso, R.A. (2016). *Crosslinguistic Influence in Second Language Acquisition*. Bristol, England: Multilingual Matters.
4. Aravind, G. & Dhar Dwivedi, L. (2015). Culture Differences: A Major Barrier in English Language Teaching and Learning. In *Journal of Culture, Society and Development,12*, 61 – 64.
5. August, D. & Shanahan, T. (2017). *Developing literacy in second-language learners: Report of the National Literacy Panel on Language-Minority Children and Youth*. Routledge: Taylor & Francis Group. https://doi.org/10.4324/9781315094922
6. Bardovi-Harlig, K. (2000): Tense and aspect in second language acquisition: form, meaning and use. In: Richard Young (ed.), *Language Learning Monograph Series.* Oxford: Blackwell.
7. Bazeley, P. (2013). *Qualitative Data Analysis Practical Strategies*. Los Angeles, U.S.: Sage.
8. Benbya, H., Nan, N., Tanriverdi, H. & Yoo, Y. (2020). Complexity and information
9. systems research in the emerging digital world. *MIS Quarterly, 44*(1), 1-17.
10. https://doi.org/10.25300/MISQ/2020/13304
11. Camilleri Grima, A. & Żammit, J. (2020). The acquisition of verbal tense and aspect in Maltese by adult migrants. *Journal of Multilingual Theories and Practices, 1*(2), 149-167. https://doi.org/10.1558/jmtp.13426
12. Caruana, E.J., Roman, M., Hernández-Sánchez, J. & Solli, P. (2015). *Longitudinal studies. Journal of thoracic disease, 7*(11), E537–E540. https://doi.org/10.3978/j.issn.2072-1439.2015.10.63
13. Cascio, M. A. & Racine, E. (2018). Person-oriented research ethics: integrating relational and everyday ethics in research. *Accountability in research*, *25*(3), 170-197. https://doi.org/10.1080/08989621.2018.1442218
14. Creswell, J.W. & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage publications, 61-94; 143- 170.
15. De Bot, K.L.W & Verspoor, M. (2005). *Second language acquisition: An advanced resource book*. London: Routledge.
16. Gathercole, S. & Baddeley, A. (2014). *Working Memory and Language Processing*. Hove: Psychology Press.
17. Gkiolmas, A., Stoumpa, A., Chalkidis, A., & Skordoulis, C. (2021). A Combination of Historical Physics Documents and Other Teaching Tools for the Instruction of Prospective Teachers in Chaos and Complexity. In *Fundamental Physics and Physics Education Research*. Springer, Cham, 251-261.
18. Gonsior, M.W., Domzalski, A. & Gątarek, B. (2014). Complexity Theory and SLA. *Michigan Teachers of English to Speakers of Other Languages Conference*. 29-37.
19. Larsen-Freeman, D. (1997). Chaos/complexity science and second language acquisition. *Applied Linguistics, 18*(2), 141-165. https://doi.org/10.1093/applin/18.2.141

20. Larsen-Freeman, D. (2011). A complexity theory approach to second language development/acquisition. In D. Atkinson (Ed.), *Alternative approaches to second language acquisition*. London: Routledge, 48-72.
21. Larsen-Freeman, D. (2016). Classroom-oriented research from a complex systems perspective. *Studies in Second Language Learning and Teaching,6* (3), 377-393. https://doi.org/10.14746/ssllt.2016.6.3.2
22. Larsen-Freeman, D. (2018). Resonances: Second Language Development and Language Planning and Policy from a Complexity Theory Perspective. In *Language Policy and Language Acquisition Planning.* Springer: Springer International Publishing, 203-217. https://doi.org/10.1007/978-3-319-75963-0_12
23. Lightbrown, P. & Spada, N. (2013). *How languages are learned* (4th Ed.). Oxford: Oxford University Press.
24. Makhdoumi, M. & Zoghi, M. (2017). Complex Dynamic Systems Theory (CDST) Approach in SLA. *Modern Language Studies Journal*, *4*(1), 1-10.
25. Martínez-Adrián, M. & Gallardo-Del-Puerto, F. (2017). The Effects of Language Typology on L2 Lexical Availability and Spelling Accuracy. *International Journal of English Studies, 17*(2): 63-79. https://doi.org/10.6018/ijes/2017/2/256411
26. Matsuda, P., Chinokul, S. & Sukavatee, P. (2017). Assessing Second Language Writing: The 16th Symposium on Second Language Writing. *Journal of Second Language Writing, 37*. https://doi.org/10.1016/j.jslw.2017.09.002
27. McKenna, L. & Gray, R. (2018). The importance of ethics in research publications. *Collegian, 25*(2), 147-148. https://doi.org/10.1016/j.colegn.2018.02.006
28. Mirski, R. & Gut, A. (2020). Action-based versus cognitivist perspectives on socio-cognitive development: culture, language and social experience within the two paradigms. *Synthese 197*, 5511–5537. https://doi.org/10.1007/s11229-018-01976-y
29. Muñoz, C. (2017). The development of language awareness at the transition from primary to secondary school. In Mayo, M. & García P. (Ed.). *Learning foreign languages in primary school: Research insights*. Bristol, UK: Multilingual Matters, 49-67. https://doi.org/10.21832/9781783098118-005
30. Murphy, V. A., Macaro, E., Alba, S. & Cipolla, C. (2015). The influence of learning a second language in primary school on developing first-language literacy skills. *Applied Psycholinguistics, 36*(5), 1133-1153. https://doi.org/10.1017/S0142716414000095
31. Nordquist, R. (2017). *What is a second language (L2)?* Retrieved from: https://www.thoughtco.com/second-language-1691930
32. Nordquist, R. (2020). *Interlanguage Definition and Examples*. Retrieved from: https://www.thoughtco.com/what-is-interlanguage-1691074
33. Norris, J., Davis, J. & Timpe, V. (2017). *Second language educational experiences for adult learners*. New York: Routledge. https://doi.org/10.4324/9781315230801
34. O'Neill, S.P. (2015). Sapir–Whorf Hypothesis*. Handbook of Language and Social Interaction*. Oxford: Blackwell. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781118611463.wbielsi086
35. Paggio, P. & Gatt, A. (2018). *The Languages of Malta.* (Studies in Diversity Linguistics 17). Berlin: Language Science Press.
36. Pallotti, G. (2018). Doing interlanguage analysis in school contexts. *Communicative proficiency and linguistic development, 1*(1), 159-190.
37. Panther, K.U. & Thornburg, L.L. (2018). Metaphor and Metonymy in Language and Thought: A Cognitive Linguistic Approach. *Synthesis philosophica, 32*(2), 271-294. https://doi.org/10.21464/sp32202
38. Pathan, H., Memon, R.A., Memon, S., Khoso, A.R. & Bux Gopang, I. (2018). A Critical Review of Vygotsky's Socio-Cultural Theory in Second Language Acquisition. *International Journal of English Linguistics 8*(4), 232-236. https://doi.org/10.5539/ijel.v8n4p232
39. Peters, R.E., Grüter, T., & Borovsky, A. (2018). Vocabulary size and native speaker self-identification influence flexibility in linguistic prediction among adult bilinguals. *Applied Psycholinguistics, 39*(6), 1439-1469. https://doi.org/10.1017/S0142716418000383
40. Resnik, D. B. (2018). *The ethics of research with human subjects: Protecting people, advancing science, promoting trust*. Springer, Cham. https://link.springer.com/book/10.1007%2F978-3-319-68756-8

41. Safari, P. & Rashidi, N. (2015). Language Learning as Chaos/Complexity System: Evidence Based on Iranian EFL Learners' Backgrounds. *Turkish Online Journal of Qualitative Inquiry (TOJQI), 6*(4), 22-56. https://doi.org/10.17569/tojqi.77606
42. Shatz, I. (2016). *Native language influence during second language acquisition: a large-scale learner corpus analysis*. In Proceedings of the Pacific Second Language Research Forum (PacSLRF 2016). Hiroshima, Japan: Japan Second Language Association, 175–188.
43. Scholz, K. (2017). Encouraging free play: Extramural digital game-based language learning as a complex adaptive system. *Calico Journal*, *34*(1), 39-57.
44. Schweder, T. & Hjort, N. L. (2016). *Confidence, Likelihood, Probability: Statistical Inference with Confidence Distributions*. Cambridge: Cambridge University Press.
45. Shorten, A. & Smith, J. (2017). Mixed methods research: expanding the evidence base.
46. *Evidence-Based Nursing, 20*(3), 74-75. http://dx.doi.org/10.1136/eb-2017-102699
47. Sorace, A. (1996). The use of acceptability judgments in second language acquisition research. In Ritchie, W. & Bhatia, T. (Eds.). *Handbook of second language acquisition*. San Diego, CA: Academic Press, 375-409.
48. Vasileiou, K., Barnett, J., Thorpe, S., & Young, T. (2018). Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. *BMC medical research methodology, 18*(1), 148. https://doi.org/10.1186/s12874-018-0594-7
49. Zafar, S. (2017). Who learns foreign language better - introverts or extraverts? *Pertanika Journal of Social Sciences and Humanities (JSSH).* In: https://www.centralcharts.com/en/news/843116-who-learns-foreign-language-better-introverts-or-extroverts
50. Żammit, J. (2019). Learning Patterns in the Acquisition of Maltese as a Foreign Language by adults. *Malta Review of Educational Research (MRER), 13*(1), 41-63.
51. Żammit, J. (2021). *A Verbal Odyssey. Learning Maltese as a foreign adult.* Germany: GRIN Verlag.

INFO

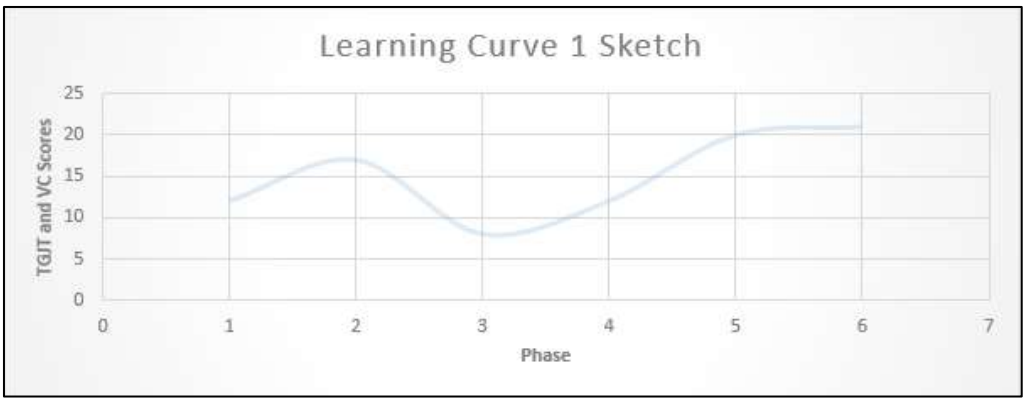
Corresponding Author: ***Dr Jacqueline Żammit, Department of Languages and Humanities Education Faculty of Education, University of Malta.***

How to cite this article: ***Dr Jacqueline Żammit, The Significance of Chaos/Complexity Theory in Maltese as a Second Language Acquisition, Asian. Jour. Social. Scie. Mgmt. Tech.2022; 4(2): 321-340.***

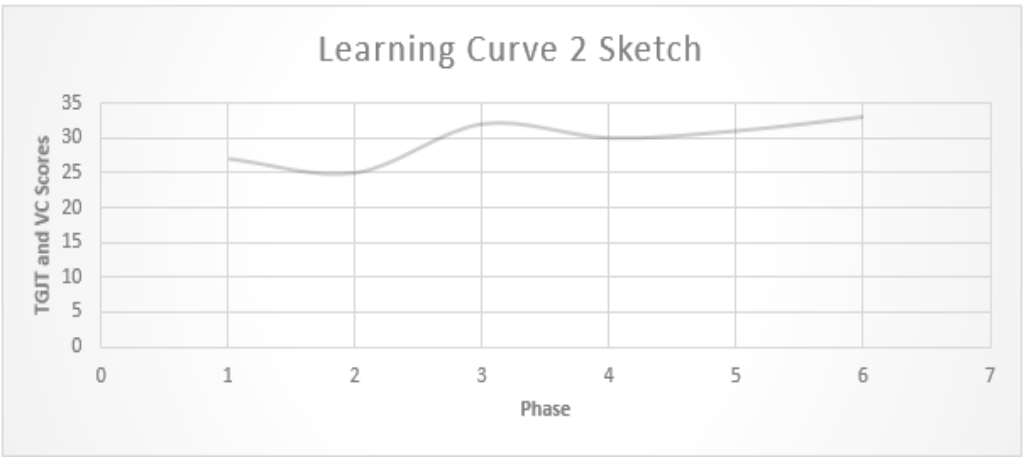
Appendix 1: The Description of TGJT and VC Learning Pattern

Learning Curve	Participants	TGJT / VC	March-May 2016 (TGJT1-2) (VC1-2)	May-October 2016 (TGJT2-3) (VC2-3)	October 2016 – January 2017 (TGJT3-4) (VC3-4)	January-March 2017 (TGJT4-5) (VC4-5)	March -May 2017 (TGJT5-6) (VC5-6)
Learning Curve 1	Adefolake Alfonso Clara Claudio Danijela Jasmina Saima Theo Namata Nazia Tytti Aksa	TGJT	progress	decline	progress	progress / plateau/ decline	progress/ decline
		VC	progress plateau decline	decline	progress	progress plateau/ decline	progress plateau
Variation 1a	Martina	TGJT	plateau	decline	progress	progress	decline
		VC	plateau	decline	progress	progress	plateau
Learning Curve 2	Carlo Gabby Hilde Talin Olga Andrei Charif	TGJT	decline	progress	decline progress/ plateau	progress / decline	progress/ plateau
		VC	decline/ plateau/ progress	progress	decline/ plateau	progress / plateau/ decline	progress/ plateau
Learning Curve 3	Ahmed Daniel Halar	TGJT	decline	decline	progress	progress decline	progress
		VC	decline/ progress	decline	progress	progress	progress decline plateau
Learning Curve 4	Sister Shai Sabal	TGJT	plateau	decline	progress	decline/ progress	progress
		VC	plateau	decline	progress/ plateau	plateau/ progress	plateau
Learning Curve 5	Jane, Jeremy Robert	TGJT	decline	progress	decline/ progress	progress	decline
		VC	decline/ plateau	progress	decline	progress	decline/ plateau
Learning Curve 6	Aksel Brunilda Mohammed Marika	TGJT	progress	progress	progress/ decline	progress /	progress/ plateau
		VC	progress	progress/ plateau	progress/ decline plateau	plateau plateau/ plateau/ decline	progress
Variation 6a	Irina Nataliya Vladimir	TGJT	progress	progress	decline	progress	plateau
		VC	progress/ decline/ plateau	progress/ decline	decline/ progress	progress / decline/ plateau	progress/ plateau

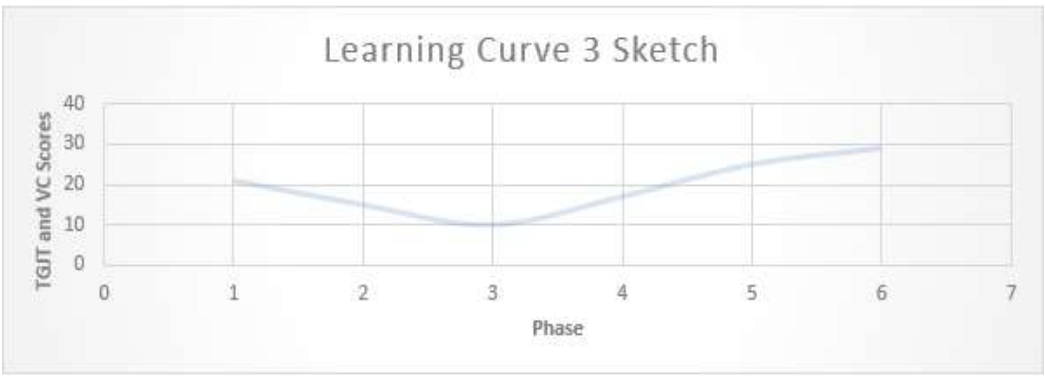
Appendix 2: The General trend of Learning Curve 1 on TGJT and VC



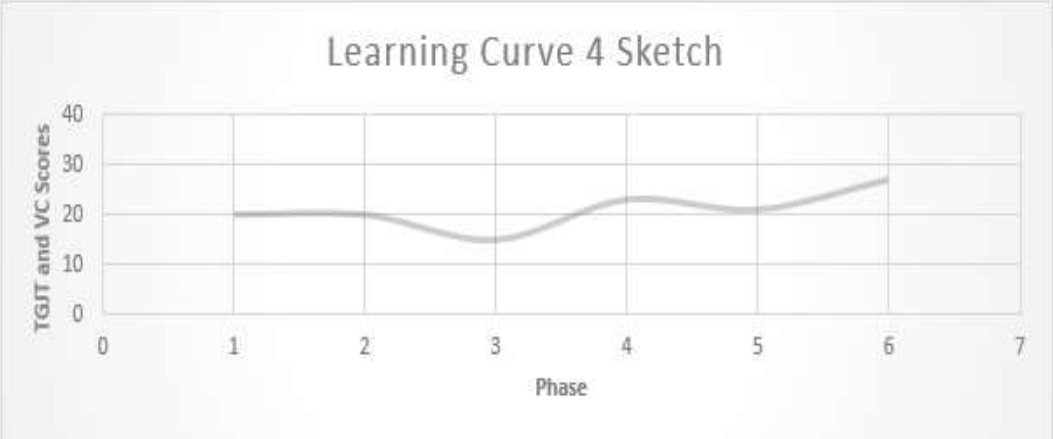
Appendix 3: The General trend of Learning Curve 2 on TGJT and VC



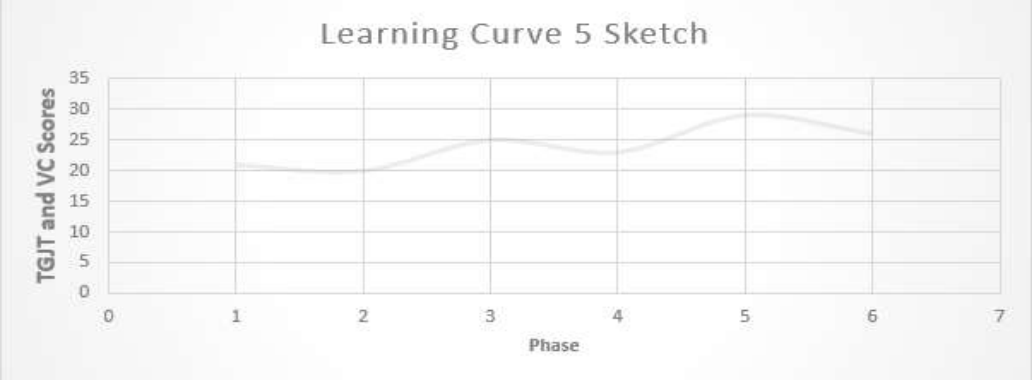
Appendix 4: The General trend of Learning Curve 3 on TGJT and VC



Appendix 5: The General trend of Learning Curve 4 on TGJT and VC



Appendix 6: The General trend of Learning Curve 5 on TGJT and VC



Appendix 7: The General trend of Learning Curve 6 on TGJT and VC