

The dynamism of strategic learning: Complexity theory in strategic L2 development

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Abstract

Learners of foreign languages (L2s) apply strategies to support learning processes and L2 development. They select strategies according to their individual needs and preferences and adjust their strategic actions to suit situational circumstances and contextual conditions. A holistic investigation of strategic L2 learning processes requires the integration of numerous interconnected, flexibly-interacting influences, which are at constant interplay with each other and whose development is difficult to predict. Validated as effective in other fields of applied linguistics, complex dynamic systems theory (CDST) can also provide an appropriate frame for researching strategic L2 learning. Based on state-of-the-art methodological guidance for complexity research, this article presents the re-analysis of empirical data from a previous study through a complexity lens. It further examines the suitability of CDST in strategy research, explores its practical value, and demonstrates that a complexity perspective can generate new, profound information about strategic learning.

Keywords: CDST; complex dynamic systems; complexity theory; dynamism; language learning strategies; strategic language learning

1. Introduction

Curiosity and skepticism are two of the forces that keep researchers ahead of the game. In combination, they fuel the work of scholars around the globe. This article is inspired by a curiosity about strategic language learning in combination with skepticism about complex dynamic systems theory (CDST), which is steadily gaining popularity in applied linguistics.

Learners' actions to support language learning have been researched since the mid-1970s (Hosenfeld, 1976; Rubin, 1975). Tightly integrated in the complex, flexible processes of foreign language learning, strategies are notoriously difficult to define. Learners select strategies according to personal preferences and situational circumstances and adapt them to suit dynamic, contextual changes. This article presents the application of a complexity approach to the re-analysis of data from a previous study about language learning strategies (Amerstorfer, 2016). It explores whether new, valuable knowledge about strategic language learning can be gained with research methods for complexity theory and evaluates the practical significance of CDST for strategy research.

The clarification of some key issues regarding strategic language learning and a review of the literature about strategy research are followed by comprehensible and concise explanations of CDST. The two themes merge in an empirical study about strategic language learning, which leads to an evaluation of the practical value of CDST in strategy research.

2. Language learning strategies (LLS¹) and strategic language learning

The beginning of research into LLS is marked by tentative attempts at describing LLS and how they support successful language learners in developing a foreign language (L²) (Hosenfeld, 1976; Naiman, Fröhlich, Stern, & Todesco, 1978; Rubin, 1975; Stern, 1975). Realizing the complexity involved in strategic language learning generated increasingly comprehensive descriptions of LLS (Oxford, 1990; Wenden, 1987). Despite continued efforts at defining the concept and functions of LLS (Cohen, 1998; Oxford, 1999), the absence of a precise and generally acknowledged definition and the emergence of some discrepancies concerning terminological issues resulted in criticism about an ambiguous overall concept of LLS and a weak theoretical foundation (Dörnyei, 2005; Dörnyei & Skehan, 2003; Ellis, 1994; Macaro, 2006).

¹ LLS refers to language learning strategies in the singular and plural form.

² L2 refers to any language(s) a person develops after the age of three, which is after the person's native language (L1) has commonly been well established (Dewaele, 2011; Lorette & Dewaele, 2015). L2 does not imply any information regarding the number of languages a person knows.

A substantial content-analytic study of 33 definitions of learning strategies (Oxford, 2017) resulted in the latest, comprehensive definition:

L2 learning strategies are complex, dynamic thoughts and actions, selected and used by learners with some degree of consciousness in specific contexts in order to regulate multiple aspects of themselves (such as cognitive, emotional, and social) for the purpose of (a) accomplishing language tasks; (b) improving language performance or use; and/or (c) enhancing long-term proficiency. Strategies are mentally guided but may also have physical and therefore observable manifestations. Learners often use strategies flexibly and creatively; combine them in various ways, such as strategy clusters or strategy chains; and orchestrate them to meet learning needs. Strategies are teachable. Learners in their contexts decide which strategies to use. Appropriateness of strategies depends on multiple personal and contextual factors. (p. 48; original italics)

It is difficult to reduce the complex notion of LLS to a one-liner. It may be possible if the definition follows a thorough discussion of all related issues (e.g., Griffiths, 2018b). Oxford (2017) chose to *include* the related issues in her latest definition, which makes it so comprehensive. Besides defining the concept, Oxford clarifies the use and the characteristics of LLS, which has been criticized as too complex to be usable from a pragmatic point of view (Thomas, Rose, & Pojanapunya, 2019). Nevertheless, concurring with Thomas and Rose (2019, p. 254), Oxford's (2017) definition is "the best we have right now" as it explicitly emphasizes dynamism, flexibility, and complexity and stresses the importance of context involved in strategy choice and application. Instead of a restricted perception of LLS with limited value for theory and practice (Dörnyei, 2009), the lens is widened to a broad, holistic understanding of strategic L2 learning (Amerstorfer, 2016; Gao, 2010; Gu, 2012, 2018; Oxford, 2017).

Strategic L2 learning distinguishes itself by definition from non-strategic processes through the component of consciousness (Cohen, 1998, 2018; Griffiths, 2008; Oxford, 2011; Williams, Mercer, & Ryan, 2015), which necessitates a distinction between L2 *learning* and L2 *development* (Larsen-Freeman, 2015a). The two concepts are inseparable and commonly used synonymously, but their differences are relevant for the current discussion. In general, L2 learning concentrates on the learner as the agent of actions to progress in the development of knowledge, ability, and skills in the target language. L2 learning means actively studying a language, which implies conscious efforts on behalf of the learner to increase L2 proficiency. Strategic L2 learning is deliberate although the degree of consciousness involved in choosing a strategy can decrease with its repeated, successful application. Automated strategy choice becomes habitual, "which no longer reflects the learner's attention, awareness, intention, or cognitive effort" (Oxford, 2017, p. 40).

L2 development, on the other hand, describes the unlimited, non-linear alterations in L2 knowledge, ability, and skills and includes effortless processes

that are beyond a learner's consciousness, for example, when a lexical item transfers from passive to active vocabulary. Besides progress, L2 development can also include undesirable, unintentional L2 alterations, for instance, habitually over-using gap-fillers such as *like* and *you know* or adopting a rare accent or regionally acceptable grammatical structures that deviate from the standard. Also temporary restrictions to the learning progress are possible. For instance, an inability to master simple constructions of the passive voice (e.g., *a net is used to catch a fish*) can inhibit the correct use of more complex constructions of the passive voice (e.g., *a net had been used to catch a fish*). Occasional regressions are the norm in L2 development (Larsen-Freeman, 2015a) although the overall aim is progress.

3. Researching strategic L2 learning

Quantitative methods have dominated LLS research (Mizumoto & Takeuchi, 2018) with the *Strategy Inventory for Language Learning* (SILL; Oxford, 1990) as the most frequently used instrument for data collection (White, Schramm, & Chamot, 2007) due to its easy handling for researchers and participants (Amerstorfer, 2018b). If adapted to suit specific purposes and research environments, the SILL is still a valuable and popular research tool despite its early publication date (Amerstorfer, 2018b; Rose, 2019). Other instruments for quantitative data collection that have also contributed to LLS research are, for example, the *Motivated Strategies for Learning Questionnaire* (Pintrich, Smith, Garcia, & McKeachie, 1991), the *Vocabulary Learning Questionnaire* (Gu & Johnson, 1996), the *Survey of Reading Strategy* (Mokharti & Sheorey, 2002), the *Language Strategy Use Inventory* (Cohen, Oxford, & Chi, 2006), and the *Metacognitive Awareness Listening Questionnaire* (Vandergrift, Goh, Mareschal, & Tafaghodtari, 2006).

However, in recent years, qualitative and mixed-methods approaches have gained popularity (e.g., Amerstorfer, 2018a; Gkonou, 2018; Griffiths, 2018a). While statistical results achieved through quantitative research methods can generate information about large numbers of learners, case studies with a qualitative orientation focus on the strategic behavior of individuals and result in detailed descriptions of situated L2 learning. Both approaches reveal valuable insights, but the outcomes of group studies cannot be generalized for individual learners, and the results of individual case studies are not generally true for groups of learners. Contextual circumstances and individual learner differences are too fundamental in educational research to allow generalizations in either direction.

Complex dynamic systems theory (CDST) merges multiple, heterogeneous datasets and analyses them within the context in which they occur. It recognizes the flexible relationships between the individual influences on learners and acknowledges the naturally arising, dynamic alterations in L2 learning situations.

CDST can change one's perception from a narrow view on isolated LLS and strategy categories (e.g., social, cognitive, affective strategies) to a broad perspective of strategic learning, where L2 learning is understood as "emergent from and dynamically interconnected with the environment" (Larsen-Freeman, 2018, p. 59).

Dörnyei, MacIntyre, and Henri (2015a) note that by 2010, research in SLA³ had undergone a "dynamic paradigm shift" (p. 1). CDST had become an important theme in the literature although most work had been theoretical in nature (p. 1). The body of CDST-related literature in the strategy field is also steadily expanding with whole chapters being dedicated to the discussion of complexity in strategic learning (Oxford, 2017; Wang, 2018). Other recent examples of complexity-related strategy research, albeit without overtly building on CDST, have been published by Cohen and Wang (2018) and Sasaki, Mizumoto, and Murakami (2018). Cohen and Wang (2018) conducted an empirical study about fluctuation in the functions of LLS with a reference to complexity theory in the discussion of the findings. Sasaki et al. (2018) investigated the developmental trajectories in L2 writing strategies in a mixed-methods study that incorporates a multitude of contextual influences. Further empirical work is underway by Oxford and Gkonou (in press), who analyze the complexity of emotion regulation strategies, and MacIntyre and Gregersen (2019), who conduct a pre-post, non-verbal strategy training study with change-point analysis.

4. Complex dynamic systems theory and L2 development

Complex dynamic systems theory entered the spheres of SLA after it had already been applied for about 40 years to research in natural sciences like physics, biology, and meteorology. What language teachers and researchers (e.g., van Lier, 1988) had already known for decades, namely that teaching is complex and that no two lessons and no two students are ever the same, could now be investigated in a scientifically appropriate manner. CDST takes a comprehensive approach rather than isolating individual aspects of L2 learners (e.g., emotions, beliefs), learning processes (e.g., strategy use, turn taking), or learning contexts (e.g., teaching materials, educational policies). A holistic perspective is valid and vital because L2 classrooms rarely display simple cause-and-effect incidents with predictable outcomes; instead they exhibit overall complex, intertwined, and constantly changing situations (de Bot, Lowie, & Verspoor, 2007; Dörnyei, MacIntyre, & Henri, 2015b; Larsen-Freeman, 2015b, 2018; Mercer, 2011, 2013).

³ In concurrence with Larsen-Freeman (2015a) and Oxford (2017), the term *acquisition* is exclusively used to refer to the academic field of second language acquisition (SLA).

The agents in L2 classrooms, learners and teachers, are at permanent interplay with each other, albeit at fluctuating levels of intensity and in varying constellations. On an individual level, the agents are characterized by a host of interconnected personal features, such as their self-concepts as actors in the L2 classroom, individual preferences regarding learning and teaching, anxieties and inhibitions, motivation, and much more. Learners' and teachers' identities outside the L2 classroom are also valid components. For example, the status they have in the communities they belong to, their religious faith, and their positions within family constellations influence their perceptions of themselves and their actions. The agents in L2 classrooms belong to a "unique network of individual cultures" (Mercer, 2016, p. 14) and are engaged in a "symbiotic co-adaptive relationship" (Ushioda, 2015, p. 47) with context, which integrates social, psychological, and environmental processes. The significance of an individual's cultures and sub-cultures as well as the reciprocal relationships between contextual elements and the agents in L2 classrooms are flexible and fluctuate across time.

The features that characterize learners and teachers as well as contextual aspects in and around the classroom are intertwined in complex systems, which are by definition "composed of at least two but usually a multitude of interrelated components which may themselves be complex systems" (Mercer, 2011, p. 63). Nested within each other (Bronfenbrenner, 1995, 2005; Davis & Sumara, 2006; Oxford, 2017; Oxford & Amerstorfer, 2018), complex systems have blurry boundaries that do not clearly demarcate one system from related systems and the context. As a complex system, L2 development is thus embedded in its spatial and temporal environment. A change in one feature anywhere in the system may affect other features within the immediate system, other features in connected systems, or the overall system as a whole. Such changes initiate new alterations whose outcomes are difficult to foresee.

Moreover, dynamic systems can attain so-called "attractor states" or simply "attractors," which describe "the outcome or pattern [a system] has fallen into through self-organisation" (Hiver, 2015, p. 25). As opposed to de Bot et al. (2007), who contrast *attractor* states with *repeller* states, Hiver (2015) emphasizes that "attractor states are not necessarily perceived as pleasant or desirable states that a person wishes to be in" (p. 21). Furthermore, "attractors do not actually exert a pulling force of attraction in the way that gravity or magnets do" (p. 21). Attractor states simply describe what a system is doing at a specific moment before it further evolves towards the next attractor state in another critical moment. It has been emphasized in the literature that complex dynamic systems are in a constant state of flux. Nevertheless, continuous movement and development can cause a system to reach and retain a form of equilibrium or "dynamic stability" (Larsen-Freeman & Cameron, 2008a, p. 43), which does not mean stagnation but continuous adaptation to maintain a certain balance.

CDST enables researchers to analyze the complexity and dynamism of L2 development, which integrates learners' cognitive involvement and social interaction (Larsen-Freeman, 2017; Larsen-Freeman & Cameron, 2008a) as well as psychological and environmental processes (Ushioda, 2015). CDST can bring order to what may seem chaotic and examine the relationships between individual features, the symbiosis of interconnected sub-systems, and the behavior of a system as a whole. It is suited to analyzing the combination and relation of multiple components as it investigates "the collective functioning of the interrelated parts of the system as one organic whole [that] cannot be deduced from an understanding of the individual components" (Mercer, 2011, p. 64).

5. The study

The study investigates one L2 learner's strategy use as a dynamic system. The case under investigation was part of a larger study conducted previously (Amerstorfer, 2016), whose data are now re-analyzed from a complexity angle. The current study draws on best practice in related domains (e.g., Mercer, 2011), explores new methodological terrain in LLS research, and aims to resolve the following questions:

1. What are the purposes of the LLS used by the learner?
2. To what degree is the complex and dynamic nature of LLS observable?
3. What new insights does the complexity approach reveal that were not gained in the original study?

5.1. Methodology

Hiver and Al-Hoorie (2016, 2020) offer guidance in the implementation of a CDST-oriented research approach in applied linguistics. They present a detailed set of guiding questions (2016) and a selection of research methods for CDST that is suitable for qualitative, quantitative, and mixed-methods research in the field (2020). The methodology of the current study is oriented towards process tracing (Beach & Pedersen, 2013; Bennett & Checkel, 2015), which takes hypothetical statements as a starting point and analyses empirical evidence to make inferences "that update our confidence in the presence of a hypothesized causal mechanism" (Beach & Pedersen, 2013, p. 73). Process tracing was selected as a suitable method to test and refine two hypotheses about LLS which were developed from an extensive literature review and the findings of the original study because it can "clarify the scope of conditions under which a hypothesis is transferable to other cases" (Hiver & Al-Hoorie, 2020, p. 112).

Hypothesis 1: Due to their flexible and dynamic nature, the participant's strategies can have varying purposes depending on contextual influences.

Hypothesis 2: Psychological influences such as emotions, self-confidence, and motivation affect the participant's strategic actions.

5.1.2. Research environment

The original study (Amerstorfer, 2016) was conducted at an Austrian vocational school whose educational philosophy demands a large amount of self-regulation on the part of the students. About half to two-thirds of the English lessons per week follow a communicative approach and are traditionally teacher-centered. In the remaining lessons, the students complete assignments, which must be submitted electronically by a certain due date. They do this independently of the teacher and in cooperation with peers. During these cooperative learning periods, the teacher functions as a consultant. The innovative teaching approach cultivates learner cooperation and, consequently, enhanced social skills. It demands advanced time-management and discipline from the students, who in return enjoy an increased amount of autonomy in comparison to more traditional, teacher-centered education.

5.1.3. Data collection

The original study investigated the LLS use of five teenaged learners of English as a foreign language (EFL) whose first language is German. Over the course of four weeks, each participant was engaged in an initial interview, in which a strategy inventory (Oxford, 1990) was administered, three classroom observations during cooperative learning lessons, and three semi-structured, retrospective interviews. The overall objective was to gain a holistic notion of the individual participants as strategic EFL learners, which was supported by questions about the participants' private lives and their study habits in and outside of school. The strategy inventory was immediately followed by questions related to the indicated frequency of strategy use. Here the focus was on the statements that received the lowest and highest possible ratings on a 5-point scale from *never or almost never true of me* to *always or almost always true of me*. The lesson observations were video-recorded and followed by semi-structured stimulated-recall interviews. All interviews were conducted in German (for details about the research design, see Amerstorfer, 2018a).

The 2016 study confirmed that research in L2 development profits from a retrospective perspective (Dörnyei, 2014; Larsen-Freeman & Cameron, 2008b). The interviews revealed details about strategic learning that could not have

been detected in observations. They provided opportunities for the participants to express their personal views and opinions, which “help identify aspects of context that seem salient to particular individuals, and thus help constrain the multitude of potential contextual factors to be considered” (Ushioda, 2015, p. 49). Although any interview’s capacity to access participants’ memory and awareness is limited, the retrospective interviews were invaluable in the 2016 study.

5.1.4. Casing and agents

CDST requires the specification of the phenomenological validity and the boundaries of a system, although “boundary does not imply closure” (Hiver & Al-Hoorie, 2016, p. 745). The system under investigation is the strategy use of 18-year-old EFL learner Sabrina (pseudonym) over four weeks. The phenomenological validity of the case is underpinned by what is already known about strategic language learning and Sabrina’s strategy use.

Out of the five cases in the original study, Sabrina’s case was selected at random to avoid selection bias (Hiver & Al-Hoorie, 2020). Other agents in the system are cooperation partners, other students in Sabrina’s class, and a teacher, with whom Sabrina engaged in the observed EFL lessons. Influences by people outside of the immediate school environment (e.g., Sabrina’s family members) were not considered. The variables that were isolated to analyze Sabrina’s case were strategic learning actions and factors that demonstrate a direct or indirect influence on her LLS.

5.1.5. Data analysis

The sources of data for the current study are Sabrina’s interviews (one semi-structured initial interview and three semi-structured stimulated recall interviews) and the strategy inventory (Oxford, 1990). The transcribed interview data underwent multiple rounds of coding in the data-management software Atlas.ti until further coding could not contribute new information to the analysis. During the coding process, strategic actions were identified and their situational purposes analyzed. Furthermore, contextual influences on Sabrina’s strategy use were marked, and connections between individual influencing factors in the system were outlined. Potential causal influences on the application of LLS were hypothesized, and, as Hiver and Al-Hoorie (2020) suggest, the predictions of a wide range of alternative explanations were drafted together with supporting and counter evidence to counteract confirmation bias. The memo function of the software was used to note down any thoughts that occurred to the researcher during the coding process. These memos were invaluable in the interpretation of the data and the emerging insights.

5.2. Results

5.2.1. Contextual information

Sabrina generally likes going to school and especially enjoys the cooperative learning pedagogy promoted at her school. While her favorite subjects are accounting and math, she feels ambivalent about studying EFL. On the one hand, she values learning English in school because it is a universal language that enables her to watch the latest movies before their dubbed versions come to the local cinemas. Moreover, Sabrina listens almost exclusively to English music and thinks that she will need English in her later work-life. On the other hand, she finds learning foreign languages difficult and cumbersome and struggles to achieve positive grades in English and Spanish. If it were not mandatory in school, Sabrina probably would not study English. She never reads or writes in English for pleasure. Nevertheless, she uses some English expressions for fun when talking with friends in German, for instance, *sweetie*, *swag* (even though she does not know what it means), and *yolo* (acronym for *you only live once*).

Sabrina enjoys working autonomously during cooperative learning periods because she can take breaks and listen to music. She favors creative tasks such as designing posters and writing texts but complains that teachers often underestimate the amount of work they require. Sabrina owns a laptop computer and a smartphone, which she uses daily for school and private matters. If Sabrina needs support with her homework, she calls or texts a classmate.

5.2.2. Results of follow-up questions related to the strategy inventory

With regard to the 12 statements rated *never or almost never true of me* (Table 1) in the 50-item strategy inventory (Oxford, 1990), Sabrina explained that some of the strategies simply do not work for her, for example, using rhymes (Item 5) or acting out new English words to remember them (Item 7). Preparing flashcards to study vocabulary (Item 6) takes too much time. Instead, Sabrina prefers to read new words and phrases repeatedly to memorize them. As Sabrina does not know any people whose first language is English, some statements do not apply to her or are restricted to using English at school (Items 14, 35, 48, and 49). Sabrina mentioned a school excursion to England in the previous year, but she lost contact with her host family. She does not read in English except for school (Item 16) and does not have a specific strategy for reading in English (Item 18). When asked why she never or almost never makes up new words if she lacks the right ones in English (Item 26), Sabrina explains that she tries to rephrase instead by using other, familiar English words. She adds in a dismissive voice that she would rather say a

word in German than make up words that do not exist and are bound to be wrong. Sabrina gives no explanations for Items 20 (“I try to find patterns in English”) and 43 (“I write down my feelings in a language learning diary”).

Table 1 Strategy statements with the lowest possible rating

Item in the inventory	Strategy statements with the lowest possible rating (<i>never or almost never true of me</i>)
5	I use rhymes to remember new English words.
6	I use flashcards to remember new English words.
7	I physically act out new English words.
14	I start conversations in English.
16	I read for pleasure in English.
18	I first skim an English passage (read over the passage quickly) then go back and read carefully.
20	I try to find patterns in English.
26	I make up new words if I do not know the right ones in English.
35	I look for people I can talk to in English.
43	I write down my feelings in a language learning diary.
48	I ask for help from English speakers.
49	I ask questions in English.

Regarding the statements with the highest possible rating (Table 2), Sabrina explains that she is fond of a British accent and tries to imitate it as much as possible (Item 11). Before she reads out words in English, she tries to imagine how they are pronounced (Item 12) with a British accent because that sounds cool and fun. During English conversations at school, Sabrina uses hand gestures (Item 25), which has proven very useful to her. Sabrina pays attention when someone speaks in English (Item 32) because she finds what they say interesting. Furthermore, careful listening supports comprehension and thereby increases the learning progress, in her opinion. To Sabrina’s mind, trying to find out how to be a better learner of English (Item 33) mainly applies to vocabulary learning. She believes in trial and error to determine which strategies work best for her and how she can memorize words more easily. Sabrina does not explain her rating for Item 45 (“If I do not understand something in English, I ask the other person to slow down or say it again”).

Table 2 Strategy statements with the highest possible rating

Item in the inventory	Strategy statements with the highest possible rating (<i>always or almost always true of me</i>)
11	I try to talk like native English speakers.
12	I practice the sounds of English.
25	When I can’t think of a word during a conversation in English, I use gestures.
32	I pay attention when someone is speaking in English.
33	I try to find out how to be a better learner of English.
45	If I do not understand something in English, I ask the other person to slow down or say it again.

5.2.3. Purposes of Sabrina's strategies

Sabrina's data show instances of strategies with clearly definable, seemingly single purposes, for example, evaluating how much time is available to complete an assignment and planning further action accordingly (2:3, 3:14, 3:20).⁴ These two strategies, which always co-occurred, were additionally aimed at lowering the distress Sabrina experienced due to the rising time pressure before the approaching submission date of the assignment. The purposes of other strategies were also multi-faceted, for example, consulting an online dictionary (2:5) or another person (2:4) to find out the translation of an unknown phrase. These strategies fulfill two purposes: first, getting an English-German translation and second, avoiding a mistake, as Sabrina states in the interview:

Interviewer: . . . and all of a sudden you asked me something.

Sabrina: Yes, because I couldn't find anything useful in the online dictionary and then I prefer asking a person rather than writing down something wrong. (2:4)⁵

Some strategies were directly connected to L2 use, for instance, mixing German and English (4:3, 4:13) "to avoid stopping in the middle of a sentence" (4:15). Others were aimed at creating favorable conditions for learning, for example, optimizing concentration (2:13, 3:5, 3:8), taking breaks to drink water (4:4), and listening to music to relax between tasks (2:14).

The following situations represent examples of strategies with purposes that are not directly connected to L2 learning. Sabrina's partner was busy with a different assignment because she had frequently been absent from school and had to catch up on what she had missed (2:2). In order to prevent a delay or even missing the joint assignment's submission date, Sabrina took the initiative and started working on it by herself. Even though Sabrina felt frustration in that situation, she would later share the results with her absent partner to save her the time and effort. The strategic actions of disregarding the prescribed mode of pair work and supporting her uncommitted partner are not directly linked to L2 learning, so technically they are not LLS. Nevertheless, they are important, contextual aspects of the complex system of Sabrina's strategic L2 learning. Sabrina does not want to fall behind in English, so the purposes for her actions are connected to her own achievements and L2 progress. Simultaneously, she wants to help her peer catch up on what she has missed, which displays good social competence and empathy.

⁴ In parentheses there are code numbers of quotes in Atlas.ti.

⁵ In this situation, the researcher did not answer Sabrina's question and clarified that her sole intention was to observe.

Keeping good relations with peers is a strategy purpose that was observed on multiple occasions. In one situation, for instance, Sabrina and her partner, who was present in that lesson, divided the workload of a task. Each student answered half of the questions in a text. While Sabrina was concentrated on reading, her partner interrupted her and asked a question, which Sabrina immediately answered (3:6). Although helping others is not an actual LLS, it is crucial in Sabrina's strategic learning for five reasons. First, it generally contributes to good relationships with peers, which adds to a positive classroom atmosphere and hence to a pleasant learning environment. Second, Sabrina profits from helping her partner because the two students are a team and will be jointly graded. Third, Sabrina's support has a motivational effect on the partner, which will consequently increase the partner's investment in the completion of the assignment, hence contributing positively to the joint achievement and therefore benefitting Sabrina. Fourth, having a good reputation as a reliable and caring cooperation partner increases Sabrina's popularity in the class. As foreign languages are Sabrina's sore point, her kindness will pay off when she needs help and her peers support her in return. Fifth, it is in the nature of human beings that helping others makes us feel good about ourselves. However, Sabrina is a person who generally cares for others, so her motives were probably genuine.

5.2.4. Complexity and dynamism of LLS

Sabrina used numerous strategies during the observed lessons and adjusted the strategic actions according to the intended purposes and situational circumstances. She demonstrated flexibility in the way she applied strategies when she ended or altered strategic actions according to contextual influences. For example, Sabrina halted a dictionary search when she spontaneously remembered an English expression while looking it up. In another situation, Sabrina altered a set of peer-interview questions, which her partner had developed, although it was not Sabrina's agreed responsibility (4:5, 4:9). Sabrina's partner was supposed to conduct the peer-interview but was again absent during that lesson. Deciding to do the peer-interview herself caused Sabrina to adjust the questions according to her interpretation of the task. The original team decisions were complemented by a strategic change of action caused by the altered conditional circumstance of her partner's absence. Another example of the flexibility of Sabrina's strategic actions occurred just before the actual peer-interview. Sabrina's supposed peer-interview partner appeared to be intensely concentrated on a different task when Sabrina was ready to start the interview. So, due to Sabrina's thoughtful nature and the new situational circumstances, she spontaneously invited a different student as interviewee (4:6).

Sabrina's approach towards reading English texts also exhibits complexity. As she reflects,

it simply depends on how intensively you deal with an assignment. . . . This is how you learn English . . . so, if you only quickly read over a text, it is obvious that nothing will stick with you, that you won't remember anything. But if you really deal with it intensively, it's different. (3:23)

For Sabrina, intensive reading in an L2 generally implies large investments of effort and time. Specifically in this situation, it further involved a partner, a set of questions about the content of the text, mono-lingual and bi-lingual online dictionaries, and a vocabulary book to keep record of new words and phrases. At the time of reading, Sabrina was already aware that her investment in reading the text would affect her understanding of a short video on the same topic, the quality of the peer-interview (both of which were part of the same assignment), and her participation during a group discussion in a follow-up lesson.

Another example of complexity was noted in Sabrina's strategic manner of handling unknown phrases in a given text (2:9). She translated them into German and then searched for "simpler" expressions in English that she could use in an imminent group discussion. While she was clarifying the vocabulary of the new text, Sabrina was already planning strategic actions for a lesson in the future. She anticipated how she could participate in the discussion without making mistakes and embarrassing herself in front of her peers and the teacher.

5.2.5. Psychology in strategic L2 learning

Sabrina tries to avoid mistakes to prevent unwanted consequences like ridicule and bad grades. Moreover, she applies strategies to reduce distress and frustration generated by the approaching submission deadline and her uncommitted cooperation partner. Overall, she manages to maintain a positive attitude, for example, by persuading herself that the tasks are better suited for individual work rather than pair work (2:11) when she finds herself working alone on an assignment that was designed for two. This reflects Sabrina's optimistic attitude towards life in general and EFL learning in particular. Instead of complaining about her absent partner, Sabrina quickly came to terms with the changed situation and assigned it a positive value, which had a self-motivating effect.

Furthermore, Sabrina decided to share the completed tasks with her partner to support her recovery. For Sabrina, it is vital to maintain valuable relationships with peers. A more egoistic person would find it unfair to share the results of assignments with a lazy student. They would believe that such students do not deserve any special treatment particularly due to the greater investment by a single

person completing the tasks rather than a pair. On the contrary, Sabrina felt sorry for her peer and decided to help. Supporting others is crucial to Sabrina, which was noticed on several occasions during the lesson observations (3:6, 3:13, 3:15, 4:7).

The strong sense of community in Sabrina's class builds on mutual support and respect,⁶ which was demonstrated, for example, by using earphones in order to keep the classroom quiet (4:2), preventing others from being distracted (4:6), lending things to others (4:8), and a polite tone among the students (4:18). Sabrina is compassionate towards her classmates and appreciates that they are empathetic too (3:17). In fact, Sabrina explained that over the years, solid friendships have developed within the class community (4:7).

In addition to the students, the English teacher also contributes to the pleasant learning atmosphere. She does not interrupt students during cooperative learning lessons and provides a secure environment in which individuals are not embarrassed or ridiculed. For example, she provided opportunities for confidential, individual consultations when returning written exams (3:9). The teacher's sensitive actions reduce stress and anxiety, demonstrate respect and support, and have a role-model effect. Due to the group cohesion and the positive relationships among the students and with the teacher, Sabrina and her peer-interview partner showed no L2 anxiety when they spoke in English (4:11, 4:12), although Sabrina repeatedly mentioned a fear of making mistakes.

The psychological effect of some strategic action was not always immediate. For instance, when Sabrina did not know the English word for remote control during the interview, she used a hand gesture instead (4:16). Her interview partner correctly guessed the German word *Fernbedienung* to interpret the gesture. After the interview, the two students searched for the word in the dictionary, which created a sense of togetherness and affirmation that it is acceptable to have gaps in vocabulary knowledge. This experience contributed to Sabrina's self-confidence as an L2 user. Demonstrating mutual empathy during L2 conversations, for instance, by active listening or backchannelling, puts students at ease and contributes to a secure learning environment.

Sometimes Sabrina lacks motivation and does not make much progress during cooperative learning lessons. In an interview, she expressed a realistic and pragmatic attitude towards temporary lapses of motivation:

Sometimes I'm not motivated at all . . . I'm not making any progress but . . . I have to finish at home or work really fast in the next lesson . . . Being lazy during cooperative learning will sooner or later fall back on you. (3:16)

⁶ For more information about the interpersonal relationships in Sabrina's class, see Amerstorfer (in press).

In such situations, Sabrina considers her options. She can either finish the tasks in her leisure time or work at a faster pace in the following lesson. Procrastination is not an option because it would lead to further problems and eventually bad grades.

Overall, the data show that Sabrina appreciates the innovative teaching approach at her school and the methodological variety in the cooperative learning assignments. Sabrina radiated pride when talking about the positive relationships she cultivates with peers and teachers and the strong solidarity among the students in her class. All of this contributes to Sabrina's positive attitude despite her fear of mistakes and her poor achievement in foreign languages.

5.3. Discussion

Complexity research about LLS requires a holistic perspective on contextualized L2 learning. All strategic actions must be considered, including those that are not directly targeted at language improvement. It is essential to acknowledge a wide context, situational circumstances, and dynamic relationships between individual agents. Furthermore, a suitable research methodology that integrates a multitude of dynamic influences and facilitates the analysis of situated strategic learning is necessary.

The 2016 study, whose data is the basis of the current study, used a grounded theory approach, an inductive research method that does not impose any hypotheses on the data. In contrast, process tracing deducts hypotheses from existing knowledge and tests them against the new information. Although the fundamentally different methodological approach of the current study led to additional findings, the re-analysis of the 2016 data caused some problems because the original study was not designed with CDST in mind. In retrospect, integrating self-report (e.g., keeping a diary) in addition to the observations and interviews could have enriched the case with insights from the student's perspective. Moreover, a longer duration of the study could have elicited further information on the developmental trajectory of the learner's strategy use even though a long duration is not a binding criterion for complexity research or process tracing.

"Recycling" the 2016 data was not a smooth process. The first rounds of data analysis were aimed at identifying all expressions of strategic L2 learning, categorizing them according to their types and functions (Oxford, 2011),⁷ and defining their specific intended purposes. However, the typological conceptualization did not contribute any significant value to the study and was terminated after three problems repeatedly occurred. First, some strategies did not fit in the typology, for example, strategies for successful and rewarding learner cooperation.

⁷ See Oxford (2011, pp. 102-136) for a summary of strategy types, strategy functions, and examples of related tactics, as reported by learners.

Second, some strategies had multiple purposes and could therefore not be clearly categorized. Third, some strategies occurred in combination with other strategies. In these instances, the strategy combinations were analyzed as joint acts of strategic learning rather than separating and categorizing the individual (language) learning strategies. These problems led to the crucial realization that a complexity approach can only add practical value to strategy research if the attention is on practically relevant issues. In other words, while categorizing strategies may be interesting to researchers in the field, the benefits of identifying typological variation have only limited practical value. Hence, the categorization was discontinued.

The purposes of strategies are flexible and dynamic. Learners select strategies to suit specific, situational purposes, for instance, to determine the meaning of a word by looking it up in a dictionary. However, individual strategies can have multiple purposes, some of which may not be initially intended but may develop during a learning situation. For instance, finding the translation of a word in a dictionary can additionally lead to example sentences and learning about synonyms, antonyms, and phonetic symbols. Although these were not the originally intended outcomes of the dictionary search, they can lead to further investigation and other strategic actions. A holistic view of strategic learning combined with a CDST-oriented research approach can reveal such wide-ranging processes and trigger complex considerations and intricate reasoning.

Compared to the original study, the complexity study disclosed more profound information about Sabrina's strategies, for instance, the multi-faceted nature of helping others. Furthermore, the new study shows examples of attractor states, for instance, when Sabrina was deeply concentrated on a task and strategically ignored all distractions to optimize concentration. This pattern ended abruptly with an interruption by Sabrina's partner. Further revelations concerned the interaction of agents and their psychological ramifications, which were noted, for instance, in the teacher's encouraging sensitivity or the frustration caused by Sabrina's partner. The study further highlighted information that was neglected in the 2016 study, for example, Sabrina's advanced awareness of the benefits of careful listening.

Despite the newly gained knowledge, one crucial question remains, which has been critically debated by strategy researchers around the globe. What are the practical implications of complexity theory in strategy research? One article that revises a single case cannot adequately answer this question. However, this article demonstrates that a complexity perspective can generate new, profound information about strategic learning even through reviewing previous data.

For example, the reanalysis uncovered a major problem induced by Sabrina's idiosyncratic way of handling unknown vocabulary. Obviously, translating unknown words and phrases into German helps Sabrina to understand what an expression means. But translating the new expressions back into "simple" English

phrases is not ideal for her L2 development because Sabrina's approach hinders vocabulary growth and consequently impacts conversational skills and variety. Sabrina should instead study and practice the new expressions rather than using their simplified versions in conversations. The reason for Sabrina's unusual approach is the fear of misusing the L2 in front of her peers and the teacher. Sabrina wants to avoid mistakes, which, in her opinion, would make her the target of ridicule and embarrassment, even though such a scenario is only hypothetical and unlikely to occur in her class. Sabrina is unaware of the drawbacks of her individual way of handling new vocabulary, which is paradoxical because she thinks that being a good language learner is mainly concerned with vocabulary learning.

The depth of Sabrina's problem was only discovered in the complexity study, which shows that a CDST-oriented research approach can have practical benefits for students' EFL development because it intertwines multiple strands of dynamic, situational information and hence enables conclusions of practical relevance. Informed by complexity studies, teachers can act upon their students' problems in targeted strategy instruction, which, in Sabrina's case, could be conducted during the individual coaching sessions offered at her school.

6. Conclusions

Students select and apply strategies according to their needs and situational circumstances, both of which change across time. They assess the effectiveness of strategies, make suitable adaptations, and use strategies or strategy combinations flexibly. CDST acknowledges the dynamism and complexity of strategic learning, which gives it a favorable appeal over more traditional, rigid theories despite restricted methodological guidance.

This article shows that complexity research about strategic learning can result in practical benefits to L2 learners and teachers. Through the discovery of information that would remain disclosed without a holistic perspective that acknowledges complexity, learners and teachers can achieve a clearer awareness of strategic actions. Teachers can deduce information about students' specific skill and knowledge areas and can hence design individualized, targeted strategy instruction that supports L2 development.

Complexity theory enables researchers to analyze a multitude of interconnected influences in contextualized strategic learning situations. Instead of exploring isolated features of a phenomenon, CDST holistically combines a host of dynamic factors that affect one another. Confirming its practical relevance to strategy research, this article intends to inspire other researchers in the field to examine the suitability, value, and practicability of a complexity perspective in their own work. Given the increasing interest in CDST and methodological guidance for

complexity research in applied linguistics, further studies about strategic learning, either reviews of previous data or specifically designed new studies, will contribute valuable knowledge to the strategy field in the future.

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