Applying Complex Dynamic Systems Theory to Identify Dynamic Properties of Plurilingual Repertoires

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ABSTRACT

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Language repertoires have been traditionally construed as a set of chronologically determined compartments (i.e., *L1, L2, Ln*), a scheme which upholds several validity and ethical issues when operationalized in research and education (Larsen-Freeman, 2017; Ortega, 2019). Complex Dynamic Systems Theory (also Complexity theory, here CDST) has been hailed as one solution to these issues moving forward. Still, CDST has rarely been used to examine multiple languages within a repertoire and thus its applicability to plurilingual settings remains largely untested. This exploratory study contributes by examining whether the inherent properties of CDST manifest in the perceptions that plurilinguals have on their own language development as their language systems change over time.

This study used retrodictive qualitative modelling (Dörnyei, 2014) where the developmental trajectory of changing language systems was discerned by working backwards through data collected during an observation window. Over a three-month period, three plurilingual individuals assessed their language systems through weekly surveys and participated in open-ended interviews. A three-stage phenomenological analysis evaluated the data against CDST's theoretical prism and allowed for the data-driven identification of five CDST properties (i.e., attractor states, phase shifts, co-adaptation, self-organization, and emergence) in the participants' perceptions of how their repertoires changed over time. Results indicate that the components of plurilingual

repertoires exhibit the aforementioned dynamics of CDST, although evidence for emergence was less certain. Importantly, this study shows that these dynamics are discernable in an individual's perception of their own language development.

Keywords: Complex Dynamic Systems Theory, Language repertoires, Multilingualism, Plurilingualism, Retrodictive Qualitative Modelling

Acknowledgements and Dedication

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This thesis regards multilingualism. For this, I must recognize the great number of individuals who have gifted me new worlds through their words which have since become my greatest source of passion and intrigue. In particular, I owe boundless gratitude to Shannon Aleman, Else Marie Bae, Сергей Гриффиц, la famille Mosimann, Micah True, Aud Skrudland, Sindre Sverdrup Strand, and Susan Uiterwijk. Without your patience, expertise, compassion and corrections, my own language learning journeys would have stalled long ago. Without you, this thesis would be devoid of linguistic perspective, insightfully nil, and most certainly impossible to complete.

I also wish to acknowledge my family and especially my parents. Their support for all I do (wherever I decide to do it) has always been so unfailing and so undisputed that Saussure would surely denote it as *the* signified of /lɐv/.

Lastly, I dedicate this thesis, as I do all things, to my partner Aleksei Kutzetcov. In my dictionary, the entry for happiness need only contain his image.

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Chapter One

Unarguably, much work in Applied Linguistics rests on the notion that humans have a "complex of communicative resources" (Blommaert & Backus, 2013, p. 12) known as 'the repertoire'. Indeed, the way this repertoire is envisioned has a central influence over both research design and data analysis (see Berthele, 2021). It is therefore not an exaggeration to say that investigations into the nature of *language repertoires* reach to the core of Applied Linguistics and are an important terrain for exploration. In this regard, this thesis aims to provide evidence that much more can occur within language repertoires than what common conventions for their study (see below) often allow.

Both inside and outside Applied Linguistics, languages in the mind are most often construed along a linear, one-dimensional and chronologically determined repertoire (e.g., a *first*, *second*, *third* language; henceforth known as the 'linear model'; Hammarberg, 2010). On the surface, the linear model appears meaningful in that it allows speakers to share information about their language backgrounds and capabilities, even though many language learners, and certainly most linguists, will admit that it provides a fuzzy picture of language competence.

In this way, I have been aware of the shortcomings of the linear model for quite some time and believed them to be rather harmless. However, it was not until I realized that the complexity of my own linguistic repertoire precluded me from participating in most linguistic research that I began to take serious issue with the model. After all, how does one make sense of a late-stage English-French bilingual Canadian who is a near-native speaker of a Nordmøre Norwegian dialect that prefers to write standard Bokmål,

but read in Nynorsk even though the language he speaks most frequently after English is Russian, a language he speaks better than Spanish, but presently understands far worse than Swedish, Danish, Dutch, Italian and written (but not spoken) Portuguese?

At the moment of this realization, I was ultimately provided with two paths for reflection: first, there is something unique about my own repertoire that renders me an outlier; alternatively, there is nothing unique about my repertoire that renders me an outliner. Following in-depth reading through this lens as well as hundreds of casual conversations with multilinguals while working as a research assistant in Concordia's Applied Linguistics lab, it became clear that the second path of reflection is far more accurate than the first; other individuals' language repertoires are very often as complex as mine, but the complexity is nullified by the way the linear model forces description and declaration of repertoires.

This is a serious problem. It is not difficult to find damning reports of how "obsolete and conclusively discredited models of language knowledge" (Blommaert & Backus, 2013, p.12) continue to affect research, education, and political policy in ways that are not trivial (for examples see May 2014a and Ortega, 2019). In this light, a brief overview of the most commonly used model to denote language repertoires (the linear model) is warranted, as well as an explanation of how this thesis became motivated to explore Complex Dynamic Systems Theory as one way beyond its many shortfalls.

The Fallacy of Linear Language Models

The linear model upholds a skewed vision of language that creates ambiguity and hides important realities. To illustrate, Hammarberg (2010) provides a non-exhaustive list of common phenomena which defy linear ordering: simultaneous acquisition (which

language is the first or the second?), scanty knowledge (at what point does a language 'count'?), type of knowledge (what if someone can read a language but not speak it?), intermittent or alternating acquisition (can the second language become the third?), and 'bonus' languages (do mutually intelligible languages count, too?). Although the linear model hides these common realities, the strongest rebukes against the model touch on a deeper, more nefarious repercussion of the linear model's continued use in research and education. Namely, it upholds far-reaching conceptions of language and language repertoires that are simply false.

For this, a summary can be provided by viewing the linear model against an extrapolated summary of three points raised in common by Blommaert and Backus (2013) and Larsen-Freeman (2017). Each point pertains to one damaging misconception of language identified by these authors. First, the linear model sustains the ideology (i.e., a deep-seated assumption) that languages exist as discreet cohesive wholes outside the user and these can be identified and named (i.e., 'English', 'Chinese', 'Swahili'). These named languages are delineated by a 'standard' that is marked as superior, prototypical or more legitimate in some way compared to other variants (e.g., dialects, registers) often by way of purity (lack of outside influence). This ideology is misleading. Standard languages are a "socio-historico-political act, not a linguistic one" (Larsen-Freeman, 2017, p. 62) and linguists know that language evolution results in spectrums of language variation where one subset has been built and crowned *the* standard in contemporary times. It is this standard that is often implied behind the *L* when talking about *L1* or *L2* speakers or users. The linear model thus glosses over the irrefutable variation that exists within any speech community and begs the question: whose language are we studying?

Next, the underlying and often unconscious acceptance of the above ideology creates the foundation for the second issue of the linear model. Here, the belief that languages are external separate entities implies that they exist as distinguishable units in the mind of the language user and that they operate independently. Different strands of research indicate this is not the case (see Gujord, 2020, for a recent overview of research into cross-linguistic influence). The linear model sustains this erroneous view. As a consequence, the languages of a single user become simplified and compartmentalized research subjects that can be operationalized independently and at will. Researchers and educators are then given license to ignore aspects of a repertoire and imagine that individuals start over each time they learn a new language; they become "budding monolinguals for the second time around" (Ortega, 2013a, p. 36).

The third issue is the reinforcement of what Larsen-Freeman (2017) calls the teleology ideology: the belief that language learning is additive and can end with the acquisition of a complete language that embodies native speaker norms according to a monolingual native-speaker model. This cannot be true: the use of language resources is an unending process of growth, decline and change. For instance, Blommaert and Backus (2013, p. 15) describe how "language as a linguistic and a sociolinguistic system is not a cumulative process", but a continued 'shedding or altering' of previously existing registers, styles, genres and linguistic varieties. For this reason, no one can master all aspects of a language and the linear model can thus underestimate (or overexaggerate) competence by portraying repertoires as the acquisition and sum of wholesale parts.

What does this mean for research in Applied Linguistics? In its simplest form, studies examining factors of language development with carefully constructed L1, L2,

L3, *Ln* participant constellations may need to be rethought even when controlled for proficiency. Put plainly, due to variation among and within individuals over time, the quest to generalize according to linear repertoires should be shelved as research that particularizes the individual is likely more meaningful (Larsen-Freeman, 2017). This idea is the central tenet of this thesis which adopts an explorative design to make this possible.

This Thesis

Given the above, this MA thesis is ultimately an exercise in uncovering the complex character of language repertoires as they change over time. The analytical framework of Complex Dynamic Systems Theory (CDST; de Bot et al., 2007; Larsen-Freeman & Cameron, 2008a) was purposefully chosen for its potential to showcase repertoires from a much wider lens than more traditional research in the hopes of identifying properties of language repertoires that have been previously missed or omitted from investigation. Of course, given the novelty of CDST's application to language phenomena and its undetermined suitability, this work also acts as an examination of CDST itself and is explorative in nature. Additionally, in contrast to the linear model's restrictive template that results in a minimized snapshot of phenomena, this thesis takes the opposite route; the breadth of longitudinal perceptions that participants have on their own language is what forms the dataset.

In line with the guidelines for a manuscript-based MA thesis, the next section constitutes "a full submittable draft of a manuscript" that explores whether CDST's signature tenets can be identified in how individuals perceive their own changing repertoire over time.

Chapter Two

Introduction

This study aims to provide empirical evidence that plurilingual language repertoires are dynamic systems whose subsystems (i.e., languages) demonstrate dynamic interactions over time[1]. In what has been called 'the multilingual turn in second language acquisition (SLA)', comprehensive and convincing critiques against a pervasive monolingual bias in applied linguistics have amassed for over three decades (see, Cook, 1992; Bley-Vroman, 1983; Klein, 1998; May, 2013, 2019; Ortega 2013a, 2013b, 2019). One particularly pervasive feature of this bias, and the one emphasized in this study, is the notion that languages used by an individual exist within a one-dimensional, linear and chronological repertoire (*L1, L2, L3, Ln;* henceforth known as the linear model).

The near ubiquitous linear model of language repertoires presents several validity and ethical issues when operationalized in research and education. Notably, it denies superdiverse language realities (see, Blommaert & Backus, 2013; Todeva & Cenoz, 2009) and construes language growth as a static cumulation of endpoints rather than an unending process of variable acquisition and attrition. What is more, the linear model may erroneously compartmentalize languages, contradicting data which indicate that the lines between styles, registers, dialects, and languages are blurred (de Bot & Jaensch, 2015; Llama et al., 2010). Perhaps more damaging is that the additive nature of the linear model flies in the face of data showing that multilingual processing and acquisition may be qualitatively unique from first-/second language acquisition (Cenoz, 2003, 2013;

[1] This study deliberately abstains from the debate on whether the terms *multilingualism* and *bilingualism* are contrastive or selfsame (see Berthele, 2021). Instead, the terms *plurilingual* and *plurilingualism* are used to denote language competence without preconceiving the attributes and components of such competence. Original terminology in citations is maintained.

Hoffmann, 2001) perhaps due to differences in metalinguistic knowledge or awareness (Angelovska, 2018; Gibson & Hufeisen, 2011; Hofer & Jessner, 2016; Jessner, 2006, 2008).

Therefore, in keeping with the monolingual bias in SLA, the linear model erases consequential aspects of plurilingualism. As a result, the only issue that truly distinguishes elements within the linear model is that of time. In this context, put most poignantly in Ortega (2013a), "SLA researchers are then free to imagine the nonnative speaking participants in their studies as budding monolinguals for the second time around, and their bi/multilingualism can be excluded from study designs" (p. 36). This issue is echoed by Aronin and Jessner (2014) who highlight the research community's dilemma of "how to treat the numerous past studies performed de facto on multilinguals, but announced as being on bilinguals or second language learners" (p. 72).

A way forward has been triggered by the introduction of Complex Dynamic Systems Theory (also Complexity Theory and Dynamic Systems Theory; here CDST) into the field of SLA (see, de Bot et al., 2007; Larsen-Freeman, 1997; Larsen-Freeman & Cameron, 2008a). Fundamentally being a theory of change over time, CDST examines the emergent properties of complex systems that arise through the interaction of subsystem components (see forthcoming section). By applying CDST to language development, linguists and theorists have generated new conceptualizations of language repertoires as non-linear, reversible, complex, adaptive, open and dynamic *systems* (see, Herdina & Jessner, 2002). This application of CDST to holistic plurilingual language repertoires is justified in theory as the different languages, variants and registers are

posited to be dynamic subsystems within the overall plurilingual system of an individual (see Larsen-Freeman, 1997; Jessner, 2008; Lowie, 2017).

Still, as Dörnyei et al. (2015) correctly note, very little empirical work from a CDST perspective has been done, and even less so when applied to the longitudinal development of holistic language repertoires. The fact remains that empirical evidence supporting CDST's claim that languages within a repertoire are indeed subsystems that interact in a dynamic fashion requires further documentation.

To this end, this study makes a contribution by identifying signature dynamics (i.e., mechanisms within a system; outlined later) of three plurilingual repertoires in development. To do this, we surveyed how three participants' plurilingual systems evolved over a three-month period and then assessed these cases by way of Retrodictive Qualitative Modelling (RQM; Dörnyei, 2014; Larsen-Freeman, 2015; see method).

By applying CDST's theoretical and methodological framework, this study has two interrelated goals. First, identify CDST's dynamic properties within plurilingual repertoires. Second, in light of this, provide support for more dynamic conceptualizations of plurilingualism by problematizing the current use of the linear system in SLA and language education.

Background

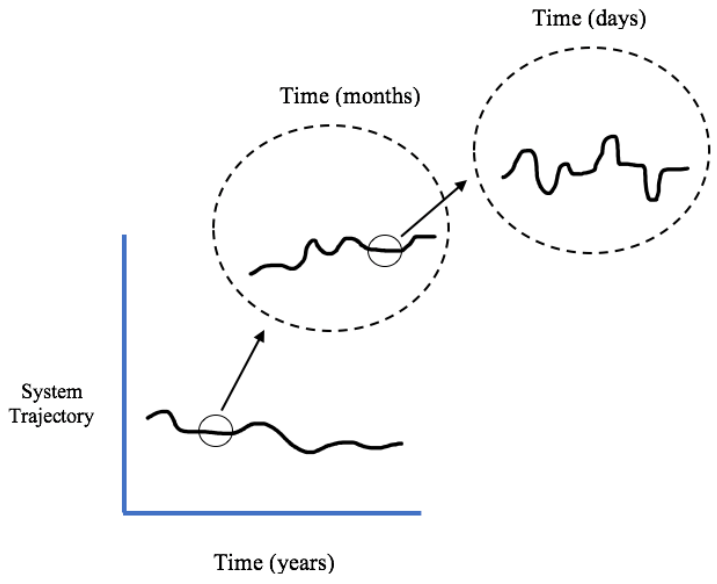
Overview of Complex Dynamic Systems Theory

CDST holds that dynamic systems arise from the complete interconnectedness of their subsystem components which are in a constant state of change (de Bot et al., 2007; Larsen-Freeman & Cameron, 2008a; Verspoor et al. 2008). Important to note is that this change is not only influenced by external energy (e.g., environmental factors like

learning environment) from outside the system, but also by internal forces (i.e., subsystems adaptively interacting with, and to, each other). In other words, the components of dynamic systems are open but completely interdependent (de Bot & Larsen-Freeman, 2011). This adaptive interaction provokes dynamic systems to develop properties that render them more than the simple culmination of their individual elements (de Bot et al., 2007; Larsen-Freeman & Cameron, 2008a). Further, dynamic systems are complex as their individual elements may be dynamic subsystems in their own right and be embedded within larger complex systems. Having nested levels of embedded complexity means that system dynamics can be viewed at different scales such as from the ecological down to the subatomic and be examined on timescales such as millennia down to nanoseconds (see de Bot, 2015). Figure 1 demonstrates how a system can be observably different depending on the timescale of observation.

Figure 1

A visual representation of a dynamic system on three timescales (adapted from Larsen-Freeman, 2015)



Language as a Complex Dynamic System

Since this study aims to provide support for a complex dynamic view of plurilingualism, certain theoretical and methodological considerations apply (see Dörnyei et al, 2015; Hiver & Al-Hoorie, 2016; Larsen-Freeman & Cameron, 2008b; Lowie, 2017; Verspoor et al., 2011). First, CDST challenges researchers to view language proficiency as an emerging property of a dynamic system in constant flux. From this perspective, language proficiency changes continually and is not acquired, but *developed*. This means skill growth and skill decline are equally relevant (de Bot & Larsen-Freeman, 2011) and worthy of analysis. Moreover, for research into language development, it is essential to define the system under investigation (Hiver, 2015) given that CDST views language as an embedded system of human cognition whose subsystem components can span all levels of human organization (e.g., sociocultural, individual, neural) as well as all levels of language (e.g. lexical, phonological, syntactic; de Bot & Larsen-Freeman, 2011; Larsen-Freeman & Cameron, 2008a). It is therefore not feasible for a study to examine language development at all its nested levels.

Accordingly, this study observes language development at the level of holistic language repertoires which Herdina and Jessner (2002) and Jessner (2008) have theorized as forming a multilingual system where the different languages, dialects and registers are subsystems. Their Dynamic Model of Multilingualism (the DMM) positions the development of multilingual repertoires as an open, variable, adaptive, non-linear, and reversible process over time. The DMM holds that language systems exhibit continuous change and non-linear growth, because an individual's resources (time and energy) are limited. In other words, the stability of a language system is dependent on the resources

invested into the system and its maintenance therefore adjusts to the perceived communicative needs of the individual in response to internal and external factors. Additionally, the DMM argues that transfer from one language system can lead to divergent results in other language systems of the same speaker due to dynamic interactions (see below) among various interdependent subsystems.

Somewhat surprisingly, this scale of investigation has received comparatively little research attention within CDST. One rare exception is Opitz (2017) who performed an ad hoc CDST interpretation of four of her previous studies on multilingual development. She concludes that all languages in a multilingual system exhibit variability at all timescales examined, but that they may enter stasis under favourable conditions. In terms of this variability, Opitz (2017) observed S shaped growth trajectories in three studies as noted in Herdina and Jessner (2002), which suggests that highly developed languages are more stable than low-proficiency languages, and that the former take longer to regress and less effort to maintain.

Unlike the current study, most L2 research from a CDST perspective has been conducted on a more macro level involving motivation (Dörnyei et al. 2015), self-concept (Mercer, 2014), and willingness to communicate (MacIntyre & Legatto, 2011), or a more micro-level focusing on the emergence of L2 linguistic constructions (Ellis & Larsen-Freeman, 2009; Larsen-Freeman, 2006), L2 accuracy and complexity (Spoelman & Verspoor, 2010), variability of L2 constructions (Verspoor et al., 2008), patterns of L2 lexical and syntactic development (Verspoor et al., 2012), and L2 writing fluency measures (Baba & Nitta, 2014). Additionally, most CDST research spotlights the development of only one language system even if their participants may have multiple.

Some exceptions include Huang et al. (2020); Lowie et al. (2014), Plat et al. (2018), and Yang and Sun (2015).

Signature Dynamics of Complex Systems

After having defined the complex system in question, one way to make sense of it is to analyze the dynamic interactions between its subsystems over time (Lowie, 2017). An appropriate way to do this is to track subsystems as they inevitably undergo periods of variability (van Dijk et al. 2011). By discussing this variability in light of CDST's key constructs (e.g., the concepts of state-space, attractor states, perturbations, phase shifts, self-organization, co-adaptation and emergence), these patterns of dynamic subsystem interaction can be conceptualized as change occurs within a language repertoire.

State-space, Attractor States and Perturbations

CDST represents system change as movement across a *state-space*, which can be conceived as a two- or three-dimensional representation of all possible states or configurations that a particular system can be in (see forthcoming Figure 3 and related discussion). As a spatial metaphor, a 'state-space' is the "landscape of possibilities" (Larsen-Freeman & Cameron, 2008a, p. 47) through which a system can roam (Henry, 2015) and this may be wide-ranging, but certainly not infinite (Larsen-Freeman, 2015). For languages, the state-space can range from no proficiency to the strongest command (the upper limit is vague, but not endless). Within this state-space, we can find the system's *attractor states* which signify a particular mode of behaviour toward which the system tends to move over time (Hiver, 2015; Larsen-Freeman & Cameron, 2008a). Attractor states are therefore pockets of stable behaviour that nonetheless exhibit some degree of variability as change is constant (Hiver, 2015; Spoelman & Verspoor, 2010). A

system leaves its attractor state in response to a *perturbation* or a disrupting force that 'jolts' a system toward a new state of being (Hiver, 2015). If a system resists change in the face of a particular perturbation, it is said to be in a strong attractor state. Systems in weak attractor states are susceptible to disturbances and can be thrown out of equilibrium. This can be evidenced by increased variability in the (sub)system's trajectory through state-space (Verspoor et al., 2008).

As it pertains to multilingual development, Opitz (2017) illustrates this construct from a CDST perspective. By examining her participants' multilingual repertoires at different time scales (days, weeks, months, years), she found that all languages within repertoires showed variability over time but that the magnitude of this change differed. Usually, one part of the multilingual system showed relative stability. Still, participants in two studies faced the major perturbation of migrating to a new linguistic environment which gave rise to phenomena suggesting that even systems in strong attractor states (L1s) became unsettled. For example, with time and a certain amount of L2 development, participants demonstrated frequent inappropriate L1 language choice and code-switching. More persistent displays of attrition in both L1 and L2s occurred later in the form of retrieval difficulties and cross-linguistic influence.

Phase Shifts, Self-Organization, and Emergence

Pertinent to this study's analysis is the identification of phase shifts, self-organization, and emergent properties. When a perturbation is strong enough to destabilize a subsystem out of its attractor state and into another, a *phase shift* has occurred. This phenomenon brings about new modes of behaviour which alter the larger system in ways which are qualitatively and observably different than before (Larsen-

Freeman & Cameron, 2008a; Henry, 2015). In this light, Spoelman and Verspoor (2010) examined the morphosyntactic and lexical complexity of 54 writing samples of a Dutch learner of Finnish over the course of 3 years. The researchers report a sudden and significant developmental jump in noun-phrase complexity between samples 44 and 45, indicating a phase shift occurred at that time.

After a phase shift, the internal dynamics of a system cause it to spontaneously re-stabilize into a new attractor (Larsen-Freeman & Cameron, 2008a). This assembly of a new order (i.e., a stability) is known as *self-organization* when caused by internal system dynamics as opposed to external factors that force the new pattern of behaviour (Larsen-Freeman & Cameron, 2008a) and is evidenced by a higher-order function (Hiver & Al-Hoori, 2016). Furthermore, self-organization may lead to the spontaneous occurrence of new patterns due to the dynamics of the system itself (van Geert, 2008), which is a phenomenon known as *emergence*. Returning to the DMM, Herdina and Jessner (2002) and Jessner (2006) argue that enhanced metalinguistic awareness and its interlingual counterpart, cross-linguistic awareness, is a property that emerges from the inherent interaction between the language subsystems of a multilingual.

Co-adaptation

Co-adaptation emphasizes the complete interconnection between (sub)systems. Specifically, it denotes system changes that are motivated by change in another connected system when the former's trajectory roams into the latter's state-space landscape (Larsen-Freeman & Cameron, 2008a). In the case of multilingual development, Herdina and Jessner (2002) argue that contact between two or more languages does not simply cause overlap of these systems but provokes a 'metamorphosis' of all language

systems involved. Importantly, some subsystems are more strongly connected than others (de Bot & Larsen-Freeman, 2011). This means identifying the co-adaptation of subsystems can involve assessing the mutual impact of a perturbation and particularly if the development of a certain system becomes a perturbation affecting others.

The Current Study

This study empirically examines CDST's theoretical claims that languages within a repertoire are interlinked subsystems of an overall multilingual system (Herdina & Jessner, 2002; Jessner, 2008). To this end, it investigates the developmental dynamics of three plurilingual individuals who are actively acquiring another language. Since CDST holds that all dynamic systems are in a continuous state of flux and that "all changing subsystems can potentially and continuously interact with all other changing subsystems" (Lowie & Verspoor, 2015, p. 73), the exact array of components (i.e., languages, dialects) that make up the repertoires of these participants does not need to be controlled because the focus is the dynamics between systems, not their make-up. Additionally, following CDST, language development is not conceived as end-point language accumulation (the linear model), but as participant reported changes in language (sub)systems over time as well as the interaction of such systems. The methodology outlined in the next section analyzes such change and interaction qualitatively with RQM as a research template and CDST as an investigative lens. This design afforded the ability to assess whether plurilingual repertoires are indeed dynamic systems with the following research question:

- Do the properties of complex dynamic systems (i.e., attractor states, phase shifts, self-organization, co-adaptation, and emergence) manifest in the perceptions that plurilinguals have on their own language development over time?

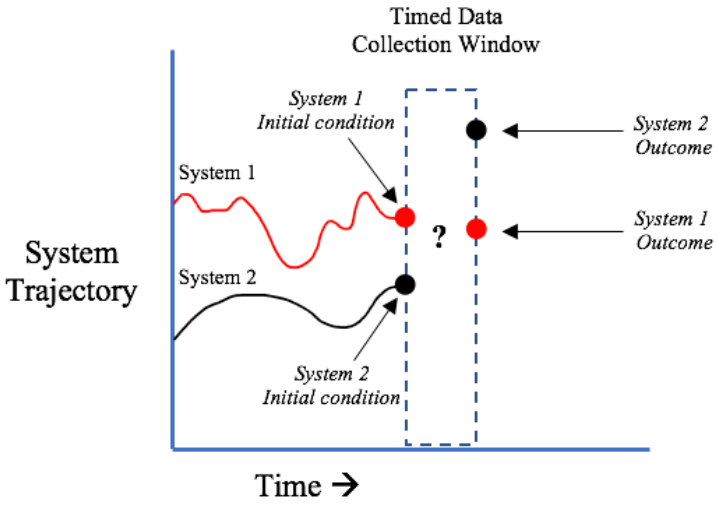
Method

Research Design

Complex systems are unpredictable because their trajectories are non-linear (Larsen-Freeman & Cameron, 2008a). Consequently, this study employs retrodictive qualitative modelling (RQM; Dörnyei, 2014; Larsen-Freeman, 2015; see Figure 2) to make sense of how a complex system arrives at a distinct outcome after change has occurred (for examples see Chan et al., 2015; Henry, 2015; Hiver 2017). RQM reverses the order of traditional research. Instead of predicting the result of a treatment, analysis begins by identifying a system's initial conditions (i.e., state and context; see *system 1 initial condition* in Figure 2) followed by its outcome after a period of time (see *system 1 outcome* in Figure 2). From here, a developmental trajectory is discerned by working backwards through data collected during an observation window, which in our case involves interviews with participants and their longitudinal perceptions of proficiency.

Figure 2

Retrodictive Qualitative Modelling Study Design



Participants

Initially, five plurilingual adults were selected from a pool of 43 individuals after a call for participation was sent to a university in Montréal, Canada. None of the participants were known to the researchers or, as it turned out, students at the targeted university. These participants were chosen because their schedules allowed for frequent interviews, each was actively learning an additional language, their backgrounds and realities differed greatly, and the principal researcher could speak most of their languages (including target languages) to allow for deeper insights during interviews. The data from two participants were excluded from this study. During analysis, it became clear that these participants did not make progress in learning their new language during the observation window, and, unlike the remaining participants, only used one or two of the languages in their repertoire. As such, their insights hinged on speculation about hypothetical language use and past learning, neither of which is suitable for RQM. The final three participants (Table 1; all names pseudonyms) self-disclosed on the initial questionnaire (Appendix A; see below) as plurilingual learners at different stages of developing a new language system: later stage (Larisa, 28, female), intermediate stage (Ramin, 30, male), and initial stage (Coralie, 26, female).

Table 1

Overview of Participants

Name	Languages	Birthplace & Longest Residence	Residence During Observation
Larisa	Catalan > Spanish > English > Norwegian > German > Russian* Catalan/Spanish (simultaneous), English, German, Russian, **Norwegian****	Catalonia, Spain	Trøndelag, Norway
Ramin	Farsi > English > French Farsi, English, **French**	Tehran, Iran	Toronto, Canada
Coralie	French > English > Spanish > Italian French/English (sequential), Spanish, **Italian**	Québec, Canada	Montréal, Canada

* order of dominance: **>** signifies the individual is more proficient in the proceeding language
** order of learning: the individual was actively learning the language in bold during data collection

Instruments

Questionnaire and Initial Interview

To identify the initial conditions of language systems so that development could be tracked, participants first completed the Language Experience and Proficiency Questionnaire (LEAP-Q; Kaushanskaya et al. 2019; Marian et al. 2007; see Appendix A) which is a validated instrument that ascertains language profiles and backgrounds. Afterwards, the principal researcher reviewed this data with each participant in a recorded, online interview over Zoom and asked additional interview questions (see Appendix B; adapted from McAdam's (2007) *Life Story Interview*).

Open-ended interviews

RQM requires that data with a time element be collected during an observation window so that system dynamics informing a developmental trajectory can be reconstructed (see Figure 2). For this, bi-weekly interviews with the participants were conducted online through Zoom. To avoid priming participant responses, these interviews were open-ended and unstructured and began with a leading question that asked participants to describe the languages they had spoken since the last interview, with whom, and under what circumstances. From there, participants were asked to share their experiences, observations and perceptions related to both the language they were learning and the languages they were using (see Appendix C for a sample). These interviews were recorded and transcribed verbatim.

Self-Assessments of Speaking Automaticity

Once per week over the course of the study, our participants self-assessed their speaking ability in each of their language systems on a sliding scale (see Appendix D) collected online using LimeSurvey. Speaking ability was chosen over other skills (e.g., writing) because we did not expect our participants to write in all of their languages each week. Speaking ability was broadly operationalized as 'speaking automaticity' defined as the mental effort and reflection required to produce language. Automaticity was chosen as it could operationalize variation in perceived speaking performance in a way that was easily understood and reported by the participants and did not rely on external benchmarks like grammaticality. These data were used as a point of comparison against the perceptions shared during the interviews and as another way to gain insight into both language system stability (i.e., attractor states) and co-adaptation.

Procedure

Over a three-month period, individual online interviews took place every two weeks (16 interviews total; 6 with Larisa, 5 with Ramin and Coralie). Each interview lasted approximately 30 minutes, except for the initial interview which took approximately 1 hour. The interviews occurred mostly in English, but participants regularly moved between languages they shared with the researcher to both express thoughts and describe perceptions. Participants self-assessed their perceived speaking automaticity in each language every 7 days through an online survey resulting in 9 assessments for Larisa and 7 for Ramin and Coralie. There were more data points for Larisa as she began data collection two weeks earlier than Ramin and Coralie and was willing to continue her self-assessments until research concluded with the other two participants. Given the individualized nature of the data collected, this extra data was preserved as our analysis did not require the participants to have an equal number of data points.

Data Analysis

Analysis of Self-Assessments of Speaking Automaticity

Analysis of the speaking self-assessments follows the approach outlined in van Dijk et al. (2011) and Lowie (2017). First, data were plotted descriptively to chart trends in subsystem fluctuations. Next, a simple min-max technique was used to locate the bandwidth value between the maximum and minimum values which charts the amount of variation in each subsystem over time. The wider the bandwidth of each subsystem, the greater the amount of variation. Given the introspective nature of these qualitative data and the few data points, it is not robust enough for further statistical analysis.

Analysis of Interview Data

Interview data underwent a three-stage phenomenological analysis using MAXQDA software guided by Smith and Eatough (2007) and Smith and Shinebourne (2012). First, in an iterative process, the transcripts were read and re-read before open-codes were assigned to phenomena related to our participants' language experiences, perceptions and observations (e.g., 'new recurring speaking opportunity'; 'uncontrolled language transfer'). Simultaneously, we flagged the language(s) that the participants referred to using an individualized language coding system. For example, when Ramin reports surprise that some French (L3) words have begun coming to mind when speaking English (L2), the codes 'Ramin: English' and 'Ramin: French' were used alongside the open-code 'novel language influence'. Second, we compiled the open-codes into thematic clusters (e.g., 'consistent language use behaviour'; 'influential individuals'). Steps one and two allowed us to examine which of our participants' languages were more (or less) present in any given theme. The final stage evaluated the generated themes against the system dynamics inherent to dynamic systems outlined in the background section.

The following section combines the traditional Findings and Discussion sections. Given that the analysis aimed to identify and explain reported language development in light of five CDST dynamics, it made little sense to present our findings independent of an interpretation. The next section begins by identifying our participants' language subsystems and their initial conditions (a critical requirement of RQM) and then sequentially presents evidence for how these subsystems exhibited the five target properties: attractor states, co-adaptation, phase shifts, self-organization and emergence.

Findings and Discussion

System Components

Before analysis could begin, the issue of what we counted as a language system within the superdiverse realities of language repertoires needed to be addressed (see Berthele, 2021; Blommaert & Backus, 2013). Language systems for this study were conceived as the languages over which our participants implied a sort of ownership through use and delineated according to what they conceived as a language entity. For Example, Larisa demonstrated keen knowledge of some Norwegian dialect features that had begun to influence her standard Norwegian that she repressed. She further stated her use of such forms was "only passive". This indicated that her conception of the Norwegian language includes a multiplicity of dialect variation, but that *her* Norwegian is currently anchored around a standard form. In short, conceptions of what 'should' constitute a language system were not imposed. Instead, language systems were located in how the participants conceived their own repertoires from the interview and questionnaire data.

Initial Conditions of System Components

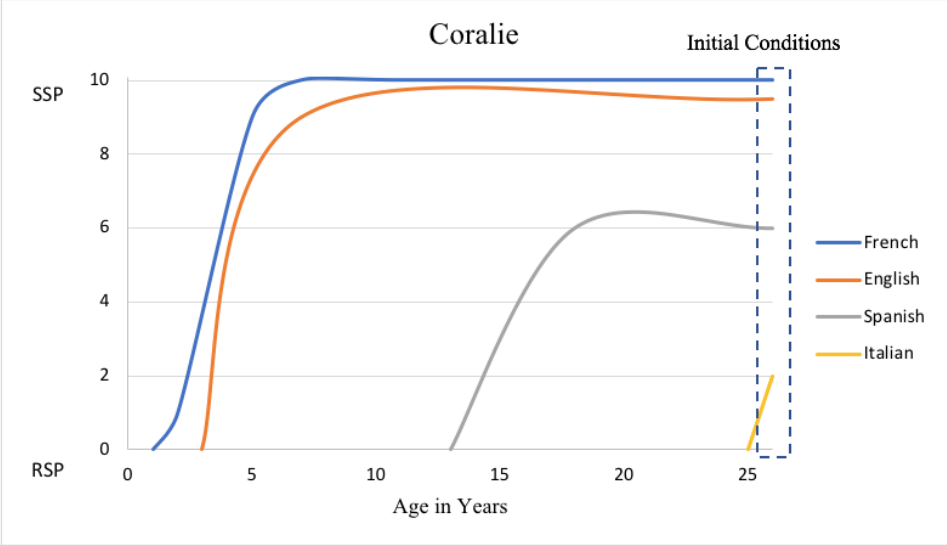
Once language subsystems were identified, their initial conditions (i.e., state of being within the holistic repertoire; comparative proficiencies) needed to be determined so that their development could be examined during analysis. For this, a graph was generated for each participant that traced the development of their language systems from birth so that a state-space landscape could be conceived for their repertoire (Figure 3). This was done with data from the LEAP-Q questionnaire (Appendix A), the initial interview (Appendix B), and subsequent interviews. Although the graphs over-simplify

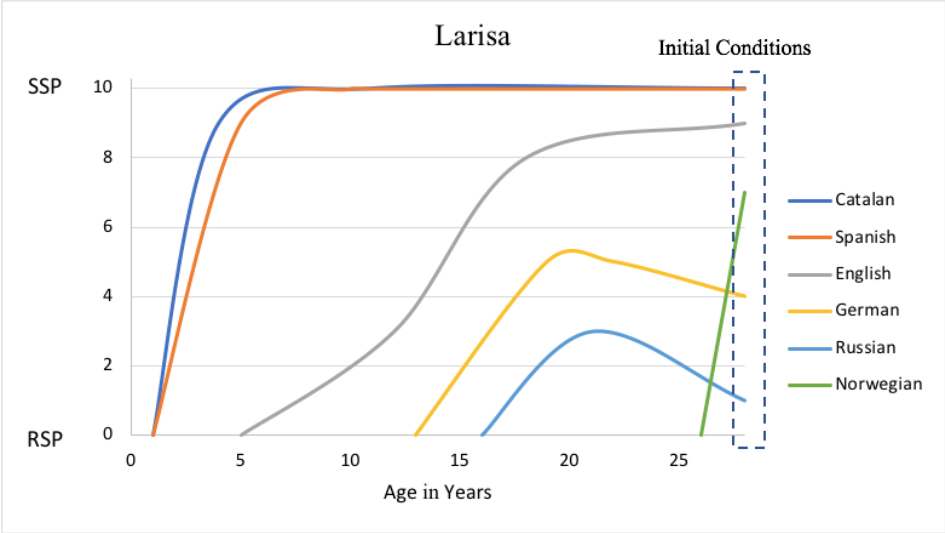
state-spaces to one timescale (years) and ignore elements such as modality (e.g., production vs comprehension), they confirmed the initial conditions of subsystems where the graphs end (see *Initial Conditions* in Figure 3). Skipping this step would promote reductionism that is contrary to a CDST approach (de Bot & Larsen-Freeman, 2011).

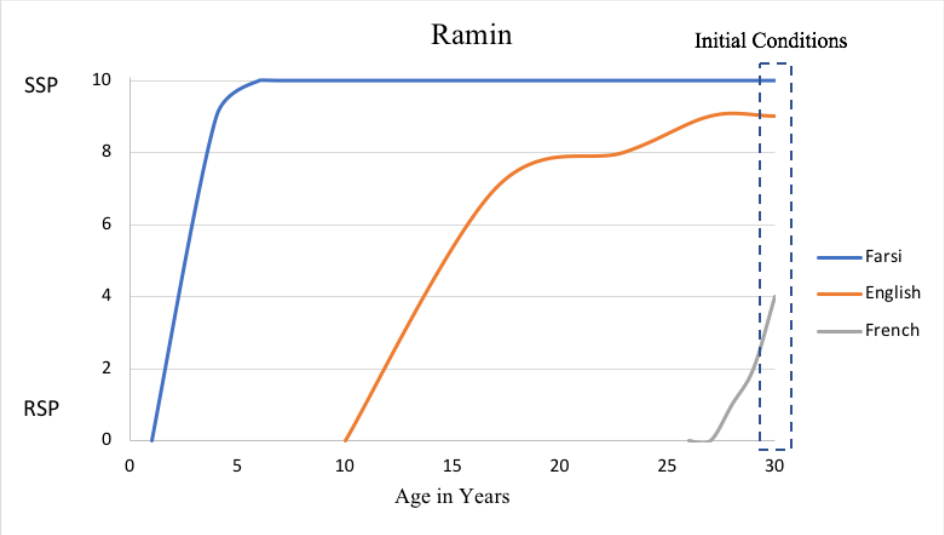
For Figure 3, the maximum and minimum values on the Y axis represent a state-space ranging from 'strongest speaker proficiency' (SSP; e.g., first or near-native language) to 'rudimentary speaker proficiency' (RSP; e.g., simple production of words and phrases), respectively. Upward trends represent periods of perceived language learning and growth (e.g., during work or student exchange experiences) while downward trends show periods of decline or regression in perceived proficiency.

Figure 3

Repertoire Development as a State-Space over Time and Initial Conditions of Subsystems







Properties of CDST in Plurilingual Perceptions of Language Development

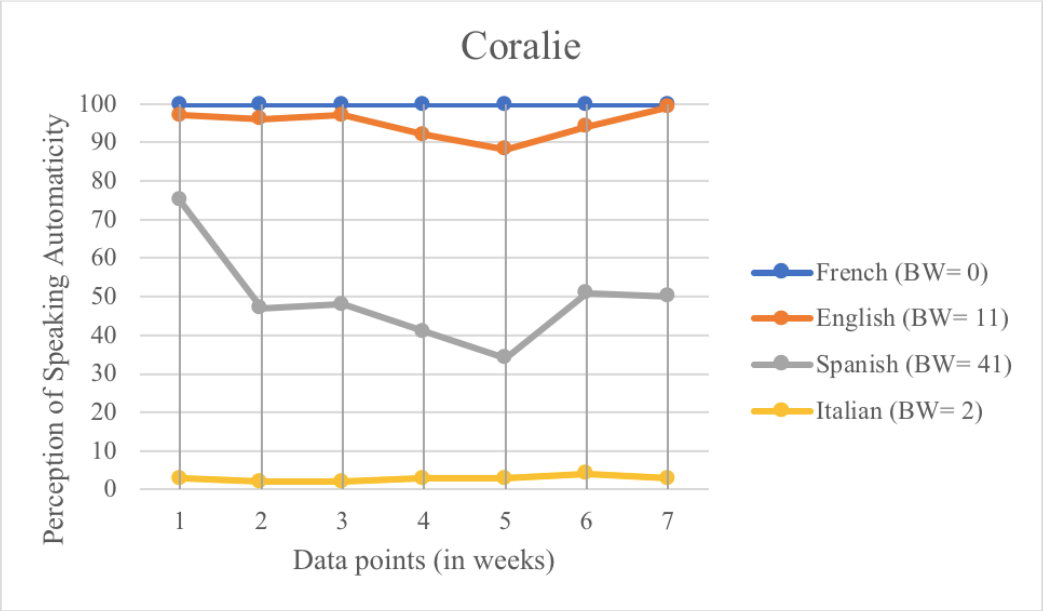
Evidence of Attractor States

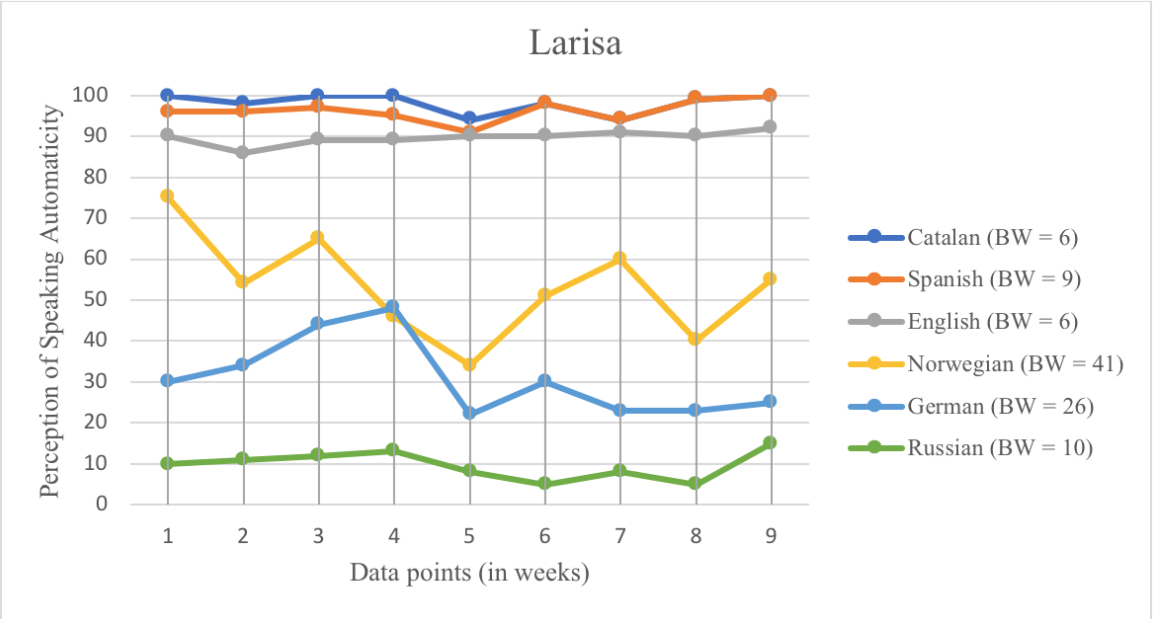
To determine whether languages are complex dynamic systems, this study's RQ asked if CDST's signature constructs can be identified in how individuals perceive their changing repertoire over time. The results begin with evidence for attractor states. Determining whether attractor states manifest in plurilingual repertoires required two steps. First, we needed evidence that the language systems of a plurilingual individual exhibit different degrees of variability. Second, our RQM analysis needed to show that

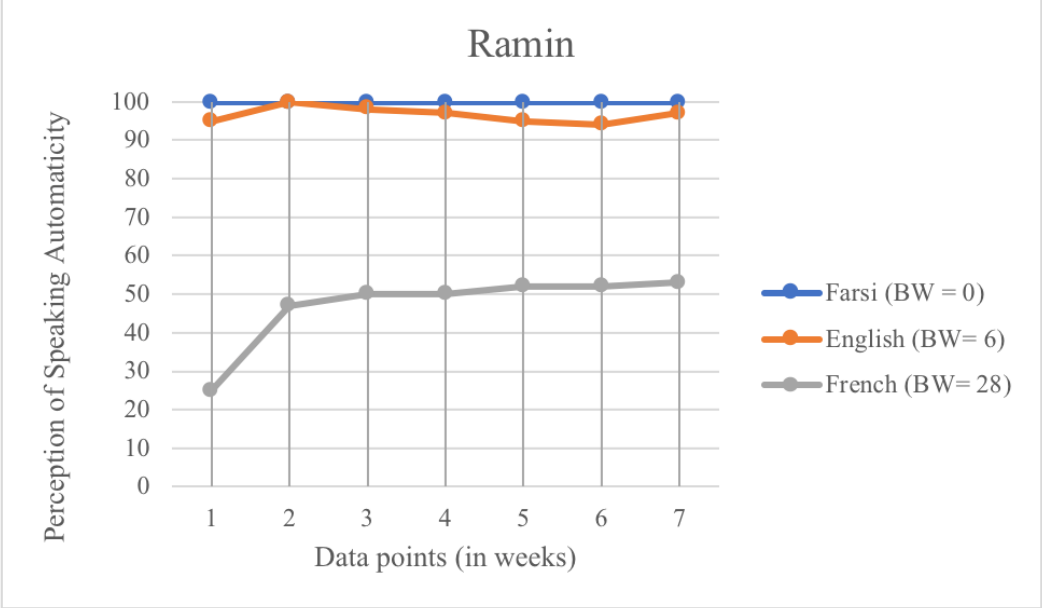
this variability had consequential impacts on how a plurilingual system developed. Both of these requirements were satisfied. To begin, data in Figure 4 show our participants' self-assessments of speaking automaticity in all their language systems over a three-month period. Here, we observe that language systems varied differentially over time as shown by their bandwidth values (BW; see method section) where higher fluctuations of automaticity resulted in higher bandwidth values and vice versa. In CDST, strong and weak attractor states are synonymous with low and high variability respectively (Hiver, 2015) and we would thus, for example, consider Coralie's English (BW= 11) to be in a stronger attractor state than her Spanish (BW= 41).

Figure 4

Self-Assessments of Perceived Automaticity when Speaking







Next, our qualitative data showed that these supposed attractor states influenced the development of repertoires in two ways as hypothesized by CDST (see Hiver, 2015; van Dijk et al, 2011). First, systems in hypothesized strong attractor states appeared more resistant to decay. Second, such systems seemed to better withstand perturbations.

For these two points, Ramin's English (BW= 6) and Larisa's Norwegian (BW= 41) offer evidence as contrastive examples. Ramin shared that his use of English (in a hypothesized strong attractor state) dropped immediately after graduating from university one year earlier yet affirmed that he did not notice much change in his spoken English during observation given this new pattern of use. Contrastively, Larisa attested to the susceptibility of her Norwegian (in a hypothesized weak attractor state) to perturbations such as those caused by social distancing measures of the COVID-19 pandemic: "…these last two days, I felt like my Norwegian was going back a little bit". Larisa offered no such comments for her English whose use was also impacted by these measures (albeit less so), or her Spanish, a language that is also in a hypothesized strong attractor state and one she spoke less frequently than both English and Norwegian.

Moreover, Ramin's French system provided an interesting case for how hypothesized strong attractor states coincide with a resistance to decay even when the system is not highly developed. For example, quantitative data (see Figure 4) indicate Ramin's French system was highly variable in automaticity for the first set of data points and then levels out. Qualitative data later revealed that Ramin's French became better attuned to its principal situation of use (i.e., settled into a new attractor) soon after data collection began, due to the routine and stable nature of the twice-weekly private French lessons that he had begun a month earlier. For instance, after speaking rather emphatically about his new French learning routine and speaking activities with his tutor, he described his language learning as moderate in later interviews and no consequential perturbations were identified for his French system in the interview data. This indicates that his French had likely become fit to its context. Consequently, CDST may see this

new stable attractor state as a reason why Ramin's French was not impacted by breaks from his usual dedicated routine.

This contrasts starkly with Larisa's experience with Norwegian where she perceived a regression in language within a matter of days. This is peculiar as Larisa's Norwegian appeared more advanced than Ramin's French when these participants spoke these languages with the researcher. To explain this from a CDST perspective, our analysis indicates that it is not only a system's state of development that regulates rates of decay, but its attractor state (i.e., fitness to an environment, degree of variability) also plays a role. For example, the continual demands on Larisa's Norwegian, particularly in the form of workplace meetings at her new job, were consistent themes in her interview data and flagged as perturbations that destabilized her Norwegian system as she adapted to a new communicative environment. From a CDST stance, it could have been this weakening of an attractor state that contributed to her Norwegian's decline, or at least perception of decline, as the system experienced unstable habits of use.

Still, a question remains. How to reconcile the data from the speaking self-assessments (Figure 4) that show less developed language systems exhibit narrow bandwidths of variation much like systems in strong attractor states (e.g., Russian for Larisa and Italian for Coralie, BW = 10 and 2, respectively)? CDST theorizes that such language systems would likely be in low attractor states evidenced by potential to decay and increased variability (Larsen-Freeman & Cameron, 2008a). Our qualitative data for Coralie indicate that this is still the case as she reports "…so few building blocks [in Italian] that [she] just forget[s] them all and [she] can't build anything with them". As such, we need to set aside the speaking self-assessments for less developed languages.

This is not surprising given that in Coralie's case, variation in speaking automaticity for Italian was essentially nil: "…unprompted I have no idea how to say any words".

In sum, data for Larisa, Ramin, and Coralie preliminarily substantiate the applicability of attractor states to holistic language repertoires; all participants report subsystem behaviours that reflect the hypothesized nature of how such subsystems would act according to the properties of CDST's attractor states (see de Bot & Larsen-Freeman, 2011; Hiver, 2015)

Evidence of Co-adaptation

The RQM analysis considered whether the CDST construct of co-adaptation applies to plurilingual repertoires in development. As defined earlier, co-adaptation pertains to the interconnection between (sub)systems and how change in one system is motivated by change in another. To this end, we note two trends in our data for Coralie and Larisa that uphold this. First, we saw how the nature of variability in plurilingual repertoires seemed to be a function of the array of subsystems (i.e., components of a repertoire) themselves. Second, we saw how the growth of one language system provoked changes in others that seemed to hinge on systems sharing a similar state-space landscape (Figure 3).

Coralie's system offers an example for the first point regarding variability as a function of system components. Here, the precarious existence of Coralie's Italian neither precluded it from variation nor sealed it within a vacuum. Instead, variation seemed to be pulled from other language systems. For instance, themes in Coralie's data indicate high variation in her Italian pronunciation, which she explicitly states to be motivated by her Spanish, such as the "dreaded [i]/[ɛ] issue" where she "keep[s] saying /i/ everywhere

instead of saying /ɛ/". Increased variation that is provoked by the existence of another language within the same repertoire speaks to the interconnectedness of systems and satisfies the theorized process of co-adaptation. Put plainly, this phenomenon would not have occurred if Coralie did not have a pre-existing Spanish system. Indeed, this kind of variation could be a hallmark of plurilingual language learning and echoes the observation in Huang et al. (2020) that L3 learners experience more variation in their L2 writing fluency than L2 writers without an L3 system. From a developmental perspective, this phenomenon could be a prerequisite for the overall plurilingual system to adapt to the growth of a new subsystem.

As for the second point of evidence for co-adaptation, our qualitative data are clear that the co-existence of German and Norwegian in Larisa's repertoire (see Figure 3) increased variation in both systems. This variation was most visible as an unevenly reciprocal cross-linguistic influence that seemed regulated by use and system growth. For example, Larisa reports trying to overcome German's influence on her Norwegian by regulating its use: "*jeg må kanskje prøve å ikke snakke så mye tysk uh på en stund fordi det er sant hvis jeg snakker mer tysk så blir norsken min dårligere*" [I may have to try to not speak so much German uh for a while because it's true that if I speak more German my Norwegian gets worse]. Additionally, Larisa also reported how growth in her Norwegian system was having an increased impact on her earlier developed German system (i.e., a shifting direction of influence): "The problem is that [now] my Norwegian is affecting my German".

It seems fitting to say that this mutual impact of systems is an example of co-adaptation. However, is this process ignited by one system roaming into another's state-

space landscape as theorized by CDST (Larsen-Freeman & Cameron, 2008a)? For this, we do note that Larisa reported a proficiency in Norwegian that had rather recently surpassed her proficiency in German. In other words, it recently crossed German's path within the state-space of her repertoire (see Larisa in Figure 3). Further, Larisa also shared memories of phenomena that occurred before observation that align with the theory that crossing state-space trajectories provokes co-adaptation. Specifically, she recalled how she would "blurt out words in Russian" (her L5) when she first began learning Norwegian (her L6). Afterwards, she described how German (her L4) overtook Russian to become the dominant influence on her Norwegian system. Thus, the increased language interaction reported above is in harmony with CDST and potentially adds a new dimension to current research trying to uncover factors which regulate cross-linguistic influence (see Gujord, 2020, for a recent review of transfer constraints).

On that note, our RQM analysis suggests that more is at play than cross-linguistic influence when such language interaction is viewed through a CDST lens. Specifically, we observed how our participants perceived an elevated control due to an awareness which contributes to a language subsystem's stability (i.e., creates a strong attractor) and safeguards it from being impacted by change (i.e., growth or decline) in a different system. For example, Larisa reported repressing Norwegian's influence on her English "the moment that [she] noticed" it had begun to sound "Norwegian-y". The potential power of linguistic awareness as a regulating force of co-adaptation was also evidenced by Coralie. In her last interview she described how she began to separate Italian and Spanish in her mind: "I stopped trying to make those connections as much as I was making them originally".

Although no supporting research into cross-linguistic influence from a CDST perspective could be found, this finding does endorse Herdina and Jessner (2002), who theorize that metalinguistic awareness is an emergent property of multilingualism that arises from increased language interaction in a multilingual mind. There is certainly more than one way to explain the behaviour of Larisa and Coralie's language systems, but from the view of CDST, it appears that co-adaptation is a suitable construct to make sense of changing plurilingual repertoires. Our data indicate that the mere existence of another language may provoke variation in others and that this variation may be directed by an individual's level of language awareness in each subsystem. Moreover, we note that change in one language can drive change in another, particularly when the former crosses the state-space trajectory of the latter.

Evidence of Phase Shifts

To satisfy CDST's view on phase shifts (i.e., sudden new modes of behaviour that are qualitatively different than before) only new language behaviour representing a novel functioning ability within one language (or between languages) was identified as evidence that a phase shift had occurred. To start, a phase shift between language systems can be seen in Ramin's reports of how his French enables him to do things differently with English. Specifically, he speaks about how recent advances in his French system have begun helping him write English, particularly when it comes to a purposeful command of register. He notes: "…there are some French words that are pretty common in French but are not common in English. They are kind of considered fancy words in English and I've started to use them a little bit in my writings". This different level of writing behaviour could prove consequential for how Ramin uses English in a more

general sense and was thus labelled as a phase shift. Although the nature of the phenomenon is different, this finding shadows the higher-order patterns in writing fluency that Baba and Nitta (2014) labeled as phase shifts in their CDST study on writing development.

In another example, a turning point in how Larisa's Norwegian system interacts with its environment is seen in how she interprets her learning of Norwegian during workplace meetings. At the start of observation, she describes these meetings as a source of anxiety. In later interviews, she reported less reluctance to engage in the language, a stronger sense of presence during meetings. Larisa speaks of this change in the context of a novel heightened awareness of how the Norwegian language is used around her. For example, she describes how previously learned words and expressions "jump out at [her]" in this new environment and that she finds herself recycling this language as a means of propelling her Norwegian forward. She reports, "this encourages me because I feel like there's some loop going on in my head like, okay, something's working". We interpret this phenomenon as a phase shift, as it goes beyond the learning and subsequent use of discrete language elements (e.g., lexemes, grammatical structures). It represents a novel functioning of the open language system itself whereby language elements now interact differently with an external environment and build a more effective feedback circuit to promote proficiency faster than before. Larisa's example is congruent with CDST which posits that "complex dynamic systems do not remain passive in light of changing events; they 'learn' or adapt to an ever-changing environment" by way of feedback sensitivity (Larsen-Freeman, 2015, p. 16).

Evidence of Self-Organization

To identify evidence of self-organization in our dataset, we considered whether the internal dynamics of a system created a condition by which the system could achieve a more stable existence (i.e., order) within its environment. Specifically, a pattern of behaviour was seen as self-organized if it was provoked by the system itself rather than directed by an external force (e.g., perturbation). For this, we note how Larisa's Norwegian language system has reached a state where it now impacts the larger world in a way that feeds its own development, namely by giving Larisa more access to Norwegian. For example, Larisa noted that since her arrival in Norway 3 years earlier, most Norwegians would speak to her in English. However, an increasingly important theme in her data shows the rise in the length and depth of her interactions in Norwegian as a function of people realizing she can communicate in the language. By providing evermore exposure to Norwegian, this creates a type of positive feedback loop that could be consequential for this system to avoid entropy within its environment (i.e., decays through lack of use or learning). Given the near ubiquitous levels of English bilingualism in Norway, which can feasibly deny learners exposure to Norwegian (a reality noted by Larisa herself), this mechanism of stability could prove definitive for this system's survival.

To this author's knowledge, no SLA research has examined such a mechanism empirically. However, new patterns of organization and attractor states are theorized to arise from change that is caused by system interaction with an environment (de Bot & Larsen-Freeman, 2011). In short, shadows of evidence for self-organization were seen in Larisa's data, but less so for Ramin and Coralie. Neither of these individuals were living

in an environment where their target languages were spoken and thus their respective contexts may not have been conducive for such mechanisms to take flight during the observation window.

Evidence of Emergence

Lastly, our analysis evaluated whether the CDST construct of emergence (i.e., the spontaneous occurrence of new patterns of behaviour) manifests in plurilingual repertoires. Here, evidence for emergence is tenuous in our dataset. To start, CDST theorists working with multi-/plurilingualism hypothesize that language awareness is the major emergent factor as a bilingual turns into a multilingual (Herdina & Jessner, 2002). In this regard, some of Ramin's insights do demonstrate an increased language awareness enabled by his new French system in the form of cross-linguistic observations (see discussion on phase shifts above). He also expresses a newfound understanding of historical linguistics and language borrowings: "I've also like thought about like…other languages in Farsi other [than French], other words, with different origins". However, even though these realizations are quite novel for Ramin and a product of his own internal observation, it is unlikely that they would be beyond his grasp had he remained a Farsi-English bilingual.

As for Coralie and Larisa, both were plurilingual before learning their new languages. As such, we cannot confirm that any language insights they shared are examples of novel language awareness or attributable to being multi-/plurilingual as opposed to bilingual. Indeed, both demonstrated deep understandings of language from the earliest moments of data collection. For example, Coralie shares an awareness of semiotics that she feels is consequential when explaining why she thinks knowing

English (her L2) makes learning Italian (her L4) easier: “The ability to be like, this item is represented by two words or like this action is represented by two words, like the ability to understand that concept…is instrumental…to learn another [language]”. To explain why these reported insights cannot be confidently considered as evidence for emergence, we support Beisbart (2021) in his critique on complexity theory’s application to multilingualism. He is clear that CDST’s fuzzy notion of what counts as new or unexpected phenomena makes emergence too difficult to identify. In sum, our RQM analysis did not clearly produce evidence of emergence in the dataset.

Conclusion

To determine whether languages are complex and dynamic systems, this study asked whether the properties of five CDST constructs manifest in the perceptions that plurilinguals have on their language development over time. Using qualitative data that examined language repertoires from a holistic view over a three-month period, this study concludes that the constructs of attractor states, co-adaptation, phase shifts, and self-organization are identifiable in how plurilinguals perceive their changing repertoires. Evidence for emergence was not clear in our data; as discussed, the current theory around this construct renders it difficult to identify. Alternatively, phenomena related to emergence could have been confounded with other CDST constructs (e.g., self-organization) and misidentified. Given the nascent nature of CDST’s application to plurilingualism, we acknowledged that such conceptual limitations are likely to have occurred in this study.

On that note, before final conclusions can be laid bare in light of the study’s goals, both methodological and theoretical limitations need to be addressed. As for the former,

methodological limitations include the short observation window and the limitations inherent in examining reported perceptions. Notably, we recognize that our study's design did not capture factors that were either imperceptible to our participants or unmarked (i.e., mundane). We do not view the small number of participants as a major limitation. In this study, evidence for complex dynamics within repertoires was unearthed thanks to an in-depth and personalized analysis that would be hindered by a greater number of participants.

As for theoretical limitations, we must first recognize that this study examined CDST constructs as they are hypothesized to apply to multi-/plurilingualism by theorists like de Bot and Jaensch (2015), Herdina and Jessner (2002) and Larsen-Freeman and Cameron (2008a). As such, the validity of this study's results must be weighed against critiques arguing that the foundational models that apply CDST to language (e.g., DMM by Herdina & Jessner, 2002) are insufficient given their ambiguity or inability to describe key constructs like state transitions (see Beisbart, 2021, for a more detailed overview).

In this way, the sharpening of the CDST model is one direction that future research should take. Specifically, engaging in deductive research like this study (i.e., viewing data in light of pre-determined constructs) is one way forward. Deductive research, as opposed to inductive research, begins with a theory and then gathers data that either support or falsify hypotheses (de Bot & Larsen-Freeman, 2011). Deductively, this study shows that the concepts of attractor states, co-adaptation, self-organization, and phase shifts are readily observed in the perceptions that plurilinguals have of their changing repertoires, but emergence was not seen, perhaps due to methodological limitations (e.g., self-reports may not be conducive for capturing emergence) or indeed

because of conceptual limitations in what constitutes evidence. Therefore, this study acts as a caution sign for CDST to continue further conceptualization that goes beyond Herdina and Jessner (2002) and Larsen-Cameron and Freeman (2008a). After such crucial details are worked out conceptually, testing through research can resume.

The above considered, does this study demonstrate that languages in a repertoire are complex dynamic systems? Yes, but with the caveat that future CDST models need to advance a clearer conception of system dynamics. Does this study achieve its goal of problematizing the use of the linear model in research? Yes. Specifically, we observed phenomena that would defy observation in traditional study designs that use a snapshot conception of competency along linear scales (L1, L2, L*n*). For example, our data show that the language systems of an individual each exhibit different levels of variability (see evidence for attractor states) and that this variability is not just moderated by a system's state of development (e.g., proficiency), but also by its fitness to context and the changing array of co-existing systems within the same repertoire. Moreover, this variability (in terms of reported episodes of uncontrolled language interaction) seems tied to growth trajectories within a repertoire and language awareness (see evidence for co-adaptation).

Further, we saw how developmental jumps toward a higher function in one language can impact behaviour and skills in other languages. In a similar vein, we saw that spurts of developmental growth also concern the learning process itself evidenced by new rates of language learning within an environment (see evidence for phase shifts). Similarly, we saw that language systems can reach critical tipping points in which they gain a capacity to feed their own development, and this, without being directly forced by external influence (see evidence for self-organization).

Each of the above phenomena require further substantiation, but the overall implication of this study is clear: the linear conception of repertoires (L1, L2, L*n*) needs to be put aside so that the full nature of plurilingual development can be investigated. Studies that operationalize language learning based on end-point orders of acquisition are deficient in capturing the above phenomena and erase them from study. Moreover, the generalizing tendencies of the linear model forces most research to exclude most people from most studies in order to be considered valid. In the future, this should be turned on its head, especially if the goal of research is to identify or explain universal language phenomena or patterns. By focusing on the individualized dynamics of language learning, this study shows that approaches like CDST can support researchers in designing methodologies that can include any individual in all their language glory.

Lastly, by engaging in a qualitative design, this study shows that concepts of CDST can be spoken about by people outside the realm of Applied Linguistics. Implicationally for education, this means that CDST could be a powerful metaphor that helps teachers conceive their students' repertoires as a holistic phenomenon that unfurls across a state-space and whose development is individualized, dynamic and ongoing. Future work can strive toward developing the pedagogical utility of CDST in at least how language repertoires are conceived and subsequently treated in the classroom.

Chapter Three

The previous chapter concluded with a short discussion on the implications that CDST may have on language education. This final chapter will resume this discussion as well as flesh out possible directions for future research in light of this study's findings.

Implications for Education

It was stated in the previous chapter that the power of CDST in the classroom lies in the strength of the metaphor that positions language learning as a dynamic process across time and space (e.g., the state-space graphs in Figure 3). But what are the benefits of such a metaphor?

To start, the broader 'ecological view' of CDST has the clear potential to usher in a "person-centered frame of reference" (Larsen-Freeman, 2017, p. 60) that allows for a deeper consideration of the individual and their language resources in light of an environment. As this study shows, a CDST metaphor can incorporate holistic repertoires into its framework. This means that CDST can advance the notion that language teachers do not just teach an L2, but instead teach students who are learning another system that must be integrated into a pre-existing repertoire. This better reflects the realities of language learning than some traditional views that often equate students with empty vessels who need to be filled with input.

Teachers could act on the CDST metaphor by engaging in conversations much like those employed in this study's methodology. For instance, through conversation with parents and students, teachers could probe which of their student's languages are stable (attractor states) by considering directions of skill decline or growth over time (state-space trajectories). Additionally, teachers reflecting on their practice could also determine

what aspects of their instruction are bringing students to higher levels of functioning (phase shifts) or if a change (perturbation) is needed to jolt students out of a period of learning stasis (attractor state). In terms of environment, teachers could emphasize skills, competencies and behaviours that enable students to create feedback loops with their language so that their learning is propelled forward, much like Larisa's experience with Norwegian (see evidence for self-organization). Such a practice is realistic. For example, traditional pedagogy often enforces native-speaker and standard pronunciation norms with little reasoning as to why. A CDST approach could have teachers purposefully emphasize certain pronunciation patterns, language use patterns, or learner identities in a way that allow a learner to interact with (or be better welcomed within) specific speech communities to gain more access to the target language. The advantage of such instruction becomes clear when considering that both L1 and advanced L2 speakers of English often have difficulty gaining exposure to non-English target languages in regions or situations where bilingualism with English is ubiquitous, such as in many regions and workplaces in Europe, or in Montréal, Québec. In sum, the benefit of an approach which sees language as a system within an environment means that the environment stops being the backdrop for language learning and becomes a stage that can be acted upon.

What is more, since this study shows that language development is a process that has impacts across a repertoire and does not occur in compartmentalized languages, a CDST view emphasizes why the entirety of a student's repertoire requires validation. As such, this study acts as another call against practices and attitudes that view selective parts of a repertoire as more worthy of instructional support than others. In a real-world example, this could rejig conceptions of the common labels like ESL or FSL (outgrowths

of the linear model) which may portray language learners as deficient. To conclude, a CDST attitude toward language education can have positive impacts on instruction.

Implications for Research

This study has implications for future research. First, this study shows that examining the way individuals perceive their own repertoires over time, regardless of the make-up of their repertoires, is a valuable avenue for future research. Since this approach can apply to virtually any language learner, the strict inclusion criteria of more traditional research can be greatly broadened to include a wider breadth of language learning realities. This could be especially beneficial in research strands such as multi-/plurilingualism where there is no agreed upon definition of what mono-/bi-/multilingualism even are. In place of this terminological debate, researchers could follow in this study's footsteps and examine patterns in which individuals conceive their own repertoires (i.e., self-ascribed category formation). Such an approach would free researchers from the burden of generalizing large swaths of a population into pre-determined construct boxes like 'bilingual' and 'multilingual'. This could prove prudent, as Berthele (2021) argues that placing such descriptors on participants could hinge more on cultural conceptions of language use than any universal quality that defines these constructs. The broad view of CDST is conducive to this type of research which spotlights an individual and their lived reality.

This study also has narrower implications for CDST research itself. Specifically, it became clear during analysis that the construct of 'mental agency' could be a consequential force for how a plurilingual repertoire develops (Coralie: "I stopped trying to make those connections [between Italian and Spanish] as much as I was making them

originally"). In this regard, mental agency could be defined as the agency (or power) that individuals have to direct the connections between their developing language systems. The concept of agency has recently come to a fore of investigation in applied linguistics (e.g., Deters et al., 2014), yet mostly from a sociolinguistic perspective in which individuals are examined as actors in their own environments. Future investigations could examine if the construct of agency applies to language development in terms of psycholinguistics as well.

Conclusion

To conclude, by adopting CDST's framework to make sense of how individuals perceive their language development, this study was able to explore a methodology in which holistic repertoires were the focus of examination instead of discreet pockets of competency. By engaging in qualitative exploration and focusing on dynamics as opposed to language features, this study avoided constructing participant groups by way of the linear model (e.g., pre-determined language constellations). As a result, its exercise in uncovering the complex character of language repertoires yielded findings that are often nullified by traditional designs. If anything, this thesis ultimately demonstrates that individuals perceive a clear interconnectedness between the components of their repertoires and that this interconnectedness is not only unique to the individual and their lived realities, but also consequential for how language repertoires develop over time. Exploring how these connections change longitudinally is one way for Applied Linguistics to uncover yet undiscovered realities of plurilingualism. If CDST truly represents a new epistemological paradigm in Applied Linguistics as Larsen-Freeman (2015) emphasises, then observation has really only just begun.

References

Aronin, L., & Jessner, U. (2014). Methodology of bi- and multilingual studies: From simplification to complexity. *AILA Review*, *27*, 56–79. https://doi.org/10.1075/aila.27.03aro

Angelovska, T. (2018). Cross-linguistic awareness of adult L3 learners of English: A focus on metalinguistic reflections and proficiency. *Language Awareness, 27*(2), 136-152. https://doi.org/10.1080/09658416.2018.1431243

Baba, K., & Nitta, R. (2014). Phase transitions in development of writing fluency from a complex dynamic systems perspective. *Language Learning*, *64*, 1–35. https://doi.org/10.1111/lang.12033

Beisbart, C. (2021). Complexity in multilingualism (research). *Language Learning*, *71*(S1), 39–79. https://doi.org/10.1111/lang.12426

Berthele, R. (2021). The extraordinary ordinary: re-engineering multilingualism as a natural category. *Language Learning*, *71*(1), 80–120. https://doi.org/10.1111/lang.12407

Bley-Vroman, R. (1983). The comparative fallacy in interlanguage studies: The case of systematicity. *Language Learning*, *33*, 1–17. https://doi.org/10.1111/j.1467-1770.1983.tb00983.x

Blommaert, J., & Backus, A. (2013). Superdiverse repertoires and the individual. In I. Saint Georges & J. J. Weber (Eds.), *Multilingualism and multimodality: The future of education research* (pp. 11-32). SensePublishers. https://doi.org/10.1007/978-94-6209-266-2_2

Chan, L., Dörnyei, Z., & Henry, A. (2015). Learner archetypes and signature dynamics in

the language classroom: A retrodictive qualitative modelling approach to studying L2 motivation. In Z. Dörnyei, P. D. MacIntyre, & A. Henry (Eds.), *Motivational dynamics in language learning* (pp. 238– 259). Multilingual Matters. https://doi.org/10.21832/9781783092574-018

Cenoz, J. (2003). The additive effect of bilingualism on third language acquisition: A review. *The International Journal of Bilingualism, 7*(1), 71–88. https://doi.org/10.1177/13670069030070010501

Cenoz, J. (2013). The influence of bilingualism on third language acquisition: Focus on multilingualism. *Language Teaching, 46*(1), 71-86. https://doi.org/10.1017/S0261444811000218

Cook, V. (1992). Evidence for multicompetence. *Language Learning*, *42*, 557–591. https://doi.org/10.1111/j.1467-1770.1992.tb01044.x

de Bot, K., & Larsen-Freeman, D. (2011). Researching second language development from a dynamic systems theory perspective. In M. H. Verspoor, K. de Bot & W. Lowie (Eds.), *A dynamic approach to second language development: Methods and techniques* (pp.85–98). John Benjamins. https://doi.org/10.1075/lllt.29.01deb

de Bot, K. (2015). Rates of change: Timescales in second language development. In Z. Dörnyei, P. D. MacIntyre & A. Henry (Eds.), *Motivational dynamics in language learning* (pp. 29–37). Multilingual Matters. https://doi.org/10.21832/9781783092574-006

de bot, K., & Jaensch, C. (2015). What is special about L3 processing? *Bilingualism: Language and Cognition, 18*(2), 130-144. https://doi.org/10.1017/S1366728913000448

de Bot, K., Lowie, W., & Verspoor, M. (2007). A dynamic systems theory approach to second language acquisition. *Bilingualism: Language and Cognition, 10*, 7–21. https://doi.org/10.1017/S1366728906002732

Deters, P., Gao, X., Miller, E. & Vitanova, G. (2014). *Theorizing and analyzing agency in second language learning*: *Interdisciplinary approaches.* Multilingual Matters. https://doi.org/10.21832/9781783092901

Dörnyei, Z. (2014). Researching complex dynamic systems: 'Retrodictive qualitative modelling' in the language classroom. *Language Teaching, 47*(1), 80-91. https://doi.org/10.1017/S0261444811000516

Dörnyei, Z., MacIntyre, P., & Henry, A. (Eds.). (2015). *Motivational dynamics in language learning*. Multilingual Matters. https://doi.org/10.21832/9781783092574

Ellis, N. C., & Larsen–Freeman, D. (2009). Constructing a second language: Analyses and computational simulations of the emergence of linguistic constructions from usage. *Language Learning*, *59*(1), 90–120. https://doi.org/10.1111/j.1467-9922.2009.00537.x

Gibson, M., & Hufeisen, B. (2011). Perception of preposition errors in semantically correct versus erroneous contexts by multilingual advanced English as a foreign language learners: Measuring metalinguistic awareness. In G. De Angelis & J. -M. Dewaele (Eds.), *New trends in crosslinguistic influence and multilingualism research* (pp. 74–85). Multilingual Matters. https://doi.org/10.21832/9781847694430-006

Hammarberg, B. (2010). The languages of the multilingual: Some conceptual and

terminological issues. *IRAL, 48*(2), 91-104. https://doi.org/10.1515/iral.2010.005

Gujord, A. K. H. (2020). Crosslinguistic Influence. In N. Tracy-Ventura & M. Paquot (Eds.), *The Routledge handbook of second language acquisition and corpora* (pp. 345-357). Routledge. https://doi.org/10.4324/9781351137904

Henry, A. (2015). The dynamics of L3 motivation: A longitudinal interview/observation based study. In Z. Dörnyei, P. D. MacIntyre & A. Henry (Eds.), *Motivational dynamics in language learning* (pp. 315-342). Multilingual Matters. https://doi.org/10.21832/9781783092574-021

Herdina, P. & Jessner, U. (2002). *A Dynamic Model of Multilingualism: Perspectives of change in psycholinguistics*. Multilingual Matters. https://doi.org/10.21832/9781853595547

Hiver, P. (2015). Attractor states. In Z. Dörnyei, P. D. MacIntyre & A. Henry (Eds.), *Motivational dynamics in language learning* (pp. 315-342). Multilingual Matters. https://doi.org/10.21832/9781783092574-005

Hiver, P. (2017). Tracing the signature dynamics of language teacher immunity: A retrodictive qualitative modeling study. *The Modern Language Journal, 101*(4), 669-690. https://doi.org/10.1111/modl.12433

Hiver, P., & Al-Hoorie, A. H. (2016). A dynamic ensemble for second language research: Putting complexity theory into practice. *The Modern Language Journal, 100*(4), 741-756. https://doi.org/10.1111/modl.12347

Hofer, B., & Jessner, U. (2016). Multilingualism at the primary level in South Tyrol: How does multilingual education affect young learners' metalinguistic awareness and proficiency in L1, L2 and L3? *The Language Learning Journal, 47*(1), 76–87.

https://doi.org/10.1080/09571736.2016.1195865

Hoffmann, C. (2001). Towards a description of trilingual competence. *International Journal of Bilingualism, 5*(1), 1-17. https://doi.org/10.1177/13670069010050010101

Huang, T., Steinkrauss, R., & Verspoor, M. (2020). Learning an L2 and L3 at the same time: Help or hinder? *International Journal of Multilingualism*, 1–17. https://doi.org/10.1080/14790718.2020.1779726

Jessner, U. (2006). *Linguistic awareness in multilinguals: English as a third language*. University Press. https://doi.org/10.3366/edinburgh/9780748619139.001.0001

Jessner, U. (2008). A DST model of multilingualism and the role of metalinguistic awareness. *The Modern Language Journal, 92*, 270-283. https://doi.org/10.1111/j.1540-4781.2008.00718.x

Kaushanskaya, M., Blumenfeld, H., & Marian, V. (2019). The language experience and proficiency questionnaire (LEAP-Q): Ten years later. *Bilingualism: Language and Cognition*, *23*(5), 945-950. https://doi.org/10.1017/S1366728919000038

Klein,W. (1998). The contribution of second language acquisition research. *Language Learning*, *48*, 527–550. https://doi.org/10.1111/0023-8333.00057

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

Larsen–Freeman, D. (2006). The emergence of complexity, fluency, and accuracy in the oral and written production of five Chinese learners of English. *Applied Linguistics*, *27*(4), 590–619. https://doi.org/10.1093/applin/aml029

Larsen-Freeman, D. (2015). Ten ‘lessons’ from complex dynamic systems theory: What

is on offer. In Z. Dörnyei, P. D. MacIntyre & A. Henry (Eds.), *Motivational dynamics in language learning* (pp. 11-19). Multilingual Matters. https://doi.org/10.21832/9781783092574-004

Larsen-Freeman, D. (2018). Looking ahead: Future directions in, and future research into, second language acquisition. *Foreign Language Annals*, *51*(1), 55–72. https://doi.org/10.1111/flan.12314

Larsen-Freeman, D., & Cameron, L. (2008a). *Complex systems and applied linguistics*. Oxford University Press.

Larsen-Freeman, D., & Cameron, L. (2008b). Research methodology on language development from a complex systems perspective. *The Modern Language Journal, 92*(2), 200–213. https://doi.org/10.1111/j.1540-4781.2008.00714.x

Lowie, W. (2017). Lost in state space? Methodological considerations in complex dynamic theory approaches to second language development research. In L. Ortega & Z-H. Han (Eds.), *Complexity theory and language development: In celebration of Diane Larsen-Freeman* (pp. 123-141). John Benjamins. https://doi.org/10.1075/lllt.48.07low

Lowie, W., Plat, R., & de Bot, K. (2014). Pink noise in language production: A nonlinear approach to the multilingual lexicon. *Ecological Psychology, 26*(3), 216. https://doi.org/10.1080/10407413.2014.929479

Lowie, W., & Verspoor, M. (2015). Variability and variation in second language acquisition orders: A dynamic reevaluation. *Language Learning, 65*(1), 63-88. https://doi.org/10.1111/lang.12093

MacIntyre, P., & Legatto, J. (2011). A dynamic system approach to willingness to

communicate: Developing an idiodynamic method to capture rapidly changing affect. *Applied Linguistics*, *32*(2), 149–171. https://doi.org/10.1093/applin/amq037

Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The language experience and proficiency questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research, 50*, 940–967. https://doi.org/10.1044/1092-4388(2007/067)

May, S. (2013). *The multilingual turn: Implications for SLA, TESOL and bilingual education*. Routledge. https://doi.org/10.4324/9780203113493

May, S. (2014). Contesting public monolingualism and diglossia: Rethinking political theory and language policy for a multilingual world. *Language Policy*, *13*(4), 371–393. https://doi.org/10.1007/s10993-014-9327-x

May, S. (2019). Negotiating the multilingual turn in SLA. *The Modern Language Journal, 103*, 122-129. https://doi.org/10.1111/modl.12531

McAdams, D. P. (2007). *The life story interview* [Measurement instrument]. https://www.sesp.northwestern.edu/foley/instruments/interview/

Mercer, S. (2014). The self from a complexity perspective. In S. Mercer & M. William (Eds.), *Multiple perspectives on the self in SLA* (pp. 160–176). Multilingual Matters. https://doi.org/10.21832/9781783091362-012

Opitz, C. (2017). Language destabilization and (re-)learning from a complexity theory perspective: Timescales and patterns across four studies. In L. Ortega & Z-H. Han (Eds.), *Complexity theory and language development: In celebration of Diane*

Larsen- Freeman (pp. 163-189). John Benjamins. https://doi.org/10.1075/lllt.48.09opi

Ortega., L. (2013a). Ways forward for a bi/multilingual turn in SLA. In S. May (Ed.), *The multilingual turn: Implications for SLA, TESOL, and bilingual education* (pp. 32-53). Routledge. https://doi.org/10.4324/9780203113493

Ortega, L. (2013b). SLA for the 21st century: Disciplinary progress, transdisciplinary relevance, and the bi/multilingual turn. *Language Learning*, *63* (1), 1– 24. https://doi.org/10.1111/j.1467-9922.2012.00735.x

Ortega, L. (2019). SLA and the study of equitable multilingualism. *Modern Language Journal*, *103*, 23– 38. https://doi.org/10.1111/modl.12525

Plat, R., Lowie, W., & de Bot, K. (2018). Word naming in the L1 and L2: A dynamic perspective on automatization and the degree of semantic involvement in naming. *Frontiers in psychology*, *8*, 2256, 1-14. https://doi.org/10.3389/fpsyg.2017.02256

Smith, J. A. & Shinebourne, P. (2012). Interpretative phenomenological analysis. In H. Cooper (Ed), *APA handbook of research methods in psychology, vol 2: Research designs: quantitative, qualitative, neuropsychological and biological* (pp. 73-82). American Psychological Association. https://doi.org/10.1037/13620-005

Smith, J. A. & Eatough, V. (2007). Interpretive phenomenological analysis. In E. Lyons and A. Coyle (Eds.), *Analysing Qualitative Data in Psychology* (pp. 35–50). Sage. https://dx.doi.org/10.4135/9781446207536.d10

Spoelman, M., & Verspoor, M. (2010). Dynamic patterns in development of accuracy

and complexity: A longitudinal case study in the acquisition of Finnish. *Applied Linguistics, 31*(4), 532-553. https://doi.org/10.1093/applin/amq001

Todeva, E., & Cenoz, J. (2009). *The multiple realities of multilingualism: Personal narratives and researchers' perspectives*. Mouton de Gruyter. https://doi.org/10.1515/9783110224481

van Dijk, M., Verspoor, M., Lowie, W. (2011). Variability and DST. In M. H. Verspoor, K. de Bot & W. Lowie (Eds.), *A dynamic approach to second language development: Methods and techniques* (pp. 85–98). John Benjamins. https://doi.org/10.1075/lllt.29.04van

van Geert, P. (2008). A dynamic systems approach to the study of L1 and L2 acquisition: An introduction. *Modern Language Journal*, 92, 179–199. https://doi.org/10.1111/j.1540-4781.2008.00713.x

Verspoor, M., de Bot, K., & Lowie, W. (Eds.). (2011). *A dynamic approach to second language development*. John Benjamins. https://doi.org/10.1075/lllt.29

Verspoor, M. (2015). Initial conditions. In Z. Dörnyei, P. D. MacIntyre & A. Henry (Eds.), *Motivational dynamics in language learning* (pp. 38-46). Multilingual Matters. https://doi.org/10.21832/9781783092574-007

Verspoor, M., Lowie, W., & van Dijk, M. (2008). Variability in second language development from a dynamic systems perspective. *Modern Language Journal*, *92*(2), 214–231. https://doi.org/10.1111/j.1540-4781.2008.00715.x

Verspoor, M., Schmid, M., & Xu, X. (2012). A dynamic usage-based perspective on L2 writing. *Journal of Second Language Writing*, *21*(3), 239–263. https://doi.org/10.1016/j.jslw.2012.03.007

Yang, W., & Sun, Y. (2015). Dynamic development of complexity, accuracy and fluency in multilingual learners' L1, L2 and L3 writing. *Theory and Practice in Language Studies, 5*(2), 298-308. http://dx.doi.org/10.17507/tpls.0502.09

Appendices

Appendix A

Language Background and Proficiency Questionnaire (LEAP-Q)

This study uses the Language Experience and Proficiency Questionnaire (LEAP-Q) developed by Marian, Blumenfeld and Kaushanskaya (2007). Below is a sample of the questionnaire showing the section on the general language profile. The full-length questionnaire can be found at: https://bilingualism.northwestern.edu/leapq/

Last Name		First Name		Today's Date	
Age		Date of Birth		Male ☐	Female ☐

(1) Please list all the languages you know **in order of dominance**:

1		**2**		**3**		**4**		**5**	

(2) Please list all the languages you know **in order of acquisition** (your native language first):

1		**2**		**3**		**4**		**5**	

(3) Please list what percentage of the time you are *currently* and *on average* exposed to each language.
(*Your percentages should add up to 100%*):

List language here:					
List percentage here:					

(4) When choosing to read a text available in all your languages, in what percentage of cases would you choose to read it in each of your languages? Assume that the original was written in another language, which is unknown to you.
(*Your percentages should add up to 100%*):

List language here					
List percentage here:					

(5) When choosing a language to speak with a person who is equally fluent in all your languages, what percentage of time would you choose to speak each language? Please report percent of total time.
(*Your percentages should add up to 100%*):

List language here					
List percentage here:					

(6) Please name the cultures with which you identify. On a scale from zero to ten, please rate the extent to which you identify with each culture. (Examples of possible cultures include US-American, Chinese, Jewish-Orthodox, etc):

List cultures here					
	(click here for scal	(click here for scal	(click here for scal	(click here for scal	(click here for scal

Appendix B

Additional Initial Interview Questions
Adapted from McAdams's (2007) *Life Story Interview*

1) Language Learning History

1.1 If you were to divide your language learning journey into a few major stages, can you identify these stages and tell me about each stage?

1.2 Can you tell me a story from each stage that will help to explain what you were experiencing?

1.3 Can you please describe a particularly happy, joyous, exciting or wonderful moment during your language learning journey?

1.4 Looking back on your life, can you think of one or two turning points that really shaped the language competency you have today? What are these events and how did they influence you?

1.5 Looking back over your life, please identify and describe what you now consider to be the greatest single challenge you have faced in developing your languages.

1.6 Can you think of one or two individuals from your past or present that played a major role in you developing your language repertoire? Who were they? How did they influence you?

1.7 Please describe an event in which you displayed particularly strong language competence. This episode could be one in which you were able to communicate particularly strongly and stands out as a proud moment. What happened? Where? Who were you with? What were you thinking and feeling?

2) Current Language Context

2.1 Do you have a project in life? A life project is something that you have been working on and plan to work on in the future chapters of your life story. The project might involve your family or your work life, or it might be a hobby, avocation, or pastime. Please tell me what it is. In what way do the languages you speak play a role in this project?

2.2 Consider each of the languages in your repertoire. Are there any which you feel are easier or more difficult to maintain? Why do you think this is?

3) Motivation to learn a new language and future plans

3.1 Are you currently learning a language? How so?

3.2 Our language repertoire is with for our whole lives and you have spent time describing your language journey up until the present. Please now describe what you see to be the next chapter in your language journey. What is going to come next in your language story?

3.3 If you were to look ahead in your life. What do you think your language repertoire will be like in 10 years, in 30?

Appendix C

A Sample of Open Interview Questions

R= Perfect. Okay, so can you just tell me about your week? How how your week has been? What's going on in your life? (Larisa, Interview 1, lines 7-8)

R= So, another question for you. Can you on that note, describe your language use this past week? What languages you spoke? And with who? And maybe a little bit why really quickly? (Larisa, Interview 1, lines 26-29)

R= And so now considering the life that you have in Norway, what do you think is going to help you reach really advanced proficiency in Norwegian? (Larisa, Interview 1, lines 207-208)

R= Yeah. And I'm just curious, can you give me any examples of some Norwegian expressions uh that are new to you, or that are catching your attention? (Larisa, Interview 2, lines 207-209)

R= Mm hmm. Yeah. So would you say that you have like, do you ever speak in dialect? (Larisa, Interview 2, lines 137-138).

R= Yeah, exactly. Have you had any other kind of language related observations over the past two weeks? (Larisa, Interview 3, lines 248-249).

R= Yeah. Have you ever noticed that before in your other languages, when you were learning them that you started to develop characteristics of one language in a different– in another language? (Larisa, Interview 4, lines 99-101)

R= Yeah, absolutely and what about your your Norwegian speaking day to day? How has that been? You know, at the grocery store, or, or whatever? (Larisa, Interview 4, lines 122-123)

R= And so and do you ever have those type of days with English, too like, do you ever have like good days of English bad days of English or, or not? (Larisa, Interview 5, lines 96-97)

R= And so kind of going back to your experience with your with your tutor. So is your experience with her changing? (Ramin, Interview 1, lines 144-156)

R= So when you're speaking French, you have the English words that sometimes come to you. %Is that what you're saying?% (Ramin, Interview 2, lines 215-216).

R= So if you could just tell me again, uh what languages you've been speaking with who and when uh general overview for the past two weeks? (Ramin, Interview 3, lines 7-8).

R= and have you noticed any changes in how well you're understanding your podcasts, for example? (Ramin, Interview 3 lines 47-48).

R= And so another question. So when you're learning a language, uh sometimes people are motivated in different ways. Are you motivated to maybe for lack of a better word, integrate into some sort of French culture or some sort of French society? (Ramin, Interview 3 lines 134-137)

R= And so you also kind of mentioned that, like, you know, you kind of put your Spanish on hold for a little bit. Why? (Coralie, Initial Interview, lines 332- 334)

R= Yeah. So are you approaching Italian already from the get go differently than you approached Spanish? (Coralie, Initial Interview, lines 455-456)

R= And so have you noticed that when you make a mistake, that mistake is coming from French more or English more or Spanish? (Coralie, Interview 1, lines 166-167)

R= So the fact that she joined, does that change? Like, either your motivation? Or the way you kind of feel about the course? Or is it just, oh, you just know somebody? (Coralie, Interview 1, lines 89-91)

R= Do you find that you've made a lot of improvements over the past two weeks, four weeks? (Coralie, Interview 2, lines 158-159)

R= Has that changed, or is that still the same? (Coralie, Interview 2, line 185)

R=Yeah. And was there anything that kind of caused you to do that? (Coralie, Interview 3, line 24)

R= Like, you're basically Are you still speaking the same languages with the same people, same proportion per day? (Coralie, Interview 4, lines 14-16)

R= Yeah. And so over the past two months, like, if you can believe it, we've been talking for two months. How would you qualify your your language learning in Italian? (Coralie, Interview 3, lines 51-52)

Appendix D

Self-Assessment of Speaking Automaticity