

## 23 Conclusion: Hot Enough to be Cool: The Promise of Dynamic Systems Research

Peter D. MacIntyre, Zoltán Dörnyei  
and Alastair Henry

Not long ago, in a special issue of the journal *Child Development Perspectives*, Marc Lewis' (2011) paper 'Dynamic Systems Approaches: Hot Enough? Cool Enough?' took stock of 20 years of dynamic systems research in the field of child development. He concluded that 'the DS paradigm must continue to be "cool" enough to attract developmental psychologists with its fresh insights and novel techniques yet strive to become "hot" enough to deliver robust findings, consistently and convincingly, through powerful analytical tools' (Lewis, 2011: 283). His analysis noted that dynamic systems proponents writing in the journal found research progress to be slower than they had hoped, yet Lewis offered an impressive list of significant contributions to understanding child development that are tied to a dynamic perspective.

Now it is our turn. To conclude the present volume we would like to summarise the main lessons that we have learned in the process of putting together this collection, informed by experience in allied disciplines. Editing this anthology has been a real learning experience, as noted in the Introduction chapter. In many ways, the field itself might be thought of as a dynamic system, constantly changing and subject to perturbations. Seminal works in the field, such as Larsen-Freeman and Cameron (2008) and Verspoor *et al.* (2011), have disturbed the status quo in L2 motivation research, and we hope that the findings and insights offered in this anthology will provide momentum for future research that will lead to a new equilibrium.

## Will Complex Dynamic Systems be a Cool but Fringe Methodology?

The advent of complex dynamic systems in language research has sprung a new type of conceptual and methodological language on the field, and we are grateful to the authors of the conceptual pieces in Chapters 2–10 for helping to clarify some of the key issues. The dynamic perspective presented in these chapters yields a unique and perhaps unfamiliar way of approaching research questions. The papers foreground concepts and subject matter rarely encountered elsewhere in second language acquisition (SLA) research in such an explicit manner, such as, for example, the question of free will, the significance of timescales, the nature of equilibrium and attractor states, the organism's sensitivity to initial conditions, as well as different types of self-organising processes within the system, such as emergence, coupling, realignment, etc. These concepts are interesting in their own right but, admittedly, do not connect easily to more familiar concepts in this research area.

The novelty of the dynamic perspective is both a good and a bad thing. As the new kid on the block, by promising to do things differently from the mainstream practice, dynamic approaches offer new and different ways of understanding the processes of SLA and development (de Bot *et al.*, 2013), potentially shedding light on as yet unresolved issues and providing inroads into uncharted areas. However, not being part of the mainstream in research brings its own set of problems. To start with, even the research questions themselves are usually substantively different from the majority of prior literature. Novel types of questions present a challenge, especially for new researchers in the field, such as those doing studies as part of a Master's or PhD programme. Many of the contributors to this volume would gladly testify to the difficulty involved in developing a dynamically oriented mind-set. We have learnt from hard-won experience that working with dynamic systems competently and confidently has a high learning threshold. Once the threshold is crossed, the toolkit becomes genuinely profitable, but most SLA students in universities at present would find few opportunities for training that can help them to get close to this threshold. This is in stark contrast with books and courses on conventional statistics and research methods that are readily available.

Does the present situation foreshadow a future whereby adopting dynamic systems principles may remain a cool but fringe methodology, chosen to be employed by a selected few 'initiated' scholars? The purpose of producing this anthology has been exactly to avoid such a marginalised fringe position, and in the rest of this conclusion we shall summarise some key maxims and recommendations that we hope will encourage researchers to 'take the plunge'. Let us, however, first state here why we think that adopting complex, dynamic system principles is integral to the language

processes we study and therefore cannot remain optional. To put it plainly, the social world around us *is* dynamic and, as one of the contributors to this volume astutely pointed out, ‘once a researcher understands the complexity worldview, in a sense there is a transformation in thinking. Everything you observe and experience from then on – whether it involves personal relationships, parenting concerns, events unfolding in contemporary society, to say nothing of SL classroom phenomena – is nothing if not complex and dynamic. This understanding leads to the conviction that there are certain things that can only be uncovered from a dynamic systems perspective’ (Hiver, personal communication). This point reiterates Thelen and Smith’s (1994) conclusion to their classic work on the topic – *A Dynamic Systems Approach to the Development of Cognition and Action* – two decades ago:

Once we began to view development from a dynamic and selectionist approach, we found the ideas so powerful that we could never go back to other ways of thinking. Every paper we read, every talk we heard, every new bit of data from our labs took on new meaning. We planned experiments differently and interpreted old experiments from a fresh perspective. Some questions motivating developmental research no longer seemed important; other, wholly new areas of inquiry begged for further work. (Thelen & Smith, 1994: 341)

## Terminology

We have already indicated in the Introduction that one of the main difficulties in adopting a complex, dynamic approach is the fact that it comes with a language of its own. Most of this terminology is imported from other disciplines. Even choosing a title for the overall dynamic approach itself differs among leading scholars. Depending on which feeder discipline a scholar has been influenced by most, the new dynamic approach has been referred to under at least four different terms: complexity theory, dynamic or dynamical systems theory, chaos theory and emergentism. In most cases, but not always, these have been used interchangeably, converging in the same general nonlinear systems approach. Some authors in this volume followed Larsen-Freeman and Cameron (2008) in referring to the theory underlying their approach as ‘complexity theory’, others adopted the practice of developmental psychology as conveyed by de Bot *et al.* (2007) by using ‘dynamic systems theory’, and we also find the compromise: ‘complex dynamic systems theory’ (CDS – a term used in this Conclusion to remain inclusive).

Once scholars have got their heads round the issue of the overall labelling of the field, they will soon encounter a more serious challenge; the terminology applied to the processes under study. As already pointed out in the Introduction chapter, most of the technical terms used in dynamic systems



approaches are rooted in mathematical representations of processes and phenomena. There is some difficulty in trying to map this terminology onto our social reality in a meaningful way. Qualitative researchers have faced a similar challenge trying to work with the constraints of terms originating in the quantitative tradition, such as validity, reliability or generalisability. This is not a trivial issue because the process of disseminating research requires that all the actors in the field – authors, reviewers, etc. – share at least some common ground.

The CDS term ‘attractor’ is perhaps the best illustration of the issue of terminology. Attractors have special significance in CDS because the concept offers a way of focusing on predictable aspects of a system, the states in which a system is most likely to settle for some period of time, even taking into account the unpredictable, chaotic elements of system behaviour. This preferred system behaviour – or equilibrium – has been referred to as an attractor state. But the term immediately raises a question; what are the ‘attractors’ in relation to this state? Can they be described as magnets that attract the system’s behaviour? If so, can attractors be equated with ‘variables’? The simple answer would be no, because these questions suggest straightforward linear causation (as if attractors cause specific system behaviour). In a discussion of this topic during the editing process, Kees de Bot (personal communication) categorically stated that ‘Attractors do not attract, they simply are. Attractors are not magnets’. David Byrne (personal communication) went even further when he concluded, ‘An attractor is very different from a variable. The term “attractor” is simply used to describe a possible state of a system. As such we can think of it as a domain in the possible (state) space’. Gregersen and MacIntyre (this volume) explicitly note that the term attractor in everyday language might mean ‘pleasant, desirable and appealing (or even good-looking)’. But in CDS terminology, attractor states are not necessarily pleasant; they just have to be stable over a specific time frame. Consequently, we have come to think of attractors exclusively as system outcome states, an understanding developed more fully in Phil Hiver’s summary of the concept (this volume, Chapter 3).

While restricting the scope of ‘attractors’ to refer only to states makes the term less ambiguous, at the same time it reveals the absence of straightforward terminology in CDS approaches for conceptualising the specific influence that some factors – such as some kind of an input – exert on the system. According to Byrne (personal communication), ‘For an individual considered as a system, an input to that system – a reward, etc. – is just that, an input ... it is still not a variable as we would normally conceptualize it’. For example, a specific analgesic drug (input) might relieve pain, have no effect or be lethal depending on the system (body) into which the input is introduced. The impact that an input has on the system can be understood in different ways. An input can be approached as a co-adaptation process between two systems. In the language of synergetics (cf. Haken, 2009), an input to the system

can refer to the influence of a control parameter, which is an existing external principle that constrains the possibilities of the system's behaviour. It may well be the case that, from a mathematical perspective, these variations merely amount to variant equations, but when we try to apply our metaphors in a phenomenologically transparent manner, we need to come up with socially accurate definitions and representations. We see that the perception of the term 'attractor' illustrates a broader issue; the difficulties inherent in developing phenomenological understandings of CDS terminology when they are applied in conceptualising and empirically investigating different SLA phenomena.

## A Set of Dynamic Principles

CDS theories have been instrumental in drawing attention to the fact that to understand the reality of phenomena in the social world we need to internalise in our worldviews certain dynamic principles. While it is often difficult to pin down this 'worldview' in terms of specific methodological propositions, it is possible to draw up a set of powerful and universally relevant maxims that are now all but indispensable for first-class research. Such key principles include the following (see also Larsen-Freeman, this volume).

- *Open system*: Studies of motivation in SLA are examining an open, inherently continuous system that involves fluctuations from one state to another with constant interference from additional motives and other processes in an ongoing, evolving and iterative basis.
- *Self-organisation and nonlinearity*: Motivation has adaptive and self-organising properties, with feedback loops that continuously integrate internal and external contexts and act as reinforcing or counteracting forces, creating nonlinear changes in levels of motivated behaviour.
- *Multicausality and soft assembly*: Motivation is multi-determined, so that no single element, input or force controls or causes change. Instead, motivational processes and outcomes are softly assembled (i.e. elements of the system interact in different ways depending on the task, context, etc.), rather than hardwired.
- *Timescales*: Language development itself occurs continuously on multiple simultaneous timescales with particular processes tied to specific timescales, meaning that conclusions about motivation are tied to the timescale on which they occur. In other words, the ongoing ebbs and flows of motivation, or the emerging cycles or repeating patterns, can be observed and described using various starting points and over various timescales.
- *Levels of abstraction of the 'system'*: The motivational patterns that we observe in SLA can be described alternatively at different levels of abstraction by focusing on the interrelationships among processes in a more

abstract sense (e.g. how vision plays a role in the formation of an ideal L2 self), processes within an individual (e.g. why an initially unsuccessful language learner will not give up), or processes at a group level (e.g. why competition within a class is productive at times, yet detrimental to motivation at others).

## Some Advice on How to Conduct Research in a Dynamic Vein

One of the fundamental lessons we drew from reviewing the submissions to this anthology is that the vast majority of the studies that were originally initiated in a non-CDS framework could not be reanalysed to yield valuable CDS insights. Many of the papers that were submitted could best be described as traditional qualitative, longitudinal or correlational studies with an introduction that focused on CDS theory. In such cases, we typically observed a disconnect between the assumed theoretical framework and the details of the research methods; quite simply the latter were not designed to produce the density of data required to study the iterative process of change. Therefore, the most basic research methodological advice we can offer someone wishing to adopt a CDS approach is that applying a dynamic perspective should begin right at the design stage, by considering the dynamics of a well-defined system.

In practical terms, operationalising the 'dynamics' part is easier; it means examining the interplay among factors and the iterative processes involved. Defining the 'system' under study might, however, be trickier than it sounds. Of particular importance is the need to consider the level of the system we wish to study, a process that is often referred to as 'casing' in the CDS literature (e.g. Carter & Sealey, 2009). The selected domain of reality in focus could be an individual person or, if we move in an upward direction, a dyad, a classroom, a social group, a culture or a subculture. Moving in the opposite direction, the system could be the cognitive or emotion system of a person, or for example, the coordination of the anxiety-arousal system. We usually can examine an issue at multiple levels, making it particularly important to 'case' the system under investigation in unambiguous terms by putting specific limits around what we study.

Identifying the focal system and the level at which it operates is only the beginning. A dynamic system is never isolated from other systems; rather, it is in continual interaction with different systems at different levels. Consequently, at the design stage of any CDS study, processes of mapping need to take place. Other systems that might interact with the focal system need to be identified, with a particular need to be alert to the ways in which the focal system might adapt as a response to the interaction. Accordingly, building in opportunities for studying such between-system interactions becomes an important aspect of CDS study design.



Framing a suitable research question might be one of the crucial phases of the process and the one that can prove to be most difficult in the CDS area. Developing research questions from a dynamic perspective requires questions about *process* rather than *product*; it really is a different way of thinking. For example, conventional research might ask about the correlation between two variables (e.g. '*What is the correlation between motivation and L2 course grades?*'); there is value in doing this research, and studies dating back to Gardner and Lambert's (1959) work have found that L2 motivation is reliably correlated with grades in a language course. Although traditional research questions such as this can lead to significant contributions, the process that connects motivation to language behaviour and outcomes has to be inferred. Adopting a CDS approach, fruitful research questions can be thought of in terms of describing a process in motion. Thus, examples of CDS research questions would be: '*What makes motivation rise and fall during a conversation/lesson/unit/semester?*', or '*How does a learner vacillate between approaching and avoiding a native speaker?*', or '*How does a specific encounter with a native speaker in the past feed back into the motivation system years later?*'

A research question phrased in CDS-terms needs to be married to an appropriate methodology for research to proceed. Conventional quantitative studies are best conducted with a large sample, reliable measures and statistical procedures to assess the probability of observing patterns of relationships, group differences or change over time in variables under investigation. Qualitative studies typically offer an in-depth examination of a small number of persons, often using retrospective interviews or focus group techniques that reflect the respondents' memory and understanding of prior events. CDS methods should offer something different, which in turn means that dynamic accounts of motivation necessitate the development of new and/or altered methodologies. Van Dijk *et al.* (2011: 62) neatly capture the idea of the data necessary to study dynamics: 'if we really want to know how an individual (or group) develops over time we need data that is dense (i.e. collected at many regular measurement points), longitudinal (i.e. collected over a longer period of time), and individual (i.e. for one person at a time and not averaged out)'. The continuing acceptance of mixed methods research (see e.g. Dörnyei, 2007) bodes well with respect to CDS studies, especially if it allows unanticipated factors into the mix. However, a mixed methods study is *not* inherently dynamic in nature, and neither does qualitative data automatically meet van Dijk *et al.*'s (2011) criteria.

The studies in the current anthology have been conducted using a variety of methods, some of which will be new to readers and might even have been used for the first time in the study of SLA motivation. These methods, and others yet to be developed, will allow future research to explore CDS questions (see Table 23.1).

Without any doubt this is a promising start, but at the same time we see it as an imperative that these and other dynamic methods be further developed

**Table 23.1** Examples of CDS methods used in this anthology

<i>Method</i>	<i>Examples in chapters by ...</i>
Two-stage qualitative interview design	Waninge (Ch. 14)
Longitudinal qualitative interview design	Henry (Ch. 19); Yashima & Arano (Ch. 18)
Qualitative interview design gathering data on multiple timescales	Mercer (Ch. 12)
Qualitative comparative analysis (QCA)	Hiver (Ch. 15)
Mixed methods research/Triangulation of multiple data sources	Gregersen & MacIntyre (Ch. 17); Nitta & Baba (Ch. 21); You & Chan (Ch. 22)
Cluster analysis	Piniel & Csizér (Ch. 13)
Q methodology	Irie & Ryan (Ch. 20)
Idiodynamics	MacIntyre & Serroul (Ch. 11); Mercer (Ch. 12)
Retrodictive qualitative modelling	Chan, Dörnyei & Henry (Ch. 16)
Latent growth modelling	Piniel & Csizér (Ch. 13)
Change point analysis	Nitta & Baba (Ch. 21)
Variability analysis	Piniel & Csizér (Ch. 13)
Trajectory equifinality model	Yashima & Arano (Ch. 18)

and refined if the field is to move forward along the dynamic path. It will be necessary to adjust the criteria for evaluating research methods in order to accommodate the dynamic turn; in this respect a future article that draws up parallels between research terms used in traditional closed systems and dynamic open systems – for example by specifying the CDS equivalent or meaning of terms such as significance, generalisability, cause-effect relations, purposive sampling, reliability, validity, etc. – would be particularly welcome.

## Positive Examples: Issues That Could Not Have Been Studied as Meaningfully Without a CDS Approach

We believe that the field already has moved past the question of whether a CDS perspective is relevant to the study of motivation in SLA – it is. By means of illustration, we have dipped into the current collection to extract some of the most telling insights into motivational processes that we believe would have not been possible without this specific toolkit. Reflecting on some of the most important findings to emerge from Chapters 11–22 we can see how:

- MacIntyre and Serroul used the idea of soft assembly of incompatible states to show how learners can react with both approach motivation



and high anxiety at the same time, documenting the effects of L2 vocabulary retrieval on a temporary repeller state in the affective domain.

- Mercer used the notion of multiple timescales to capture the nuances of self-development in a set of nested concepts that showed considerable variation across levels, reinforcing the importance of explicitly taking timescales into account.
- Piniel and Csizér identified patterns of change in the relationships of L2 self-related variables over an academic term, using advanced quantitative modelling of change processes.
- Waninge used a series of short interviews to identify four salient attractor states (interest, boredom, neutral attention and anxiety) with an emphasis on the transitions and variability among states as well as the interaction of motivation, cognition and emotion.
- Hiver was able to show that the notion of a self-organising system, rather than personality traits, can be a more appropriate way to conceptualise the development of teacher immunity among his participants.
- Chan, Dörnyei and Henry observed the back and forward shifting between different sources of motivation, which would have been difficult to explain without the aid of cyclic/closed-loop attractors.
- Gregersen and MacIntyre used a triangulation of qualitative data to show a dynamic, iterative process within the self-system of teachers/learners that is best understood using properties of a dynamic system.
- Yashima and Arano were able to consider dense data on motivation over three different timescales to account for what they deem puzzling phenomena and inconsistencies in emerging motivation.
- Henry documented the sometimes rapid changes into and out of attractor and repeller states, showing the sensitivity of the motivation system to a variety of influences, some of which would not have been anticipated prior to the study, reflecting the properties of an open system.
- Irie and Ryan use the conflicted messages encountered in their understanding of motivation from their dual perspective as teachers and researchers, settling on the idea of attractor states to capture differences among types of study abroad experiences of students, along with the variability (and unpredictability) in the trajectories that students follow.
- Nitta and Baba used multi-level data to describe the complex, adaptive relationship among L2 self elements and L2 motivation.
- You and Chan identified and documented how dynamic changes in imagery develop complex patterns of self-development and L2 motivation.

These results, and the more detailed ones to be found in the chapters themselves, point to the beginnings of several new research directions. As with virtually every study in the literature, the research can be refined and new questions developed; we hope that future studies will build upon the

lessons described in the preceding chapters in further developing both CDS conceptualisations of motivational processes and the methods to address them.

## Concluding Thoughts: Although a Road That May Not be Widely Travelled, DST is Not a Cul-De-Sac!

It is said that ‘the perfect is the enemy of the good’. As editors, we have learned that the expression is prescient when applying a CDS perspective to language learning motivation. Future researchers, including graduate students and their advisors, must not be dissuaded by the seemingly impossible standards demanded in some publications in this area. A CDS approach might offer imperfect metaphors adopted from the natural sciences, but even in its incompleteness it has important implications for understanding language learning and development. We do not see the CDS perspective as a theory in a strict sense, but rather a way of thinking about the world and a way of addressing questions that differs from traditional approaches. Because of the complexity of the processes under investigation, CDS, to be honest, is more difficult to apply than traditional methods of data collection and analysis. However, as a counterbalance, a CDS approach can be more rewarding in the sense of the feeling gained that the study is closer to describing events as they actually occur. Moreover, as the contributions to this anthology reveal, it also allows for genuinely new insights and understandings.

Just as they have not supplanted traditional longitudinal studies in developmental psychology, CDS methods are unlikely to replace other approaches to research in our field. Correlations, analysis of variances, interviews, classroom observation schemes and other methods will continue to have their place in the literature for the foreseeable future. Alongside these methods, filling in some of the blanks left by the focus on product, will be studies of dynamic processes. Each strand will inform the other. As John Schumann noted in the Foreword, a dynamic perspective will ‘value variation as strongly as states’, and that really is a new development for our field.

The state-of-the-art research collected in the current anthology is a sign that some researchers have found the CDS approach both ‘cool’ enough to explore in a research project and ‘hot’ enough to inspire new ideas. Of course only time will tell what impact the studies in this volume will have on understandings of motivation in SLA in the years to come. Nevertheless, we are optimistic. Looking into the future, we envisage current trends continuing, the pace of CDS research into L2 motivation gradually gaining momentum, the dynamic toolbox expanding (and with time becoming more useable) and, as a consequence, the emergence of genuinely new insights.

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