Translation as a complex adaptive system
A framework for theory building in cognitive translatology

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4.1 Introduction

Cognitive Translation Studies is a generic cover term referring to a research tradition within Translation Studies that focuses on explaining the cognitive foundations of translating and other language mediation tasks like interpreting. Such studies have also been referred to as translation process research (an older term describing a variety of studies during the last three decades) and more recently as cognitive translatology, a paradigm for the study of translation and cognition that has moved forcefully to articulate the nature and principles of contemporary Cognitive Translation Studies (see Muñoz Martín, 2010, 2015). Some of the issues we take up in this chapter are, in fact, an exploration of the implications of some of the key proposals of cognitive translatology for building cognitive theories of translation within the jurisdiction of a specific theoretical framework—namely, complex adaptive systems (CAS) theory. In this chapter I will use the term cognitive translatology preferentially because I believe that it labels the most useful current framework for understanding translational phenomena from a cognitive perspective. Cognitive translatology has the scope to usefully encompass all forms of theory building in cognitive translation research.

The study of translation and cognition is by nature interdisciplinary and intersects with cognitive science, neuroscience, psychology, philosophy, linguistics, anthropology, artificial intelligence and other disciplines that illuminate our understanding of the mental and social processes that underlie the highly complex observable behaviour of translation. Theoretical constructs have entered our interdisciplinary quite opportunistically from a wide variety of sources. As a result, multiple definitions or interpretations of basic theoretical constructs often co-exist and have not yet been conceptually aligned and integrated (Muñoz Martín, 2010, p. 180). Similarly, the natures of the theories emerging from cognitive translatology and other prior cognitive study frameworks have varied widely, influenced by their multiple disciplinary wellsprings.

For instance, Sandra Halverson’s theoretical work (Halverson, 2013) derives much from cognitive linguistics. Gregory M. Shreve and Barbara Moser-Mercer have explained the development of the translation skill through the lens of expertise studies in psychology (Moser-Mercer
et al., 2000; Shreve, 2002). Tymoczko (2012) and others (Annoni et al., 2012) have examined the implications of neuroscience for understanding translation. Hanna Risku explored the implications of the situated cognition model from general cognitive science for Translation Studies and has examined, along with her colleagues, notions of extended and distributed cognition (Risku & Windhager, 2013). Our cognitive literature is rife with other examples.

Cognitive translatology can be situated within the boundaries of cognitive science generally. Cognitive science, of course, is also interdisciplinary, and has itself struggled (and is still struggling) with integrating constructs that arose from multiple disciplinary frameworks. Indeed, many of the most pressing issues of cognitive translatology today are reflections of issues facing cognitive science broadly; for instance, how to integrate more traditional computationalist (information processing) models of cognition with both connectionist and extended cognition frameworks such as distributed and situated cognition.

It is not my intent here to review all of these different, and sometimes competing, constructs, but to outline the possible nature of a more coherent framework for building cognitive translation theories and integrating conceptual frameworks that appear, at first glance, to be incommensurate. To that end, we propose looking at translation as a complex adaptive system, detailing how some of the properties of such complex systems could be extrapolated as general principles for reinterpreting cognitive translatology.

4.2 Core topics

4.2.1 Cognitive translatology

“Cognitive translatology” was first coined as a term and articulated as a disciplinary stance by Ricardo Muñoz Martín in a seminal 2010 paper. The paradigm is evolving rapidly, especially as it encourages interdisciplinary relationships and “borrowing” (under certain principled conditions) from the other cognitive disciplines. But, as O’Brien points out,

cognitive translatology has matured over the last few years, but it is arguably still in its infancy. There are many ways in which further development could take place by borrowing even more from more established disciplines.

O’Brien, 2013, p. 13

What O’Brien suggests is most certainly true, but one could extend that argument. Our disciplinary borrowings might be even more fruitfully integrated and their utility for theory building in cognitive translatology even further enhanced if they were placed in the context of an integrating theoretical framework that has garnered wide support in most of the disciplines we currently borrow from.

Of course, borrowing the complex adaptive systems framework to extend cognitive translatology only makes sense if there is some conceptual consonance between the two. If we lay out in a brief fashion the main arguments of cognitive translatology, we can perhaps then proceed to see where CAS might provide theoretical support. Muñoz Martín articulated a total of ten postulates to define cognitive translatology (2010, pp. 173–179):

1. “The aim of translatology is to offer a realistic, detailed account of a set of special, complex communicative events and their products.”
2. “Translatology should include cognitive approaches to account for translation and interpreting.”
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3. “Cognitive translatologies need to be based on scientific, empirical research.”
4. “Cognitive translatologies need to make their account of human translation and accord with what is generally and currently known about the mind and brain.”
5. “Cognitive translatologies are functional by definition.”
6. “It is interpretations, not texts or discourses, which are translated or interpreted.”
7. “Translating is an interpersonal activity.”
8. “Translation is a form of creative imitation.”
9. “Translation expertise implies the continuous development of natural cognitive skills.”
10. “Cognitive translatology should focus on the interaction between translators and their environment.”

Taken together, these postulates lay out some important properties of translation from the perspective of cognitive translatology. I take the liberty of abstracting them in a deliberate fashion in Table 4.1.

Even if we consider Table 4.1 simply a foil for advancing my thesis, a close reading of the author’s paper will find that these ideas (expressed in a variety of ways) pervade his argument. While not mentioning the CAS paradigm directly, it is our argument here that Muñoz Martín has nevertheless presciently laid out a framework perfectly consonant with that paradigm and has therefore led us to a closer disciplinary integration with the social and behavioural sciences (and an emerging paradigm in linguistics).

To give credit where it is due, I am not the first translation scholar to recognize the value of complex systems theory in Translation Studies. Kobus Marais (2014) had already detailed the implications of complexity thinking for Translation Studies and focused on translation as an emergent phenomenon. However, in a fortuitous case of parallel thinking, I had not yet read his work when drafting this paper—yet we have reached many of the same conclusions.

4.2.2 Complex adaptive systems

Complex adaptive systems have been a topic of discussion in the philosophy of science, cognitive science and physics, and other disciplines for many decades. Ledyman et al. (2013), Heylighen (2008), and Beckner et al. (2009) provide an excellent overview of the central concepts—the third citation focusing specifically on language as a complex adaptive system. Ledyman (2013, p. 27) proposes a useful starting definition, stating: “A complex system is an ensemble of many elements which are interacting in a disordered way, resulting in robust organisation and memory.”

Complex systems are composed of multiple ensembles (collections) of multiple similar elements. Thus, a social organization is a grouping of many human individuals; a neural network is a

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<tr>
<th>Table 4.1 Properties of translation from the stance of cognitive translatology</th>
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<td><strong>Property</strong></td>
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<tr>
<td>Translation is complex, communicative and interactive</td>
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<td>Translation involves multiple agents</td>
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<td>Translation is cognitive, adaptive and continuously develops</td>
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<td>Translation is goal oriented</td>
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<td>Translation is both ordered and disordered, but patterns emerge</td>
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<td>Translation is multi-scale and hierarchical</td>
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<td>Translation involves response to the environment</td>
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<td>Translation can be understood empirically with proper methods</td>
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collection of a great number of neurons. These multiple similar elements are organized hierarchically; that is to say, they exhibit different levels of organization.

Ensembles of similar elements at one level form a higher-level structure, which then interacts with other similar higher-level structures. As an example, consider a society. Many cells make up a human body; many human bodies make up a group; many groups make up a societal structure.

Ladyman et al., 2013, p. 28

The elements and ensembles must be able to interact directly via some mechanism. In neurons, this interaction occurs via some sort of biochemical information transfer; in human beings, gesture, facial expression, language and artefacts enable interaction. The interaction of elements and ensembles is continuous—and the interaction “affects all the other variables contained in the system and thus also affects itself” (Van Geert, 1994, p. 50). Thus, there is always a strong and active interdependence both between elements and between elements and other ensembles in the system. Heylighen (2008, p. 4) makes the observation that in complex systems the “components are both distinct and connected, both autonomous and to some degree mutually dependent”.

The unitary and collective elements of the system are generally referred to as agents, and this term reflects their active role. Agents act upon their environment in response to the changes or events they experience in that environment. Due to the high connectivity of agents at all levels of organization, the actions they take (e.g. in their responses to local conditions) may affect the actions of other agents. The impact of any given response may propagate outwards from local agents to more distant ones:

Such interactions are initially local: they start out affecting only the agents in the immediate neighbourhood of the initial actor. However, their consequences are often global, affecting the system of agents as a whole, like a ripple produced by a pebble that locally disturbs the surface of the water, but then widens to encompass the whole pond.

Heylighen, 2008, p. 4

In a complex adaptive system, agents are also assumed to be goal directed and adaptive. Holland and Miller (1991, p. 365) explain:

An agent in such a system is adaptive if it satisfies an additional pair of criteria: the actions of the agent in its environment can be assigned a value (performance, utility, payoff, fitness, or the like), and the agent behaves so as to increase this value over time.

Agents can act upon and change their environment, but they may also change themselves in keeping with the goal of maximizing their (let us call it for now) utility. As Odell says, such “agents must be able to react to their environment and possibly change their behaviour” (2002, p. 37). Changes in behaviour can be precipitated by inputs from the environment but can also be mediated by mechanisms such as positive and negative feedback to their own actions. A change in any agent can cause a very small change in the overall system, a very great change, or perhaps no change at all.

Thus, the dynamics of change in complex adaptive systems are non-linear—that is to say, “the effects may not be proportional to the causes” (Heylighen, 2008, p. 4). The non-linearity of such systems results from the amplification effects of positive feedback, where small changes
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(perturbations) are reinforced as they propagate through the systems. Similarly, negative feedback can lead to a dampening effect (2008, p. 5). Ultimately, this means that we cannot easily (or at all) predict system outcomes from initial conditions. Complex adaptive systems are quite sensitive to initial conditions: "small differences in the values of the initial conditions may make for radically different macrostates" (Ladyman, 2013, p. 5).

This entails the idea that while complex adaptive systems exhibit structure, changes to that structure are generally not explainable by recourse to simple rules and cannot be accounted for without looking at other levels of the system—that is to say, at lower and higher levels of agents. So far, we have argued that the “changes” effected by the actions of local agents, by dint of the dense interconnectivity of complex systems, affect other agents more globally; we have also emphasized that complex systems are in continuous interaction—this dynamic aspect balances such systems between order and disorder.

Order and disorder are both present in complex systems, but “processes of self-organization literally create order out of disorder. They are responsible for most of the patterns, structures and orderly arrangements that we find in the natural world” (Heylighen, 2008, p. 2). A completely disordered system would show no patterns—the relative states of the agents or elements would be random; a completely ordered system would show no change—the states of the agents would always be identical.

Complex systems are always balanced on the turbulent “edge of chaos” (Heylighen, 2008, p. 4), but structures, patterns and organization (e.g. some sort of stable spatial-temporal configuration of agent states and agent relationships) can arise via the processes of emergence and self-organization. Emergence is a property of the collective interactions of system elements at the micro-scale. Their interactions produce a macro-level (higher-level) pattern that cannot be explained by examining the constituent agents alone. Self-organization and emergence are related concepts, and there is no need to debate any further theoretical distinctions here. Heylighen provides a definition that equates the two usefully enough for our purposes:

Self-organization can be defined as the spontaneous emergence of global structure out of local interactions. “Spontaneous” means that no internal or external agent is in control of the process: for a large enough system, any individual agent can be eliminated or replaced without damaging the resulting structure. The process is truly collective, i.e. parallel and distributed over all the agents. This makes the resulting organization intrinsically robust and resistant to damage and perturbations.

Heylighen, 2008, p. 6

Emergence and self-organization can create patterns that appear to be purposefully adaptive—goals are met, intentions are realized. The constant action of agents in maximizing their utility seems to provide evidence of central control, of planning and direction, but it is instead sometimes just the result of the constant jostling of agents to find utility or fitness in their local environment.

Sometimes the patterns (structure, macro-level behaviours) that arise from complex systems persist for a time. Heylighen called these patterns “robust”, and Ladyman (2013, p. 29) uses this expression also but adds the condition that “on an appropriate time scale the order is robust”. The notion of robustness implies that even as individual elements continue to “interact in a disordered way”, some of the patterns that have emerged from the collective action may persist for a time. Although order arises, any particular pattern or structure is not necessarily permanent— it persists for a time and will potentially alter as the elements of the system continue to interact and respond to one another.

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Thus, it is important to understand the temporal nature of order in complex systems, an idea captured in the notion of *dynamism*. Ladyman also termed the persistence of pattern in complex systems *memory*. Memory or robustness also plays out in another way, in that previous patterns of the complex system, because they are retained for a time, can influence the way the system will behave in the future. The *past history* of a complex system becomes another critical factor in its future behaviour.

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There is certainly much more we could say about complex adaptive systems; this is a brief introduction to some of the main concepts we want to align with cognitive translatology. The first assertion to be made is that cognitive systems, of which translation would be an example, are complex adaptive systems. Many cognitive scientists share this point of view (see Jordan et al., 2015). A unifying characteristic of a complex systems view of cognition is that it challenges the idea that “cognition, perception, and action constitute system functions that can be isolated and measured independently of the rest of the organism–environment system” (Jordan et al., 2015, p. 316). A cognitive system would share the general properties of other complex systems—but it remains to specify exactly what merits the modifier *cognitive*. Rather than review the (copious) literature arguing this point, I advance a different practical argument, pertinent to cognitive translatology.

4.2.3.1 Cognitive translation processes

A fundamental notion in cognitive translatology, and one with great longevity, is that of *translation processes*. The term is generally taken to refer to a variety of mental operations that engage during a translation task and enable its completion. Cognitive science has generally seen cognitive processes as (relatively) discrete mental operations that have some sort of circumscribed scope, although there is not, as yet, a single commonly accepted definition of what such processes are. Newen (2015, p. 8) has argued that cognitive processes are *information transfer processes* that “connect multiple (or complex) informational inputs to form a minimally flexible cognitive system with a spectrum of minimally flexible behavioural outputs”. What makes these processes *cognitive*, Newen argues, is primarily the fact that they involve the paradigmatic process domains of the cognitive sciences: perception, memory, learning, emotion, intentionality, self-representation, reasoning, problem solving and so on.

Newen’s argument is quite pragmatic and has some utility for theory building in cognitive translatology, since it claims, in part, that what *cognitive* means is, at least at this stage of development of the cognitive sciences, circumscribed by what constructs those disciplines have adopted as objects of study. Thus, the notion of cognitive processes in our area of study is greatly dependent on “actual practice in the typical cognitive sciences, the development of specific research methods, etc.” (Newen, 2015, p. 17). In our attempts at building translation process theories, we in cognitive translatology have basically enacted Newen’s approach. As we imported certain constructs from our sister sciences, we implicitly demarcated them as cognitive because the disciplines we borrowed them from had already done so. We did not provide a grounding definition of our own and, more importantly, perhaps we didn’t need to. Nevertheless, as we import ideas like “cognitive process”, we need to be clear about their disciplinary origins and entailments, and where they might fit into our own schemes for theoretical integration.

If we want to retain the notion of cognitive processes for a complex adaptive systems view of translation, then how would we explicate such processes from that theoretical position? Process
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would be understood primarily as the response of a collection of agents to conditions in the environment (implying the receipt of information), resulting in a change of state in the system. That changed state, in turn, is an information unit. From a complex systems point of view, processes are not just actions or responses of individual unitary agents, but a term to describe changes emerging as a pattern, behaviour or structure at a macro-level due to the continuous interaction of agents at lower levels. Thus, processes have to be understood as multi-scale (they can apply at different levels of system organization) and dynamic.

By classifying cognitive processes as information transfer operations, as Newen does, some other insights emerge. First, cognitive operations are transformative. They take inputs, whether from the outside environment (including from other agent collectives) or from precedent processes, and always modify them in some fashion. Theoretically speaking, it makes no sense to posit a process that simply “passes through” information unchanged. The process perforce generates outputs, or modified information, passing them to other downstream processes, some of them emerging eventually from motor processes as visible behaviour. The type of input, the type of output and by implication the nature of the transformation provide a basis for understanding the scope of a process and demarcating it from other processes. Complex systems theory also requires us to specify the level of organization at which the process is operating—the scale at which a structure or behaviour emerges and what agents are involved.

This notion is particularly useful for looking at translation, where we have (certainly) complex informational inputs, in the form of the source text and its context of situation, and a recognizable behavioural output in the form of the serial production and revision of target-text segments. However, from a cognitive science perspective, the notion of a singular discrete translation process seems unlikely. Rather, it is more probable that what we call translation processes are actually more “paradigmatic” processes that engage and interact in a flexible way during a translation task—and at different levels in the system hierarchy. In building cognitive process theories of translation, we need to, as Muñoz Martín (2010, p. 174) also argues, “be consonant with the findings of the other cognitive sciences”. This means, minimally, that we shouldn’t introduce novel process constructs that can’t be integrated with the existing process constructs of our sister sciences—but we should take it as also implying that we need to be clear about systemic questions: what are the agents, how do agents interact, what is the environment to which the agents are responding, and how do changes in the collective states of agents become interpreted as processes, structures or behaviours at higher and lower levels of scale?

Shreve and Lacruz (2014) conceptualized translation as a “higher-order process”—meaning that multiple lower-order (e.g. paradigmatic) constituent processes are engaged serially and in parallel during a given translation task within a finite time course. These processes, brought online during the task, interact with one another, comprising what Newen termed a “minimally flexible cognitive system”. This means that the system output is not rigidly determined by the input but that the system of interdependent “processes” is flexible enough to produce variable outputs. This flexibility is due in great part to variability in the interaction of constituent processes—collections of agents don’t exchange information in a predetermined way. Further, the transformations they produce are dependent on the current environmental conditions to which the system is responding. Complex systems are dynamic, and that dynamism derives not only from environmental variability but also from the intrinsic interactive nature of the cellular agents of the body (neuronal, motor, organ). It also derives from the unpredictable way in which system outcomes are associated with variations in initial conditions. I can’t help thinking here of Muñoz Martín’s postulate number 8 concerning imitation and creativity.

The source text comprises some of the initial conditions for the engagement of a temporally circumscribed local “translation system”. We can’t predict the outcome of that system to a high
degree of precision—the contrastive “rules” of language don’t alone suffice. There is some “imitation” (constraint on the outcome) but also, quite necessarily, “creativity” (divergence, novelty). This is in the nature of the propagation of the signal through the complex system. We don’t know exactly where we will end up.

Viewing cognition during translation from a CAS perspective has, we feel, great value in theory building. Cognitive translatology needs to directly confront the systemic nature of cognition during the translational act. In this chapter we will argue that useful theories of translation and cognition are, to a great extent, complex adaptive systems theories. This implies, at least, that when building cognitive translation theories, we need to deal with systemic questions.

4.2.3.2 Cognitive system boundaries

One of the explicit entailments of cognitive translatology is a questioning of the boundaries of cognition; this critical stance is quite consonant with a CAS view. From a complex system point of view, we must consider that the boundaries of any “complex” cognitive translation system under study are quite possibly flexible from a theoretical view. If translation is a complex system of structures or processes at multiple scales, then the initial boundaries of the system could be set at the initiation of the first information transfer, that is, with the processes of visual perception that accompany reading. The terminal boundary would be a terminating behaviour, such as a final text production or revision act or a final reading of a source or target-text segment, after which no further task-relevant behaviour is deemed to occur. The cognitive system is demarcated at one temporal pole by an initial perception of stimuli from the environment and at the other by a terminating act.

However, this demarcation is at least partially a matter of disciplinary tradition and of theoretical convenience. In the first case, we study the systems as our colleagues have studied them (for commensurability) and in the second case, because our research questions often assume an object of study that is presumably contained within the system boundaries we have set.

We could set the boundaries of the system differently, and if we do so, then we extend the cognitive system beyond the traditional boundaries of what is thought to be cognitive: that is to say, the mental operations of an individual mind. Theories of situated cognition do not so abruptly set the system boundary at individual perception, because the relationship between the perceiving agents and the situation, environment or context is conceived of quite differently. Cognition, in this view, must explicitly include the immediate context in which an intelligent agent acts; there is a dynamic interchange between the so-called affordances present in the situation and the processes of perception and later cognition that subsequently occur (Gibson, 1977). This view of translation processes fits very well with several new research directions emerging in Translation Studies and with the principles of cognitive translatology.

Similarly, cognitive systems need not be constrained to an individual mind. Distributed cognition (Hollan et al., 2000; Hutchins, 1995) argues that cognitive systems can extend to include not only other minds but also artefacts in the environment. A distributed cognitive system is one “whose structures and processes are distributed between internal and external representations, across a group of individuals, and across space and time” (Zhang & Patel, 2006).

It is beyond the scope of this paper to describe these extended cognition frameworks in detail (see Clark & Chalmers, 1998, on the “extended mind”), but if we are building cognitive translatology theories, it is important to specify the scope of the systems we are trying to explain. Where we set the boundaries of the system determines how we conceptualize the (arbitrary) initiating and terminating states of the system and which processes (and their associated input conditions and output phenomena) are presumed to be actively interdependent during a given time course—and therefore of presumed relevance to the explanation we are seeking.
From a practical standpoint, complex systems theory reminds us that any “discrete” system we study is linked to systems both above and below it in a multi-scale hierarchy. However, we cannot hope to study the entirety of a system’s entanglements with other systems—this is why we set specific system boundaries in theory building. If we do not, then we have a practical “theory management problem”—the object of study becomes too diffuse, the inputs and outputs too diverse and too many; the patterns and structures are at an unwieldy diversity of scales.

Also, the scope of any theory is necessarily coextensive with the observational limits of the phenomena under study and the observational methods available in the discipline. We can’t study all the interactions multiple processes in any given system might have with other processes—and all the inputs and outputs. To some extent, what we do is only study processes that seem to be of explanatory relevance—that is, that pertain to the research question asked, and where the chosen methods of observation and analysis can yield some grounds for claiming that some output is the complex result of the active interdependence of specifiable collections of agents.

4.2.3.3 Hierarchy in the cognitive translation system

When building theories in cognitive translatology, we have to “situate” the explanatory objectives of any theory at the appropriate level of the cognitive system. We have argued, to this point, that a cognitive process is a label for some condition-action event associated with a collection of elements at a certain scale; changes of system state occur, and information is transformed. Because complex systems are multi-scale, our process explanation can also be at different levels of scale.

For the sake of argument, and setting the system boundaries at the individual mind, we could consider translation as involving collections of agents interacting to enable comprehension, transfer and production processes. These processes are at a very high level of scale; for some explanations, for certain research questions, this tripartite granularity may be quite sufficient. But comprehension itself may be viewed as involving both reading and memory retrieval; thus, a more granular explanation of comprehension in translation—a more specific research question—would involve specifying the systemic nature of those two processes and how they interact.

Reading may further be functionally decomposed into even more granular processes of signal perception and processing. Composition and decomposition, from a complex systems perspective, is a theoretical process of moving up and down the hierarchy, or as Ladyman argues (2013, p. 32), recognizing that “the different levels of the hierarchy are made up of regroupings of lower levels, of a redefining of the system’s boundaries”.

Cognitive translatology has historically concerned itself with rather broad higher-order “meta” processes that take place online during translation. The term “meta” here signifies that such processes are convenient constructs for discussing events that, in fact, involve large numbers of interacting elements at different levels of structural consideration. We “collapse” all these details into a construct that encapsulates the details and focuses on compositional abstractions—we abstract the relevant input conditions, emphasize certain changes of state, and focus on certain outcomes.

The further down we go to the “bottom” of the systemic hierarchy, the closer we get to the individual and more unitary agents that are presumed to enable the operation of the entire complex system. In an embodied (human) cognitive system, the lowest level could be claimed to be neurons—although, in fact, one could make the case that at the ultimate level of decomposition, we are left looking at collections of specialized body cells—of the eye, of the brain, of the muscles with which we type our translations. As we travel further “up” the system hierarchy, we extend
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the system boundaries outside the individual mind and include not only other individuals but also the artefacts their own system processes have produced.

Of course, while all these levels are within the scope of theory building, we always delimit ourselves (Shreve, 2018, p. 106):

When we seek explanations of how any task can be carried out, we can go quite possibly very much further down in levels of explanation; the neuron networks of the brain are not the lowest level of consideration. We could proceed to the cellular, the molecular, the atomic, and, perhaps, the quantum. As we move up in levels of explanation from the situated task, we could also go quite a lot further up, from the social and cultural perhaps all the way to the cosmological. But, as a matter of necessity, we circumscribe our levels of explanation, restricting our interests to those task-adjacent levels that contribute materially to the robustness of the explanation we wish to furnish.

4.2.3.4 Translation as task

Theory building in cognitive translatology must be concerned with where we set the boundaries of the translation system. Those boundaries can be flexible, but, in reality, they generally reflect the research questions we ask, the character of our observations, and to a great extent the observational methods we can use.

We can argue, as externalism does, that cognition extends beyond the individual mind to include external actors and artefacts—and therefore, by implication, that the time course of a set of cognitive system processes is not necessarily initiated at individual perception and terminated in a final individual act. Yet, it seems unworkable—with respect to practical research questions that we might hope to answer—that we should extend cognition outwards to include all possible influencing processes, artefacts and actors. On what basis should we constrain the system we wish to explain?

In their discussion of extended cognition, Clark and Chalmers (1998, p. 8) offered a useful basis for limiting the scope of a cognitive system as an object of study: “all the components in the system play an active causal role, and they jointly govern behaviour in the same sort of way that cognition usually does”. This formulation generally considers that we would constrain the system by being able to demonstrate which processes were active and therefore had some demonstrable influence on subsequent or concurrent processes. Whether they are internal (of the mind) or external (of the environment—or even outputs of the behaviour of others) is in this view irrelevant—an external process is a cognitive process if its presence or absence influences the “system’s behavioural competence”—its ability to achieve its functional goal. External and internal resources are temporarily “coupled” during the time course of any given cognitive task.

Any given act of translation is a transient system, brought online for goal-oriented reasons emerging out of a social-communicative context. The “functional” behaviour of the system, potentially involving external actors and processes, is objectively directed to the completion of a particular task. In theory building in cognitive translatology it is imperative to recognize how the notion of a task is critical to theory building. Muñoz Martín (2010, p. 173), articulating the principles of cognitive translatology, argues that the “aim of translatology is to offer a realistic, detailed account of a set of special, complex communicative events and their products” (postulate 1); a few paragraphs later, he adds “cognitive translatologies are functionalist by definition” (postulate 5). If we take these two statements together, they underscore an important underpinning of theory in cognitive translatology; it is communicative—and therefore must at some point account for the influence of external entities and extend itself into the social—and it is functional.
Both of these properties of cognitive translatology align very well with complex systems theory. We will briefly explore these two notions before turning to the question of task.

The communicative property speaks directly to the nature of interaction between collections of elements (in this case stakeholders in the translation process); as such, translation can be seen at the social system level as a complex behaviour that emerges, at least initially, from the collective behaviour of individuals acting together in a social structure. We can understand intent, purpose, function and even the setting of task conditions (e.g. schedule, deadlines) as properties emerging from the social system. The fact that we can communicate—and that we share certain language knowledge, world knowledge and domain knowledge—can be seen as a property of the extended social system. Each of these systems can play a role in cognition—properly extended via the right research question; although it does not follow, if we circumscribe the scope of our explanation properly, that we must deal with those systems. Still, the point here for scholars in our discipline, like Hanna Risku, Maureen Ehrensberger-Dow and Ricardo Muñoz Martín, is that cognition can and does extend to those systems—and theories developed in cognitive translatology must account for that extension.

The functional property of translation also aligns quite neatly with complex system theory. Earlier we discussed the property of agency and its relationship to goal orientation, and here Heylighen, once again, provides a useful perspective:

To explain the appearance of organization, we need to make one further assumption, namely that the outcome of interactions is not arbitrary, but exhibits a “preference” for certain situations over others. The principle is analogous to natural selection: certain configurations are intrinsically “fitter” than others, and therefore will be preferentially retained and/or multiplied during the system’s evolution. When the agents are goal directed, the origin of this preference is obvious: an agent will prefer an outcome that brings it closer to its goals.

Heylighen, 2008, p. 7

Functionalism has a long history in Translation Studies, going back to Hans Vermeer’s 1978 articulation of Skopos-theorie, with its emphasis on the functional purpose of a translation as the primary determinant of translational strategy. It is time for us to recognize (as Muñoz Martín exhorts us to do) that we can’t ignore the fact that translation, at whatever level of system explanation, is goal directed. All of how translation behaviour plays out in real life and real time is inextricably related to the goals the translator sets for the activity—or perceives as having been set. Goals are notoriously slippery to grasp, however. We can talk about the goals of a translation at the social system level—e.g. with words like “purpose” or “function” and terms like “translation brief”. But we must also consider that system elements are goal oriented at levels further down in the systemic hierarchy. So, what are the “goals” of lower-level agent ensembles—or, better yet, how do the goals at greater system levels scale down to explain lower levels? Similarly, there are goals further up the systemic scale—the translator’s objectives for the act of translation don’t appear suis generis but derive from the outputs of external social agents.

Let me give an example here of scaling down and take the case of a translator proceeding through a translation sentence by sentence. During translation the translator appears (from the empirical evidence) to work on discrete “chunks” of textual material. A specific and specifiable (via eye-tracking and keystroke logging technologies) segment of source text appears to be focused on by the translator and its meaning extracted. That meaning is then “transferred” into a target-language production, a target segment taken to be a re-expression of the message of the
originating segment. This chunk, a so-called translation unit, is demarcated from preceding and succeeding units by pauses.

We have, apparently, during the time course of the entire translation, a recursive process whereby several successive cycles of reading, text comprehension and text production occur. Each of these chunks is initiated (we have empirical evidence of such) by an initial eye movement and terminated by final production behaviour before another cycle begins. The theoretical question here is this. At this level of granularity, how would we characterize the goal of this particular condition-action sequence? Certain broad conditions were set, certainly, before the entire sequence was kicked off—but are these conditions specific enough to explain why the transition between one chunk and another was made, or, rather, why the decision to move from one chunk to the next was made? (See here the notion of “tipping point” in CAS theory (Gladwell, 2000)—the point at which a system moves away from one state to another.)

Functional considerations had to play a role in the decision to continue, did they not? Yet not all the goal setting was external and broad—the translator must have set some more specific internal goals him- or herself; and therefore, some goals pertain to the chunk rather than to the textual process as a whole. What I am suggesting here is that “previous states” of the translator’s cognitive system (the history of the system—its memory) may have contributed additional internal goal conditions. The translator may have had certain expectations—set additional micro-goals—that needed to be met. These were extrapolated both from the initial conditions and from the memory of past translations. Such a conception fits not only with what we know of metacognition but also with complex systems theory. We could continue our consideration of goal orientation all the way down to examining why a particular neural array activates and deactivates—should our research focus require this. Interestingly, recent work by Carl, Tonge and Lacruz (forthcoming) in human and machine translation provides some avenues for investigating the micro-scale emergence of structure and changes of state in translation processes using the framework of “dissipative systems” and “entropic gravity”. Their work may allow us to better understand how and when translational tipping points are reached.

Now we turn our attention to the notion of the translation task—a construct, I believe, central to cognitive translatology. The translation task is functionally motivated, arising from the constraints placed on it by other agencies in a social network; it is communicative, because at some point, like other agents, during its time course, processes engage that accept information from external sources, transform it and then pass it to others before moving beyond the translator’s individual scope. But, additionally, we have to consider whether the construct of the task really represents the way the external aspects of cognition impinge upon the internal aspects. In Translation Studies and in functional linguistics we have long understood the role of ideas like “context of situation”. The pragmatic turn in Translation Studies was a widespread recognition that translation, as a system, is exquisitely conditioned by its external parameters. This orientation of Translation Studies is perfectly consonant with how complex system theory understands the relationship of system and environment and applies directly to theory building within cognitive translatology.

4.2.3.5 Translation, system experience and control

Complex systems are dynamic, but also adaptive. Cognitive systems not only adapt but also can preserve aspects of the adaptation in memory to influence future adaptation. A long-standing interest in cognitive translatology is how the ability to translate develops. Various constructs such as competence, and more recently, expertise, have been used to look at what accumulation of experience is most efficacious in translational success. It should be noted here that both competence and expertise necessarily involve not only acquiring experience but also transforming
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it in some way so as to benefit the future performance of the system in meeting its goals. The cognitive system transforms raw experience, preserving that which has proven efficacious—a sort of fitness or utility function—in achieving goals. Expertise is an adaptation, a construct that captures not only the goal orientation of the translation system but also the results of competition between alternative experiences. Which ones get preserved—stored in system memory? There has to be a mechanism that explains what is retained and what is discarded—or, rather, what leaves a more persistent cognitive trace rather than a weaker one. Here, of course, theoretical notions stemming from cognitive linguistics, such as entrenchment and salience, would come into play as possible explanatory mechanisms.

Thus, all sorts of constructs we use in cognitive translatology, from decision making to problem solving, proceduralization, schematization, automatization and translation strategy (among others), could be seen as various aspects of the pattern-creation properties of complex systems. Each of these ideas involves the longer-term persistence of certain patterns in the system—stored in some way for later use in achieving the goals of similar tasks.

Some constructs we use in cognitive translatology, such as planning and metacognition, relate to the issue of control in the system. Cognitive translation scholars have long understood that translation is a composite systemic activity, bringing together within the scope of a specific translation task an array of cognitive resources activated by constituent processes within the scope of the task; we’ve done this implicitly even if we haven’t used the language of complex system theory to express the ideas.

We assume that the constituent processes are coordinated under the constraints of a given translation task for the fulfilment of a specific communicative goal. The notion of coordination is an important one; it implies that there is control, e.g. that the constituent activities are, somehow, both integrated and directed to the completion of the task. Complex systems theory can give us another perspective on this, suggesting that there is no “hierarchy of command and control”, as Kaisler and Madey (2009) claim: “there is no planning or managing, but there is a constant re-organizing to find the best fit with the environment”. From this perspective, much of what we think of as control is, in fact, an aspect of self-organization within the confines of a task—with the consideration that previous patterns (a redacted history of system states preserved, literally, in our memory) may serve to help certain patterns of action to emerge rather than others.

As an example, task awareness is a central concept in metacognition. But we could conceive of it as simply an emergent property of the current state of the system whereby the awareness of the current task is conditioned and precipitated by our precedent experience of the task. Translation strategies, similarly, are a stored pattern extracted from previous experience, represented ultimately as a network of interconnected neurons that activate under the right conditions. Even our decision making and problem solving aren’t the simple acts of will we might imagine them to be, but a result of our history of experience interacting dynamically with the currently engaged system.

4.2.3.6 Transformation, language and artefact

In dealing with translation we cannot, of course, avoid dealing with language. Language, too, is a complex adaptive system. This perspective has gained significant disciplinary traction in recent years (see Beckner et al., 2009, and Baicchi, 2015, for an overview). We cannot treat with this subject extensively here, but simply make the claim that the patterns of language, from the phonological to the textual, are patterns emerging from the interpenetrating actions of systems of agents at multiple scales.

We have used the word “pattern” to refer to a persistent, stable configuration of system states over a finite time course. We can also give another interpretation to the term (Baicchi,
2015, p. 19): “In complexity theories the term information is synonymous with the presence of distinguishable patterns and relationships.” Thus, one way we could conceive of the stock-in-trade of the translator—words, sentences, paragraphs and texts—would be to see them as persistent emergent patterns, structures arising from large numbers of interacting agents at the social level influencing the formation of patterns at multiple levels in individual minds—this would also alter our view of the notion of mental representation. Or, as Baicchi describes it (2015, p. 22),

If we […] observe the internal structure of language, we realize how the different levels, or sub-systems, of its organization constantly compete, merge and adapt so as to produce a coherent text. In other words, the textual requirements involve the interactions of various sub-systems (the phonological, morphological, syntactic, lexical sub-systems), which feed into one another in ways that are instrumental to produce a text that is efficient and appropriate to the situational context. The different language levels can be conceived of as multiple agents that co-adapt their behaviours in order to synergistically produce an optimal text for the specific situation of occurrence.

From this point of view, we can understand a text as an emergent structure arising from the interaction of multiple systems—some biological, some cognitive, and some social. At the point at which it becomes written down, the text becomes an artefact. Artefacts might be seen as an end result of interacting cognitive and social systems—patterns that take on a higher level of persistence by being deliberately manifested or realized as (or in) material objects because they have greater utility in that state. Artefacts have a central role in theories of distributed cognition because they are an element of extended cognition, “external representations” (Zhang & Patel, 2006) of knowledge and structure. And when they are externalized, they also become part of a broader system with which an individual mind interacts—and through which it influences other minds at greater spatial and temporal dimensions.

At this point an interesting question arises concerning agents and agency. We have implied, of course, that translators and their clients, among others involved in any given translation interaction, are agents. Further, we have argued that neurons and collections of neurons are potential agents. But are words, sentences or texts agents? Baicchi (2015) argues that the different levels of language can be seen as agents—but I think it is useful to deconstruct the implications of that statement.

First, it is clear from a CAS perspective that the structures of language are the products of agent interaction. We can conceive of a mental representation of a word as a persistent ensemble of agents. The transient representation of a sentence in memory is also an ensemble of agents. Yet, once uttered or written and sent into the environment, are these system outputs still agents? Can they be the product of agents and also agents themselves? One possible solution to this conundrum is to focus upon issues of goal orientation and functionality. As Muñoz Martín argues, translations (and indeed all produced language structures) are not just communicative; they are functional. They are intended to do something: to influence, to persuade, to inform, to entertain and so on. This is an insight that has long informed Translation Studies, discourse analysis, text linguistics and systemic functional linguistics.

Thus, to the extent that language structures carry, for lack of a more useful word, intent, I would argue that they also carry agency. Because they are released into the environment to affect other social agents in some deliberate way, they become part of external ensembles that interact with other ensembles to influence future social and communicative outcomes. In their very shape and nature, they are tools, and, as such, carry with them signals of their producer’s
goal orientation or intent and markers of their producer’s purpose. They embody agency, and therefore become agents.

Source texts are artefacts, external material representations of the results of an author’s cognition and purpose—of patterns that emerged from competition to be captured in writing (or digitally) and to some extent frozen. During the time course of a translation, this artefact—and specifically its constituent elements—enter into interaction with other systems. First, the active social system provides a social context—with the intents, purposes, desires and needs of a group of social actors exerting influence on the translation. Other relevant artefacts in the environment—from dictionaries to search engines to software tools—will also enter into the equation. Target texts will also become artefacts when the time course of an active translational system ends. They will persist to influence others and to be of value in achieving future goals.

4.2.3.7 Translation units

Explaining what happens during the time course of an active translation system has been the traditional objective of cognitive translatology. Yet, as we have argued here, we cannot, if even by failure to clarify, assume that all of what happens next is internal—nor is it as linear as we might suppose. The “translation task” begins externally and manifests as a specific temporal progression of system interactions—or, rather, multiple systems at multiple levels of scale interact. It ends when, for all practical purposes, the translator fails to return to modify the text in any way. Establishing the temporal boundaries is necessarily arbitrary—and conforms generally to the research questions posed.

We do seem to know with some degree of certainty that translation proceeds in a chunk-wise fashion; we have already introduced the notion of the translation unit. What this means from a system’s point of view is that there is a constant oscillation between creating internal patterns and processing external patterns. For instance, if we take reading as an example, several internal systems (and their component elements) must engage to process the perceived graphemes and then engage lexical systems. Grammatical systems must engage, including conceptual systems, to work out contextualized meaning. There are undoubtedly competing patterns, but it is the one that emerges successfully that is then committed to writing. But even here, there is microstructure; there are micro-patterns within the unit, chunks within the chunks. The emergence (and I use the word here both metaphorically and in the complex system sense) of a target segment is by fits and starts—as can be seen from eye gaze patterns and keystroke logs. There are pauses internal to the chunk—micro-pauses—and revision behaviours, deletions, retyping, and so on. The translator may move her eyes to the source text again and again and then watch her own typing as the target text takes shape. All of this takes time; but in some sense, the time it takes, the number of pauses, the extent of keystroking, the looking here and there, are all constituents of the temporal space it takes for the engaged systems to resolve upon a sufficient determination of fitness so that the translator moves on to the next chunk. And, all this activity in the time course necessary to determine fitness is the behavioural manifestation, certainly, of what we normally call cognitive effort in the discipline. A multi-scale view of translation would, however, also extend the notion of effort out beyond that manifesting in the individual mind—what about interpersonal effort, social effort?

I’d also like to point out that as the translator proceeds chunk by chunk, he or she is externalizing internal patterns—creating another artefact. This is at least partly the result of the cognitive constraints of working memory (a system limitation); the information created in the mind has to be offloaded—distributed to an external artefact to preserve it. Once externalized, it becomes another environmental influence and provides new inputs into the system to affect subsequent
processing. From a distributed cognition and complex systems view, it is a memory—just not a neurologically realized one.

4.2.3.8 Translation and transfer
A consistently bothersome and persistently fuzzy concept in cognitive translatology has been the nature of “transfer”, a kind of black box construct that links the reading of the source-text segment to the production of a target-text segment. It seems to me that at least one useful way for us to address the nature of transfer is to define it as an “outcome” of the utility-driven competition of competing systems and patterns. There is no specific control mechanism (e.g. something like Green’s language task action schema (Green, 1998)) that links certain kinds of language input (in the L2) to certain kinds of language output (in the L1), as I used to believe. Rather, a pattern emerges from the interaction of the relevant systems and element collectives and survives the fitness test.

There is no transfer in any simple sense. There is no mysterious undefined “something” existent in the source text that is “carried over” to the target. Discussions about the transfer of “message” or “sense” only work because we simplify and abstract those constructs so that we can talk about them to students and colleagues. Rather, “transfer” is a convenient label for a non-linear pattern that emerges dynamically during the time course of a translation. Transfer is initially a locally emergent phenomenon—localized in discrete translation units. A source-text production and its precedent context enter the translation system and are influenced by pertinent agent collectives stored in the translator’s memory. A translation unit emerges into a target-text production. As new productions are added to an also emerging text, past productions become new influencing factors. Those productions may themselves later be revisited and modified. Why? Because re-reading of the source text and the progressively greater coherence of the target provide new information that stimulates new patterns to emerge. Choices made affect future choices—both elaborating and constraining the possibilities of outcome. By the time the entire emergent pattern is released back into the environment, we have a target text: one that we say, quite simplistically, has “transferred” the meaning of the source. But the transference itself was anything but simple.

The source text was an artefact—but it was also a representation of a state of affairs (what Kintsch (1988, p. 180) called a situation model). One of the things we have to account for is exactly how the situation model is “transferred” or, rather, reconstituted for the target reader. The translator hasn’t just produced a system of words on paper but produced an output that will be the environmental input to someone else’s act of cognition—and there propagate, in unpredictable ways, through the constellation of systems it touches.

4.3 Concluding remarks
To a great extent, much of what I have argued here requires that we accept a complex adaptive systems view of translation—from that basis, when I use terms like perception, reading, comprehension, production, even “transfer”, it is with the understanding that each of these is a label for information transformation operations—emergent pattern and structure building—realized by multiple multi-scale systems of agents. It is not my objective to “prove” that reading or writing, or language in general, can be understood via CAS—others have already begun to make more convincing arguments than I. I have accepted this perspective as a fruitful one and offer it here as a useful way of understanding and elaborating some central constructs of cognitive translatology. Cognitive translatology made a call for a paradigmatic shift in previous approaches to Cognitive Translation Studies, and one way to accomplish this is to harness our local disciplinary shift to a greater one.
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Given the constraints of space, there are necessarily many theoretical constructs important to Translation Studies that have not been given attention here. For instance, we interpreted translation strategies earlier as an example of a kind of persistent emergent pattern—particularly in the context of the individual translator’s mind. But, of course, one could extrapolate to the notion of procedural norms at the social level—and contextualize translational norms of all kinds as robust emergent patterns that have self-organized in the community of translation practice. Still, my objective was not to address every critical issue in our discipline—although I have touched on many—but to argue that Muñoz Martín’s innovative cognitive translatorialy can be supported by a broader disciplinary shift in the physical, natural, social and behavioural sciences. If we accept that argument, then the corollaries of complex adaptive system theory will greatly and gradually inform theory building in our discipline.

Earlier I mentioned the work of Kobus Marais. Where his work concentrates on the general implications of complexity thinking for Translation Studies broadly, mine focuses more specifically on its utility in understanding translation and cognition. Yet, because of the very nature of complex adaptive systems, CAS theory may serve to unite cognitive theories of translation with more general theories and point the way to a unified theoretical framework. The different levels of scale, in particular, help us deal with issues not just of translation process, but of translation product and function.

Translation—the act of translating—is a complex adaptive system. The complexity engages systems of agents from the level of the neuron upwards to include social systems. A translation—the product—is also a “memory”—a persistent ordering of linguistic elements at various levels. Some of the order that emerges during a particular time course (translation options that arise only in the mind and are not preserved in the target text) may be persistent for only a short time—during the time course of a translation unit. However, the final translation product is an artefact of greater longevity that preserves an order and intent that arose from the unpredictable yet organized interaction of many concurrent and precedent system states. It is a material memory. Similarly, the act of translating, though transient, affects the patterns of neurons. The individual stores some record of the experience—memory in a more direct sense—to influence future translation and translations.

Further reading


Baicchi makes the case for viewing language as a complex adaptive system. Individual agents (people) interact in speech communities. Over time, their interactions produce emergent linguistic regularities. The author makes the case that grammar and lexis are the emergent “sedimentation” of frequently used forms. We can view translations and translating from a similar perspective.


The authors argue the position that processes of human interaction collaborate with domain-general cognitive processes to create the structures of language. These social and cognitive processes are interdependent facets of a larger complex adaptive system with multiple agents, evidence of adaptive behaviour and speech productions that are the consequence of competing factors ranging from perceptual constraints to social motivations. According to the authors, the structures of language emerge from interrelated patterns of experience, social interaction and cognition. The same case could be made for the products of translation.


This article introduces some of the main concepts and methods of the science of studying complex, self-organizing systems and networks. A complex system is a hierarchically organized collection of interacting
agents at different levels of scale. Because of the nature of the interactions, the systems behave in a non-linear fashion and are, to some degree, unpredictable and uncontrollable. However, Heylighen argues, such systems tend to self-organize, and out of a multitude of local interactions, global coordination and persistent regular patterns emerge. In this chapter we use many of Heylighen’s conceptions to understand translation as a self-organizing system with different levels of scale and thereby address some current issues in cognitive translatoLOGY, such as distributed cognition.


Many disciplines, including our own, Translation Studies, are beginning to use the notions of complexity and complex systems. Ladyman points out that there is no concise, commonly accepted definition of a complex system. This article reviews various attempts to characterize complex systems and considers a core set of features we could ascribe to such systems. Ladyman’s work provides a basic architecture for considering whether translation can be successfully understood as a complex system.

Marais, K. (2014). Translation theory and development studies: A complexity theory approach. New York and Abingdon: Routledge. Marais uses complexity theory to try to reframe translation theory, arguing that translation in all its aspects, especially the social, is a complex system. Marais argues that the complex systems view addresses some fundamental epistemological problems in Translation Studies and, as in the case of this work, offers some elegant solutions to persistent thorny issues in the discipline. While Marais does not specifically address cognitive translatoLOGY, nevertheless his monograph is among the first to look at translation from a complex systems point of view.

References
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