Going the distance
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Let's begin again, begin the begin, Let's begin again like Martin Luther Zen
The mythology begins the begin Answer me a question I can't itemize

Begin the Begin by REM from the CD Life Rich Pageant

1.0 The Droste effect

Causes of change have traditionally been written in formulas or equations like “If y happens, then x is the cause.” These sorts of rather simple, mostly linear relationships are still in use to describe or explain all kinds of behaviour. However, in recent years, new research is focussing on more complex relationships. For example, dynamic systems theory (see also chapter 3) does not use linear, but non-linear relationships. These relationships lead to fascinating new theoretical and practical insights. To give an example: in the field of these non-linear theories researchers discovered the fractal. A fractal is a mathematical structure. Its overall structure is infinitely repeated on smaller scales. Usually, fractals are depicted as a drawing, and they are supposed to be very common. For example, the drawings found on tins of the Dutch chocolate manufacturer Droste, hence the Droste effect, shows the effect of a drawing in a drawing on smaller and smaller scales. Fractals have become popular with the introduction of the so called Chaos theory. This theory was soon to be followed by other non-linear theories like, for instance, Catastrophe theory. These non-linear theories constitute an important part of this thesis, because linear models fail to explain at least some of the models in developmental psychology.

The central research question of this dissertation, formulated in the next section, pays attention to both linguistic and psychological theories of human development in combination with empirical evidence. Language development is analysed by applying non-linear theories to quantified language variables to find evidence for discontinuities in human development. Begin the begin, so to speak a very small fractal captured by the
rock song by REM, refers to the start of human development, to the way a child develops, and to how to define the start of acquiring his\(^1\) language.

**1.1 A brief history of views on change**

The study of change in the development of any (including human) behaviour is not new. In the course of history, there has always been a discussion whether nature is static or ever changing. In the 6\(^{th}\) and 5\(^{th}\) century BC, the Greek were concerned with change in nature, and they had two opposite views. Parmenides, on the one hand, had a rather conservative view on the world: everything in our world had existed ever since the world was created, no change has ever occurred. According to Heraclite, on the other hand, everything flows, and change is essential to nature (Störig, 1972). In his *Historia Animalium*, Aristotle takes yet another point of view. In book VIII, after having discussed the physical characteristics of animals, he states that *Natura non facit saltus* (‘nature does not jump’). A problem was added to the discussion on the nature of men by Plato. In *Meno*, Plato worked out some of his ideas on the problem of novelty. Is everything we humans are innate or is everything we are handed over by the environment (e.g. our parents)? Plato’s choice for innateness and his ideas on change have been challenged. This dissertation illustrates that the ancient discussion on human behaviour and change has not ended at the end of this millennium.

The question of change or no change still exists in our time. Views on the development of language, with respect to change and statis, were challenged in the late fifties and early sixties when a behaviourist psychologist, Skinner, and a young linguist, Chomsky, set fire to the views on language and to the issues of change and novelty in language development. Chomsky stressed the importance of *structure* in language. It was recognised that the structure and order in language development were by no means accidental.

The criticism by Chomsky and other generative grammarians was directed against research preceding the introduction of generative grammar. Language, in those pre-generative days, was seen as a collection of words, a way to communicate, a carriage to express thoughts. There was a strong influence from philosophy and from (developmental) psychology. Emphasis was put on, for example, philosophical problems. However, since there is *structure* in language (expressed in the grammar of a language), the question is how this structure is acquired in the process of language development. One of the goals of this study is to explain the development of these structures (e.g.

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\(^1\) *He* is used as a gender neutral pronoun to refer to a child in general, male or female.
An introduction

grammar), development is seen in its context of a process, i.e. something that has an index of time, and it’s main characteristic is change.

The forms of change, the relationship between these forms, and the (underlying) reasons and causes of change are the main topics of this dissertation. The ancient ideas about the nature of change still stand, but new methods and tools have been developed to demonstrate all sorts of change, including gradual, fast, and sudden discontinuous change. These tools and methods will be applied to developmental issues to answer the research questions in the next section.

1.2 ‘Houston, we have had a problem’

When Apollo 13, one of the space rockets that went to the moon and back, got into trouble, all sails had to be set to get the astronauts back to Earth safely. Due to an unforeseen problem the Apollo flight could not return to Earth smoothly using standard procedures. Inventive minds had to come up with a creative solution. A non-standard situation like the problem with Apollo 13 calls for a non-standard solution. We will see that a non-standard approach is also needed for at least some of the questions in developmental psychology.

In the study of development, some approaches assume a linear or continuous underlying change of psychological processes, which is reflected in the use of statistical tests like regression. Other approaches, however, claim that development is discontinuous (e.g. in Piagetian theory where stages are assumed). The problem is how to prove discontinuities and how to define stages. Various scholars have tried to provide a solution to the problem (see for an overview Boom, 1993). The many (near-)synonyms of stage (like period, phase and level) are an indication of more problems, since the term ‘stage’ embraces two concepts, namely equilibrium and instability. These concepts reveal new problems: how are equilibrium and instability defined? No satisfactory answers have been given so far. So, in developmental psychology, ‘we have had a problem’. There is a claim of discontinuity, but there is no model for explaining discontinuities. This is a surprise, since the assumption of discontinuous development is widespread within, for example, (neo-)Piagetian research. So, we need to come up with a non-standard solution, since standard solutions refer to continuous change.

Mathematical theories and methods elicit the sort of change. On the one hand, there exist, apart from linear models, growth models. These models are used to explain continuous change in development. On the other hand, there is Catastrophe theory, that is very helpful for fitting and explaining discontinuous change in development. These
non-linear models have been chosen to define (dis)continuity and to answer the following questions (with the chapters in brackets):

1. What is development, and does behavioural development (i.e. language development) consist of sudden discontinuous change, or is it continuous? [Chapter 2].
2. What theories are useful to prove (dis)continuous change in development? [Chapter 3].
3. What method is needed for the longitudinal study of discontinuities, and what is the empirical evidence for discontinuous development? [Chapters 4 and 5].
4. What does discontinuity mean for the study of development in general, and for the study of language development in particular? [Chapter 6].
5. What is the relationship of the data with linguistic and psychological theories, and what do non-linear models have to offer? [Chapter 6].

The central question is:

What are the paths of language development (in quantitative terms), and how can these paths of development be explained by linguistic and/or psychological theories?

More specific, this study reveals possible evidence for a transitional (for the time being defined as discontinuous) change in the ontogenetic (i.e. in a child) development of language.

1.3 The dissertation from a bird’s-eye view

In Chapter 2, I deal with the two central concepts of this study: development and language. Development is closely related to novelty in behaviour and to the nature-nurture debate. Furthermore, I discuss the notion of discontinuities in development. In the second half of the chapter I stress that linguistic theories use (underlying) structures in language to explain language properties. Some problems and questions remain, because until recently there were no theories or models to empirically prove discontinuous behaviour.

Chapter 3 contains a discussion on a branch of mathematics that has been developed in the past twenty years. Non-linear models and theories, especially dynamic models and catastrophe theory, offer a method to study non-linear and even discontinuous change. This chapter also presents some promising studies in the field of developmental psychology.

Of course, theoretic reasoning needs empirical support, which in turn cannot do without a method. In Chapter 4 the variable of the analyses, function words, is discussed. The choice is based on findings by Roger Brown (1973). I also discuss the conditions
that must be met to study quantitative change in language development, and I will present the subjects in this study (i.e. six children), the recordings and the transcripts employed.

In Chapter 5, the Results, I first discuss indicators from Catastrophe theory (i.e. the flags) that were found in the language of the six children. Second, the results from continuous models are presented, namely fits of the time series. This chapter ends with explanations for the change found in the data.

Chapter 6, the Discussion, starts with a summary of the evidence presented in chapter 5, and I discuss what this evidence means for the study of change in (language) development. Psychological and linguistic theories of chapter 2 return in this chapter. The question is how these theories relate to the findings from this study. I discuss non-linear models and theories like Catastrophe theory and Connectionism and I also go into the matter of the problems that come with the method of this study. Some solutions are proposed, and the completion of this thesis includes some tentative predictions based on this study, and future improvements to find more evidence for either continuous or transitional change.