Word in process
On the interpretation, acquisition, and production of words

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Word in Process

On the interpretation, acquisition, and production of words

Een wetenschappelijke proeve op het gebied van de Letteren

Proefschrift

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Abstract

This dissertation deals with the relation between words and meanings. Word meanings are flexible. The same word may have different interpretations, dependent on the context in which it occurs. In this thesis, I argue that a meaning is not a static property of a word but that it is the input to the process of the production of a word or it is the result of the process of interpretation. The focus of this thesis is on the factors that determine the outcome of these processes.

Interpreting and producing words are processes of optimization. The output of the process is the candidate that best satisfies a set of ranked constraints. The idea that language use involves optimization forms the basis of Optimality Theory. In chapter 2, I introduce the basics of Optimality Theory (OT) and of connectionist models, on which OT is based.

Chapter 3 deals with the interpretation of words. I argue that words are associated with a set of semantic features. An interpretation of a particular occurrence of a word depends on this set of features and on the nature of the context in which the word is used. This view on the interpretation of words is illustrated with an analysis of the meaning and interpretation of the Dutch particle *wel*, which is highly polysemous. I argue that all uses share a core meaning, namely that they function as a denial of a negation, but the uses differ in semantic strength. Which of the meanings is actually interpreted by a hearer is determined by two possibly conflicting constraints, STRENGTH and FIT.

Chapter 4 deals with the acquisition of word meaning. In this chapter, I investigate how children acquire the different uses of the particle *wel* that were distinguished in Chapter 3. By comparing corpus data of the use of *wel* by adults and children, I show that, although the strongest meaning of *wel* is strikingly rare in the adult data, children use it very frequently and seem to acquire this use more easily than the weakest use, which is very frequent in adult speech. I argue that this pattern is caused by the same constraints that are active in adult interpretation, STRENGTH and FIT. However, the way the constraints interact changes gradually during the acquisition process.

Chapter 5 takes the perspective of the speaker. The production of words starts with a speaker's intention to express something. The meaning a speaker wants to convey consists of a set of semantic features. Candidate

words are compared with respect to how much of the features of the intention they express. In this chapter, I will show (amongst others) how insertions of bilingual speakers are the result of the competition between several words to express a particular meaning.

In sum, this thesis investigates what factors play a role during the process of interpreting, acquiring and producing words.

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Chapter 1
Introduction

This dissertation is about words. To be more precise, it is about the relation between words and their meanings. You may wonder whether there is much interesting to say about that; every language consists of a set of words which are each related to a specific meaning and every speaker of a language knows this list of form-meaning combinations. However, things are not as simple as that. Consider sentence (1).

(1) My mouse makes a weird sound when I touch it

If (1) is uttered in a vet's practice, the hearer will probably interpret *mouse* as referring to a small animal. However, when uttered at a computer store, the sentence is interpreted as a complaint about the pointing device of the speaker's computer. In other words, the interpretation of the word *mouse* depends on the context in which the word is used.

Example (1) shows us that there is not always a one-to-one correspondence between words and meanings. If every slightest difference in meaning resulted in a different form, every language would consist of an innumerable amount of lexical items. Instead, the lexicon of a language is organized economically. In every language, all possible meanings are expressible by a set of lexical items. The possible meanings are thereby divided over the set of words. Let me clarify this with a concrete example. Figure 1 illustrates a semantic domain consisting of the concepts 'tree', 'wood', 'firewood', 'small forest' and 'large forest'. In Danish, this set of five meanings is expressed by two forms. The concepts 'tree', 'wood' and 'firewood' are grouped together under the label *trae*, and the concepts 'small forest' and 'large forest' are grouped together under the label *skov*. In French and German, the five meanings are expressed by three forms and in Spanish each concept has its own label (Hjelmslev 1963).

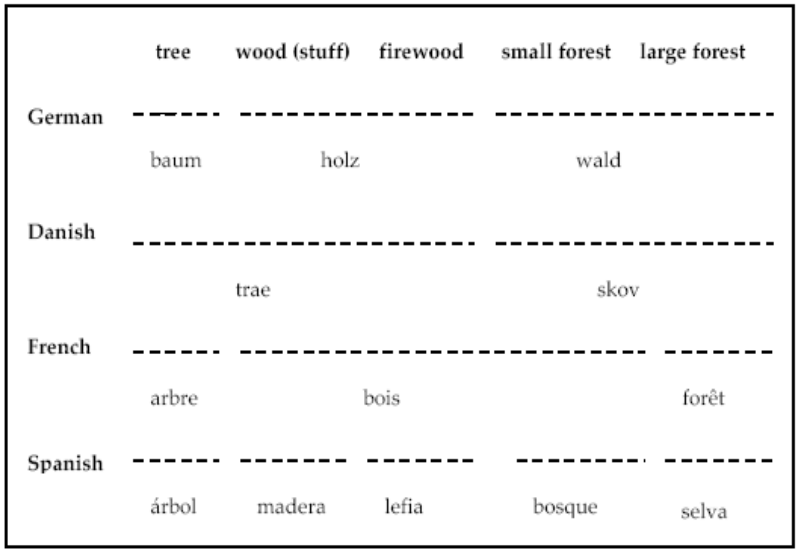


Figure 1: semantic map by Hjelmslev (1963)

A division of forms over concepts in a particular semantic domain, as in Figure 1, is called a *semantic map* (e.g., van der Auwera and Plungian 1998, Haspelmath 2003, Zwarts 2008). The semantic map in Figure 1 raises a number of questions. The figure shows that a speaker of French hearing the word *bois*, has to choose between three possible meanings. How does she know which meaning was intended by the speaker? Similarly, how does a speaker of German know that she can use the same form for 'small forest' as for 'large forest'? In other words, if language users do not have a list of word-meaning(s) combinations in their heads how are they able to interpret words and how do they know which words to use?

In this thesis, I argue that a meaning is not a static property of a form but that it is the input for the process of the production of a word or the result of the process of interpretation. Furthermore I argue that they are processes of *optimization*. Example (1) shows that when a particular word is used, there is not one corresponding meaning which the hearer can automatically associate with it. Instead, the hearer chooses the best or optimal interpretation of a word in a given situation. Similarly, when a speaker wants to express something, there is not always a form available that perfectly corresponds to the intended meaning. Therefore, the speaker

chooses the word that corresponds to the intended meaning the best, in other words, she chooses the *optimal* form. The focus of this thesis is on the factors that determine the outcome of these optimization processes.

1.1 Semantic features

As we saw in example (1), the interpretation of a word depends on the context in which it is used. One and the same word may have a different contribution to the meaning of a sentence dependent on the context. Consider the examples (2) and (3). The word *but* in (2) expresses something different than *but* in (3).

(2) *Mary is rich, but also very nice*

(3) *Mary is but a girl*

In (2) *but* is used to create a relation of contrast between the two clauses and in (3) it indicates that being a girl is considered to occupy a low position on a certain scale of alternatives, probably including males. The examples (1) to (3) show that the speaker can use the same form for different meanings and that the hearer can come to different interpretations upon hearing the same form. However, the range of interpretations a word can induce is limited. In examples (2) and (3) we see that the context plays a role in the interpretation of *but*. However, no matter how hard we try, we cannot interpret *but* in (4) as referring to a banana.

(4) *Give that monkey a but*

Word meanings are flexible but not that flexible that they can just mean anything. So, although a form does not correspond to one particular meaning, it does correspond to aspects of meaning which restrict the use and interpretation of the word.

In this thesis I assume that a word is related to a set of semantic features. The knowledge of a language user concerning the lexicon of her language does not consist of a list of word-meaning combinations but of connections between forms and semantic features. During the process of interpretation, candidate interpretations compete for becoming the optimal output. Similarly, during production candidate forms compete for being chosen to express the intended meaning. One of the determinants in both processes is

how well the intention or the interpretation fits the set of semantic features that is related to a form. However, although the output always depends on this set of features, it is not the only determinant. This thesis main concern is determining the factors that influence the process of interpretation, acquisition and production of words.

1.2 Interpretation

The process of interpretation starts with a form. A hearer is offered a word and has to find the optimal interpretation for it. Crucially, as example (1) showed, the same form may yield different interpretations in different contexts. In the previous section I assumed that a form is associated with a set of semantic features. This set of features is stable across contexts. However, which of the features of this set are part of the interpretation of a particular occurrence of a word varies.

Upon hearing a form, candidate interpretations compete for becoming the optimal interpretation. In chapter 3, I argue that the hearer preferably interprets all features that are related to the form. However, a hearer also assumes that the speaker makes sense and will therefore not choose an interpretation that is not in line with the context. We can thus identify two possibly conflicting forces in the interpretation process. On the one hand the hearer wants to be faithful to the set of features that are associated with the form she is presented with. On the other hand, the output interpretation should not be in conflict with the context. I will show that the latter force is stronger than the first. A feature that is in conflict with the context will not be part of the optimal interpretation.

In chapter 3, I will illustrate the process of optimization in interpretation by giving an analysis of the meaning and interpretation of the Dutch word *wel*. *Wel* is a discourse marker that can be used to express several related meanings. The two conflicting forces are presented as constraints in Optimality Theory (Prince and Smolensky 1993/2004). The constraint that pertains to the role of the context is FIT and the constraint that pertains to the semantic features is STRENGTH. The importance of the context is realized by ranking the constraint FIT higher than STRENGTH.

1.3 Acquisition

A language user associates forms with semantic features. Clearly, children are not born with such associations. Children start the acquisition process

with no knowledge about the relation between words and meanings. When they are presented with a word for the first time, the context is the only information children can rely on. Therefore, only the constraint FIT is active for beginning language learners. The factor context gets competition when the experience with the words of the target language grows. The association between forms and semantic features grows gradually, making STRENGTH more important. Once a word is properly acquired, the importance of the context diminishes, and a situation arises in which a hearer can 'choose' between the candidates that are possible interpretations in view of the associations between a form and a set of semantic features. In other words, in view of the constraint STRENGTH.

The process of acquisition is illustrated in chapter 4 by a corpus study on the acquisition of the Dutch discourse particle *wel*. In chapter 3 I argue that people have a preference for strong meanings in interpretation. In chapter 4 I will show that this preference also exists in acquisition. In contrast to their parents, children use *wel* to express the strongest meaning more often than they use it to express the weakest meaning. I argue that the interaction of the two constraints explaining the interpretation of *wel* by adults also accounts for the acquisition data. However, the way the constraints interact changes during the acquisition process.

1.4 Production

In chapter 5, I will show how the fact that there is no one-to-one relation between meanings and words, also affects the production of words. Production starts with a speaker's intention to express something. This intention comprises a set of features. There may very well be no form available in the lexicon of the speaker that is related to precisely this set. The candidate forms are compared to each other with respect to how much of the intended meaning they convey.

The hearer and the speaker have different roles in conversation. Whereas the hearer has no choice but to interpret the form that is offered to her to the best of her ability, the speaker has to balance costs and benefits in choosing a form. Therefore, in contrast to the hearer, the speaker does not only want to be faithful to the input, she also wants to be economical. These two forces can be in conflict. This conflict becomes apparent in code switching. Bilingual people have two lexicons at their disposal. The words of the two lexicons both join in the same competition. Consider example (5) (Backus 1996, p. 164)

(5) Şöyle, şey ben *arbeidsbureau´*ya gittim
'Like that, I went to, you know, the *employment agency'*

In (5), the Dutch word *arbeidsbureau* 'job office' is inserted in a sentence that for the remainder consists of Turkish words and is construed according to Turkish grammar. In chapter 5, I will show that the competition between the lexical equivalents of two languages is determined by two conflicting constraints. On the one hand the speaker wants to choose the word that best expresses her intentions, or in other words, that is most faithful to the features in the input. On the other hand, switching between languages is costly and violates a markedness constraint against code switching.

In chapter 5, I will discuss code switching and several other linguistic phenomena that can be explained by the interaction of faithfulness constraints and markedness constraints.

In this introductory chapter, I outlined the content of this thesis. In short, chapter 3 deals with the interpretation, chapter 4 with the acquisition and chapter 5 with the production of words. In the next chapter I will first introduce the theoretical framework that I will use in this thesis.

Chapter 2
Theoretical background

In this chapter, I introduce the theoretical framework I use in this thesis. In chapter 1, I argued that a meaning is not a static property of a form but that it is either the input to the process of the production of a word or that it is the result of the process of interpretation. I also argued that interpretation and production are processes of optimization. The output of the process is the candidate that best satisfies a set of ranked constraints. The idea that language use involves optimization forms the basis of Optimality Theory. Optimality Theory is a grammatical framework which describes linguistic knowledge as a system of ranked constraints. I will describe the basis characteristics of Optimality Theory in the next section.

The roots of Optimality Theory lie in connectionism. Connectionist models are based on the idea that the human brain is a parallel computational device. Processing in neural networks occurs through the propagation of activation through networks of simple processing units. Optimality Theory is founded on the insight that networks can settle into a stable state through the interaction of conflicting forces (Soderstrom, Mathis and Smolensky 2006). I will discuss the basic characteristics of connectionism in section 2.2.

2.1 Optimality Theory

Optimality Theory (OT) forms an important part of the Integrated Connectionist/Symbolic Cognitive Architecture (ISC) (Smolensky and Legendre 2006). ICS is a framework that integrates lower level connectionist representations and higher level symbolic representation. By doing so, symbolic theorizing has benefited from insights at the lower level of description. One of the most important insights was that networks can settle into a stable state through the interaction of conflicting forces (Soderstrom, Mathis and Smolensky 2006). Optimality Theory is based on this principle. In OT, linguistic knowledge is described as a system of ranked constraints. The constraints are ordered according to a strict priority ranking and they are potentially conflicting. A constraint may be violated to satisfy higher ranked constraints. OT hypothesizes that every language shares the same set

of constraints. The fact that languages differ from each other is explained in OT by a different ranking of those constraints.

OT specifies the relation between an input and an output. The machinery that is used for this specification consists of GEN and EVAL. GEN (for generator) generates the possible output candidates on the base of a given input. EVAL (for evaluator) evaluates the different candidates. The output candidate that best satisfies the ranked constraints emerges as the optimal output for the given input (Prince and Smolensky 1993/2004). In phonological production the input is an underlying linguistic representation and the output is an uttered combination of sounds. In syntax the input is a meaning or a concept one wants to express and the output is a combination of words that expresses that meaning. In semantics the input is an utterance and the output is the meaning or interpretation one ascribes to that utterance.

As said, the optimal output for a given input is determined by means of a set of ranked constraints. There are two types of constraints: faithfulness and markedness constraints. Faithfulness constraints order the output to be faithful to the input. Markedness constraints are solely concerned with the output. They indicate that an unmarked output is preferred over a marked output. To put it briefly, structures that are more complex are considered to be marked structures and structures that are less complex or more natural are considered to be unmarked. As faithfulness to the input may sometimes require marked structures, faithfulness and markedness constraints are potentially conflicting.

The process of evaluation of the possible outputs through a set of ranked constraints is visualized in OT by means of so-called tableaux. Let me clarify the process of optimization and the use of tableaux with an example. A common example that is used to illustrate OT is the difference between the way English and Italian express the proposition 'it rains' (Legendre 2001). In the English sentence, *it rains,* the subject *it* is present, even though that word does not refer to anything. In the Italian sentence, *piove,* no subject is present. This fact is ascribed in OT to two constraints that are ranked differently for the two languages. One is the faithfulness constraint FULL-INT (full interpretation) and the other is the markedness constraint SUBJECT.

FULL-INT: Constituents in the output must be interpreted

SUBJECT: Clauses must have a subject

In Italian the constraint Full-Int is ranked higher than Subject. In English it is the other way around, as can be seen in Tableau 1.

Input:	SUBJECT	FULL-INT
☞ Output: it rains		*
Output: rains	*	

Tableau 1: the optimal expression of 'it rains' in English

In the upper left box the input is given. In this case, the input is the meaning 'it rains'. The two boxes below the input contain (two of) the possible outputs which are generated by GEN. In the middle and right box of the upper row, the relevant constraints are given. The constraints are ordered according to their position in the hierarchy; in this case SUBJECT is ranked higher than FULL-INT. An asterisk represents a violation of a constraint. Both candidates violate a constraint. However, the constraint that is violated by the output *rains* is ranked higher than the constraint that is violated by the output *it rains*. This makes *it rains* the optimal output, which is indicated by the pointing finger. In Italian the constraint FULL-INT is ranked higher than SUBJECT, which makes the sentence without the subject the optimal output for Italian, as can be seen in the Tableau 2.

Input:	FULL-INT	SUBJECT
☞ Output: piove		*
Output: *subject* piove	*	

Tableau 2: the optimal expression of 'it rains' in Italian

Optimality Theory is based on connectionist principles. However, OT has abstracted away from the details of connectionist computation. As such, OT differs from other connectionist approaches to language. According to Prince and Smolensky (1993/2004) connectionist approaches to language can generally be classified as being of one of two types: eliminativist

connectionist approaches and implementationalist connectionist approaches. Eliminativist connectionist approaches try to show that "a. basic analytic concepts of generative theory can be eliminated in some sense; b. that numerical computation can eliminate computing with symbolically structured representations and c. that knowledge of language can be empirically acquired through statistical induction from training data" (Prince and Smolensky 1993/2004, p.217). Implementationalist connectionist models on the other hand try to implement insights from generative grammar and symbolic theory into connectionist networks. OT does not belong to either of the two types but tries to enrich generative grammar with knowledge of connectionist computation.

OT analyses normally do not involve reference to the connectionist level of explanation. Nonetheless, in this thesis I will sometimes substantiate the working of OT constraints by making reference to connectionist principles. The difference between this thesis and most other work in OT is that the linguistic knowledge the constraints in this thesis relate to is lexical knowledge. The relation between words and meanings is undoubtedly language-specific and the specific relation between a form and its meaning is learned through experience. A theory of lexical knowledge may therefore be more likely to benefit from a more eliminativist approach than for example theories about grammatical or phonological knowledge.

In the next section I will outline the basics of connectionism.

2.2 Connectionism

Connectionist models are based on the idea that the human brain is a parallel computational device. Processing in neural networks occurs through the propagation of activation through networks of simple processing units. In a connectionist network, input is provided by activating the input units. The activation propagates along the connections until some activation emerges on the output units. In between the input and the output units may be hidden units that do not influence the representation of the input or output directly. The way the activation flows through the network and which output units are eventually activated depends on the strength or the weight of the connections between the units. The weights can be seen as representing the knowledge of the system (Smolensky and Legendre 2006).

Let me give a simple example of a connectionist model to clarify the basic ideas of connectionism. The following example is taken from Sharkey

(1988). Figure 1 represents a simple network containing three processing units.

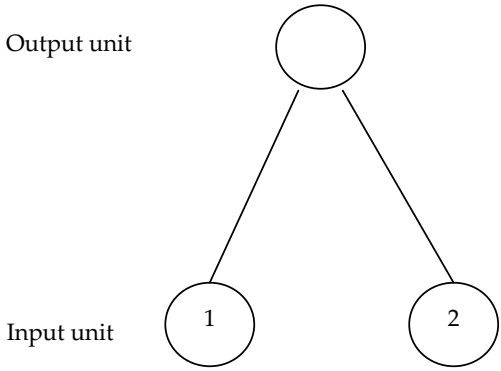


Figure 1: simple neural network with two input units and one output unit (Sharkey 1988, p. 160)

In this connectionist network with two input units connected to one output unit, the value of the output is the weighed sum of the inputs (assumed for simplicity). Say, the strength of the connection between input unit 1 and the output unit is 1.0, and the strength of the connection between input unit 2 and the output unit is 2.0. The weights of the constraints form a weight vector **w:**

$$\mathbf{w} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

The values of the input units form an input vector. Say the first input unit has an activation value 1.0 and the second a value 0.0, then the input vector **i** is:

$$\mathbf{i} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

With this information the output of this activation pattern can be computed. The activation of input unit 1 by 0.0 contributes (1.0 x 0.0 = 0) to the output value. The activation of input unit 2 by 1.0 contributes (1.0 x 2.0 = 2.0) to the output value. The output value (0.0 + 2.0 = 2.0) forms the output vector **o**:

o = [2]

In general, the net input to a unit *j* (i.e. the activation propagated from the input units to the output units) is described mathematically by $net_i = \Sigma_i w_{ij} a_i$ where a_i is the activation on the *i*th input unit linked to the *j*th output unit and w_{ij} is the weighed connection between *i* and *j* (Sharkey 1988).

As mentioned above the output of a system is the weight sum of the inputs. Using linear algebra, this can be computed by taking the inner product of the weight vector and the input vector. The inner product of two vectors is derived as follows (Sharkey 1988):

1. Multiply the first element of the input factor, i_1 = 0.0 by the corresponding element in the weight factor, w_1 = 1.0.
2. Multiply the second element of the weight factor, w_2 = 2.0 by the second element of the input factor i_2 = 1.0.
3. Add 1 and 2 together and this is the inner product of **wi**, and also the output.

The network we discussed above only had one output unit. However, when people perform any kind of action many neurons are active simultaneously. Although the amount of computation that must be done is much greater for more complex networks, the basic idea stays the same. Say there is a network with two output units as is illustrated in Figure 2.

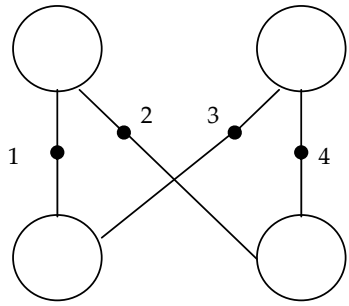


Figure 2: a system with two output and two input units (Sharkey 1988, p. 161)

For this network there are two weight vectors, one for each output unit:

$$\mathbf{i} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \qquad \mathbf{w1} = \begin{pmatrix} 1 \\ 2 \end{pmatrix} \qquad \mathbf{w2} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$$

When there are multiple weight vectors, they are usually put together in a weight matrix.

$$W = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

The output can then be computed as follows (Sharkey 1988):

1: Strip the first row vector of the weight matrix, **W**.
2: Compute the inner product of step 1 with the input vector **i**.
3: Put the value of step 2 into element 1 of the of the output vector **o**.
4: Strip the second row vector off the weight matrix and compute the inner product with the input vector. Then place the value in element 2 of the output vector.
5: Continue the process pf stripping the row vectors of the weight matrix, taking the inner product with **i**, and putting the value into **o** until there are no vectors left in **W**.

A concrete example might clarify the ideas outlined above. This example is again taken from Sharkey (1988). Let us assume that knowing a word means associating a set of features with a word label. If the input is a set of features, the output is a word label for the object, which is a combination of the features. Say, the concept 'bird' consists of two features: 'flies' and 'has-wings'. Input vector **i** has three values that each represents a feature i.e. 'has seeds', 'has feathered wings' and 'flies'.

If the features 'has-wings' and 'flies' are present, the input vector looks as follows.

$$\mathbf{i} = \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$$

Say, the output vector for the word *bird* contains three units each representing a word label, say *bird, fruit* and *dog*. Only the unit representing *bird* will be active:

$$\mathbf{o} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

The knowledge of association between features in the world and the word label exists as a set of weighed connections. One set of weights that enables the current association is:

$$W = \begin{pmatrix} 0\,1\,1 \\ 0\,0\,0 \\ 0\,0\,0 \end{pmatrix}$$

The input pattern of bird features produces the desired output, corresponding to a level of activation 2.0 for *bird* (this can be thought of as being the degree of confidence in the evidence for the presence of a 'bird' (Sharkey 1988)).

It is important to realize that a crucial feature of connectionist networks is that it stores multiple associations between input and output patterns in one weight matrix. Say, the word *fruit* is associated with the feature 'has seeds'. The output and input vector look as follows:

$$\mathbf{i} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{o} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$$

A possible weight matrix for this pattern is:

$$W = \begin{pmatrix} 0\,0\,0 \\ 1\,0\,0 \\ 0\,0\,0 \end{pmatrix}$$

Now we can simply combine the weight matrix for the association of *bird* with 'flies' and 'has wings' and for *fruit* with 'has seeds' into one matrix:

$$W = \begin{pmatrix} 0\,1\,1 \\ 1\,0\,0 \\ 0\,0\,0 \end{pmatrix}$$

I have now outlined the basics of connectionism. We saw that words are linked to semantic features through connections between processing units. When the units that represent a word are active, the corresponding semantic features will be activated as well. In chapter 1, I argued that meanings are context dependent. I argue that words are linked to a stable set of semantic features but which part of this set of features forms the meaning of a particular occurrence of a word differs. The idea that word meanings are context dependent is not uncontroversial. Fodor and Pylyshyn (1988) for example argue that meanings must be context independent. Furthermore, they see this as an argument against connectionist principles as the driving force behind cognition. In the next section, I will outline their argumentation and I will show that meanings can be context dependent if we assume that the relations between forms and meanings are determined by processes of optimization[1].

2.3 Context dependence, connectionism and coffee

In a famous paper published in 1988, Fodor and Pylyshyn argue against connectionism and for classical models of the mind. Classical models of the mind are derived from the structure of serial machines like Turing and Von Neumann machines while connectionist models are derived from fundamentally different machines: parallel machines (Fodor and Pylyshyn 1988). According to Fodor and Pylyshyn, two architectural differences are behind the disagreements between the classical and the connectionist view (p. 8):

> "1. *Combinatorial syntax and semantics form mental representations*. Classical theories – but not connectionist theories – postulate a 'language of thought' (see, for example, Fodor, 1975); they take mental representations to have a *combinatorial syntax and semantics*, in which (a) there is a distinction between structurally atomic and structural molecular representations; (b) structurally molecular representations have syntactic constituents that are themselves either structurally molecular or are structurally atomic and (c) the semantic content of a (molecular) representation is a function of the semantic contents of its syntactic parts, together with its constituent structure. For purpose of

[1] A similar line of argumentation is put forward by de Hoop, Hendriks and Blutner (2007) who argue that compositionality is explained by the process of bidirectional optimization.

> convenience, we'll sometimes abbreviate (a)-(c) by speaking of Classical theories as committed to 'complex' mental representations or to "symbol structures".
>
> "2: *Structure sensitivity of processes*. In Classical models, the principles by which mental states are transformed, or by which an input selects the corresponding output, are defined over structural properties of mental representations. Because Classical mental *representations* have combinatorial structure, it is possible for Classical mental *operations* to apply to them by reference to their *form*. The result is that a paradigmatic Classical mental process operates on any mental representation that satisfies a given structural description, and transforms it into a mental representation that satisfies another structural description. (So, for example, in a model of inference one might recognize an operation that applies to any representation of the form P&Q to produce P is satisfied by, for example, an expression like "(AvBvC)&(DvEvF)", from which it derives the expression "(AvBvC)"."

In short, the principles come down to 1) mental representations are compositional, which means that complex or composite representations are built out of simpler representations and 2) the processes by which representations are formed and transformed are defined by the structural properties of the constituents as described in 1. Fodor and Pylyshyn argue that the principles 1 and 2 define classical models and they emphasize the importance of principle 2: "[…] the Classical theory is committed not only to there being a system of physically instantiated symbols, but also to the claim that the physical properties onto which the structure of the symbols is mapped *are the very properties that cause the system to behave as it does.* In other words the physical counterparts of the symbols, and their structural properties, cause the system's behavior" (p. 9).

Fodor and Pylyshyn argue that connectionist models do not have the properties 1 and 2. Consider the representation in Figure 3. In this simple connectionist network, the excitation of node 2 will be caused by the excitation of node 1.

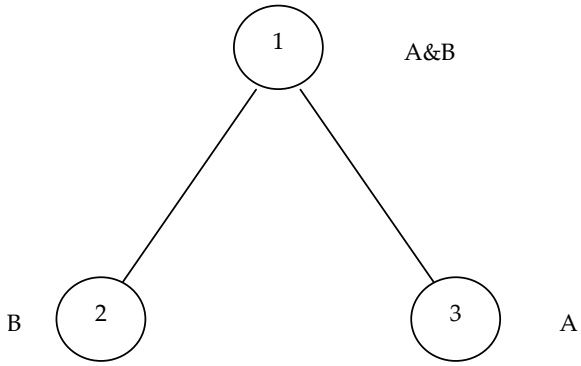


Figure 3: complex mental representation (Fodor and Pylyshyn 1988, p. 10)

A classical machine, on the other hand, works as follows. The machine has a tape on which it writes expressions and whenever a token of the form P&Q appears on the tape, a token of the type P appears on the tape. Thus, a tokening of the type A&B on the tape causes a tokening of the type B on the tape. Now, Fodor and Pylyshyn argue that in connectionist models there is no structural relation that holds between node 1 and 2. There is only a causal relation between the excitation of 1 and the excitation of 2.

Smolensky (1991) reacts to the paper by Fodor and Pylyshyn by arguing that connectionist networks *can* incorporate principles 1 and 2. However, an important prerequisite is that representations are distributed and not local as they are in Figure 3. To generate distributed representations, Smolensky makes use of microfeatures (Hinton, McClelland and Rumelhart 1986). He illustrates the working of such microfeatures by means of his famous coffee example. According to Smolensky, we can depict the representation of *a cup with coffee* as the combination of certain semantic features like 'upright container', 'hot liquid', 'porcelain curved surface', 'burnt odor' etc. Critics would argue that this view on representations cannot be right because the representations of *cup without coffee* and *coffee* should be subtractable from the representation of *cup with coffee.* Now, Smolensky argues that we *can*

subtract the representation of *coffee* from the representation of *cup with coffee*, only this will be a representation of *coffee in a particular context.* There is not one representation for coffee, but a collection of representations knit together by family resemblance. The particular representation that will emerge in a given situation is therefore context dependent. Nonetheless, *coffee* is a constituent of the representation of *cup with coffee*. However, this constituent relation is not part of the mechanism within the model. The representation therefore satisfies principle 1 but not, at least not explicitly, principle 2. This type of compositionality is therefore called 'weak compositionality' by Smolensky (1987).

Why doesn't Smolensky's solution work? Fodor and McLaughlin (1991) argue that systematicity requires *context-independent constituents.* In Smolensky's solution, the representation of *coffee* you get by subtracting it from the representation of *cup with coffee* is not a representation of *coffee* when it stands alone. The representation of coffee that you get from *cup with coffee* does not give the necessary conditions for being *coffee* for a representation of coffee in a can with coffee would yield a different set of features. And, Fodor and McLaughlin argue, it is not a sufficient set of features either. So, Fodor and McLaughlin wonder, what does make a representation a coffee-representation? There is no single vector that counts as *the* coffee-representation and therefore there is no vector that is a component of all the representations, which in a classical system would have *coffee* as a classical constituent. Fodor and McLaughlin suggest that Smolensky confuses being 'a representation of a cup with coffee' with being a CUP WITH COFFEE representation':

> "Espying some cup with coffee on a particular occasion, in a particular context, one might come to be in a mental state that represents it as having roughly the microfeatures that Smolensky lists. That mental state would then be a representation of a cup with coffee in this sense: there is a cup of coffee that it's a mental representation of. But it wouldn't of course, follow, that it's a CUP WITH COFFEE representation; and the mental representation of that cup of coffee might be quite different from the mental representation of the cup of coffee that you espied on some other occasion or in some other context. So, *which mental representation a cup of coffee gets is context dependent*, just as Smolensky says. But that doesn't give Smolensky what he needs to make representations themselves context dependent" (p. 342).

Smolensky argues that the semantic 'representation of a cup with coffee' can vary over contexts. Fodor and McLaughlin (1991) argue that the 'representation of a cup with coffee' that for example arises upon seeing one may be context dependent but this is not the type of representation that is part of the combinatorial system of language and thought. This latter type of representation, a CUP WITH COFFEE representation, is context independent.

The view outlined in this thesis on the distinction between the two types of representations is the following: intentions (to express something) and interpretations are of the type 'representation of a cup with coffee'. This representation consists of a set of features which may vary across contexts. Words *are* linked to an invariable set of features. However, these features are not directly accessible by language users but may surface in semantic representations that form the intentions or interpretations. As for the relation between words and meanings, Fodor and Lepore (2002) say: "we assume, for the present discussion, that words express concepts, and that the content of a word is the content of the concept that it expresses" (p. 43). As I outlined in chapter 1, I argue that words do not contain concepts but that concepts are the output of processes that take a word as their input or the input to processes that have a word as their output. The relevant question to ask then is not: what are the conditions for *being* COFFEE but what are the conditions for *calling* something coffee. The answer to this last question is that there are no necessary and sufficient conditions to label something as *coffee* but what matters is that the label *coffee* is better at expressing the intended meaning than the other available labels

2.4 Conclusions

In this chapter I introduced Optimality Theory. Optimality Theory is a grammatical framework that describes linguistic knowledge as a system of ranked constraints. The roots of Optimality Theory lie in connectionism. Connectionist models are based on the idea that the human brain is a parallel computational device. Processing in the neural networks occurs through the propagation of activation through networks of simple processing units. Words are linked to semantic features through connections between processing units. When the units that represent a word are active, the corresponding semantic features will be activated as well. I concluded that meanings (a set of semantic features) are context dependent and there are no sufficient and necessary features that define the meaning of a word.

What matters is that a particular word is better at expressing the intended meaning than the other available labels.

Chapter 3
Features that fit the context

3.1 Introduction

In chapter 1, I argued that there is no one-to-one relation between forms and meanings. Instead, the interpretation of a word depends on the context in which it is encountered. However, the range of possible interpretations is limited. In this chapter I will investigate how the interpretation of a word in its context is established. I will first examine the range of possible interpretations of a particular lexical item, the Dutch particle *wel.* Subsequently, I will investigate which meaning in this range is chosen as the interpretation of a particular occurrence of *wel*.

Particles are an interesting class to study because their meaning is highly context dependent. They typically function in different word classes and their contribution to the meaning of a sentence is usually highly pragmatic and hard to define. However, even though the functions of *wel* seem very diverse at first sight, I will show that a core meaning can be identified in the different uses. Which variant of this core meaning is optimal for a particular occurrence, is dependent on the context. It is therefore not possible to determine *the* meaning of *wel* in isolation. Instead, the form *wel* is associated with a specific set of semantic features. The (sub)set of features that constitute the optimal interpretation of a particular occurrence is the result of two potentially conflicting forces.

I will begin this chapter with a report of a corpus study on the use of *wel* in spoken Dutch. I will describe the different uses of the particle that I found in the Spoken Dutch Corpus and I will argue that they share a common feature. I will define the meanings of *wel* in the framework of Layered Discourse Representation Theory. Because *wel* is primarily used to regulate conversation its semantics is best formalized in a dynamic system. After having described the possible meanings of *wel*, I will examine which of those meanings is actually chosen by the hearer in a particular context. I argue that the interpretation results from two constraints in an Optimality Theoretical framework.

3.2 The meaning(s) of *wel*

3.2.1 Introduction

In an internet forum that discussed a newspaper article about the death of a famous Dutch journalist I found the following example[1] (bold is mine, LH).

(1)	*Willem Oltmans*	*zal*	***wel***	*in stilte*	*begraven*	*worden*
	Willem Oltmans	will	WEL	in silence	buried	become
	'Willem Oltmans will be buried in silence'					

One of the commentators to the forum mentions that he finds the use of the word *wel* in this example very inappropriate. "Was he such a noisy man?" he wonders. This comment leads forum members to begin a discussion on the reason why the word *wel* is used here. One discussant offers that the word indicates that Willem Oltmans' body will *not* be put on display to a full Arena stadium (unlike the famous Dutch singer André Hazes who died just before Willem Oltmans). Another person suggests that the way he will be buried is contrasted with the image of his rather turbulent life which is discussed in the remainder of the article. Finally someone suggests that the word *wel* indicates a contrast between the fact that he will be buried in silence and the fact mentioned in the previous sentence (not cited on the forum) that a public website has been created where people can offer their condolences.

Wel could be called the positive counterpart of *niet* 'not'. When children disagree about a certain fact they often use those two words as recurring arguments: *wel(les), niet(es), wel(les), niet(es)* 'is not, is too, is not, is too'. Because the affirmative meaning of a sentence is the unmarked one, adding the particle *wel* has to have another reason than just creating a positive meaning. The most obvious reason to use *wel* is to contradict a previous denial of a certain fact, as in (2).

(2) a.	*Jij*	*heet*	*echt*	*geen*	*Jan-Peter!*
	you	name+have	really	no	Jan-Peter
	'Your name isn't Jan-Peter!'				

[1] The forum can be found at: http://webtwee.net/archive/2004/09/30/willem-oltmans-willem-oltmans-willem-oltmans

b. *Ik heet* ***wel*** *Jan-Peter!*
I name+have WEL Jan-Peter
'My name *is* Jan-Peter!'

But it can bring about other, at first sight totally different meanings too. Consider for example (3).

(3) *Ik heb vandaag* ***wel*** *honderd boten geteld!*
I have today WEL hundred boats counted
'I have counted like a hundred boats today!'

In (3) the speaker indicates by using the word *wel* that she thinks a hundred boats is a lot.

Another function of *wel* is illustrated in (4).

(4) *Het feestje afgelopen zaterdag was* ***wel*** *leuk*
the party last Saturday was WEL nice
'The party last Saturday was OK-ish'

Here the speaker says that the party was OK, not good not bad. *Wel* functions as a moderator to the predicate *leuk* 'nice', and weakens its meaning.

And what about the, for non-native speakers of Dutch quite confusing use of both *wel* and *niet* 'not' right next to each other? In (5) the speaker expresses her surprise over a situation in which it appears that the addressee has eaten a lot of cake.

(5) *Grote grutten, hoeveel taart heb je* ***wel*** *niet gegeten?!*
great groats how much cake have you WEL not eaten
'My God, how much cake did you eat?!'

Besides the fact that the word brings about such different meanings, there is another reason why it is interesting. *Wel* is used very frequently. In the Spoken Dutch Corpus it takes the twentieth position in the frequency list containing all words.

Note that some uses of *wel* are similar to the English *well*. In that case *wel* has the meaning 'good' or 'right'. This is especially the case when *wel* is used in fixed expressions like *dank je wel* 'thank you' *wel te rusten* 'sleep well' and *vaarwel* 'farewell'. Here, I am not interested in *wel* having the meaning 'good'

because outside expressions such as the above, the use of *wel* meaning 'good' has become archaic and very rare in Dutch.

As we saw from the examples above, *wel* is polysemous. It has a set of different meanings or uses that are related to each other[2]. In this section I will argue that all uses of *wel* share a common feature, namely that they are a denial of a negation. I will make this common feature explicit by analyzing the different uses in Layered Discourse Representation Theory (Geurts and Maier 2003). Furthermore, I will argue that the uses differ in semantic strength, that is, weaker uses of *wel* are entailments of stronger uses.

To summarize, in this section I will give an analysis of the Dutch word *wel.* This analysis consists of an inventory of the different meanings or functions of *wel* and a description of the relation between those different readings. However, before I will give my analysis of the particle *wel,* it is useful to provide some information about the term *particle.*

3.2.2 Particles

I have been calling *wel* a particle but what is the definition of a particle? Vandeweghe (1984) gives some formal characteristics of particles, such as the fact that they are not inflectable and don't have the status of a constituent. They function in between constituents (autonomous particles) or cling to a constituent and can be placed in front of the finite verb together with that constituent (non-autonomous particles). A semantic or pragmatic characteristic is that particles have no referential meaning but much implicative meaning. They signal how the *state of affairs*, that which is expressed by the sentence, fits into the bigger whole. However, Vandeweghe acknowledges that these criteria do not give a solid demarcation of the notion *particle* since there are many words which meet these requirements but also have other (related) meanings that function in a different word class.

Within the class of particles Vandeweghe distinguishes two main categories: the propositional particles and the *schakeringspartikels* sometimes called *downtoners* in English. The propositional particles have a direct linking to the proposition of the sentence. They indicate how the state of affairs should be interpreted in the *universe of interpretation* which allows for alternatives. Downtoners don't signal how a proposition should be

[2] I use the terms *meaning, use* and *reading* indiscriminately to refer to the different interpretations.

interpreted with respect to possible alternatives but they give the hearer a clue about the intent of the utterance, or the illocutive tenor, and about how the utterance fits into a broader framework of speaker-hearer-expectations and -preferences.

Foolen (1993) gives a thorough description of the class of particles. Foolen defines the term *particle* as every element that does not add to the propositional meaning of an utterance. He distinguishes several different subclasses of particles. The first subclass is formed by the *interjections* or *discourse particles.* They are not embedded in the sentence structure and their function is to express the speaker's emotion or to indicate the course of the conversation. English examples are *oh, well, you know.* Next, Foolen distinguishes the *conjunctions*. Foolen considers coordinating conjunctions to be particles because besides denoting a relation between propositions they can also indicate a relation between speech acts. Another class of particles is formed by the *adverbs*. Because connective adverbs like *bovendien* 'moreover' and *trouwens* 'besides' have a primarily connective function they are comparable to the connectives. Modal adverbs express the speaker's subjective position with respect to the proposition of the sentence. Some adverbs indicate how likely the speaker considers the proposition to be true, for example *maybe* or *probably*. Other elements express the emotional attitude towards the propositional content, for example *fortunately* or *unfortunately*. An additional class of particles is formed by the *focus particles*. Focus particles come together with an element of a proposition in focus and they evoke a (set of) alternative(s) for the element in focus.

With respect to focus particles it is useful to refer to Rooth (1992), who formulated an influential theory concerning focus. This theory is based on the idea that focus evokes a set of alternatives. The idea of 'alternative semantics', as he calls it, is to formalize the notion of focus by adding a semantic value for a phrase containing focus. Assuming the semantic value of a sentence is a proposition, the focus semantic value of a phrase could informally be described as "the set of propositions obtainable from the ordinary semantic value by making a substitution in the position corresponding to the focused phrase" (Rooth 1992, p. 2). This means that for a sentence like *John likes Mary* with phonetic focus on *Mary* the focus semantic value for that sentence is the set of propositions of the form *John likes x*. And if the focus were on J*ohn*, the focus semantic value would be the set of propositions of the form *y likes Mary*. The content of that set, the possible alternatives, must be recovered with the help of the context. The focus semantic value constrains the set of alternatives to all elements that share the relevant property (e.g. *liking Mary*). From the context one has to

recover or construct the relevant alternatives which can be considered substitutes for the focused element.

Foolen (1993) discusses two parameters that can be distinguished with respect to the function of focus particles. The first one is addition versus restriction. Additive focus particles indicate that the utterance is additionally true with respect to the element in focus. Restrictive focus particles exclude other elements with respect to which the utterance is true besides the focused element. This sometimes means the utterance is true only with respect to the element in focus (e.g. *exactly, only, precisely*) but this is not necessarily the case. The second parameter is scalarity. A particle can be called a scalar particle when the element in focus and its alternatives are ranked with respect to each other. The focus particle indicates where the element in focus should be placed on the scale of ordered alternatives. This order can be social by nature. For example, *only* in *John is only a secretary of state* implicates that being a secretary of state takes in a low position on some social scale, which probably also includes being a minister or prime minister. The ordering can be purely numeral as well, for example in *John has only two hundred books.*

Finally, Foolen (1993) distinguishes the *modal particles*. They seem to have scope over the whole sentence, in contrast to focus particles. In contrast to modal adverbs they cannot be in sentence-initial position on their own. A defining property of modal particles, according to Foolen, is that they function at the illocutionary level of a sentence. They do not define the illocutionary content but they indicate that a certain aspect from the context is relevant with respect to the illocutionary function of an utterance. A modal particle indicates that the speaker is aware of the existence of alternatives for the relevant speech act or an aspect of it. This alternative is usually the direct negation of the act or a related aspect. The alternative must be contextually relevant for the utterance to be adequate. According to Foolen, a modal particle can also relate to a mental act, a decision a speaker takes in her mind. An example of the modal particle *maar* related to a mental act is given in (6).

(6) *Nou, dan ga ik maar*
PRT then go I PRT
'OK, I think I'll go then'

Here *maar* is related to the decision the speaker made in her mind to go. By uttering it the speaker indicates that the status of the utterance is a decision she just took. The alternative would be not taking the decision.

A more formal analysis of particles (or *discourse markers*, as particles are also called) is provided in the work by Zeevat (e.g. 2000, 2002, 2004). Zeevat (2002) analyzes (discourse) particles as *presupposition triggers*. A sentence A *presupposes* sentence B if the speaker of A automatically commits herself to the truth of B. This is, however, not a conclusive definition of presupposition. It is sometimes argued that there is no single notion of presupposition but instead there is a set of items and constructions which have similar characteristics which need explanation (Beaver, 1997). Among this set of items and constructions are definite NPs, factive verbs and NPs, intonational stress and certain particles/adverbs. A sentence will only have a truth value if all the propositions it presupposes are true. Usually, a presupposition is assumed to be common knowledge among the discourse participants. If the presupposed information can be found in the context, the presupposition is said to be bound by an antecedent. However, it is possible to presuppose new information, if this information is not too important or surprising (Geurts 1999). The hearer of such presupposed new information then has to adapt her representation of the common ground in such a way that it includes the information. This is called *accommodation.*

Zeevat (2000, 2002) analyses discourse particles as a specific set of presupposition triggers. *Too* in (7), for example, triggers the presupposition that other people are also having dinner in New York (Kripke 1990, cited in Zeevat 2002: 3):

(7) John is having dinner in New York too

Note that the presupposition trigger *too* must be taken as an anaphor to specific information in the context. If it would be an anaphor to the general information that millions of people eat in New York every evening, the presupposition would be trivial. Zeevat discusses some aspects of *too* that make this particle different from typical presupposition triggers. The first is that *too* does not seem to allow accommodation. If it did, *too* would be allowed in too many contexts. Given that millions of people have dinner in New York every evening, an occurrence of *too* would only add information that is already true in the context. Furthermore where *too* is used felicitously, it cannot be omitted. Omitting discourse particles results in a strange and maybe even incomprehensible discourse. Additional problems are that *too* on itself does not add new information (it has no meaning apart from its presuppositional content) and that it takes unexpected antecedents, as in (8).

(8) A: My parents think I am in bed
B: My parents think I am in bed too

Sentence (8) can be interpreted with *too* referring to the complement of B's utterance. However, the antecedent *A is in bed*, is not entailed under the operator *B's parents think*, which would be necessary according to the presupposition theories by Heim (1983) and van der Sandt (1992). In view of these problems, Zeevat proposes three adaptations to the existing theories. The first is to liberalize the set of allowed antecedents. The second is to assume a generation constraint and the third is to embed this in Bidirectional Optimality Theory. I will discuss the second and the third proposal in section 3.4.2.

In more recent work, Zeevat (2004) concludes from the differences between discourse markers (or particles) and presupposition triggers (discourse markers do not accommodate, discourse markers cannot be omitted, discourse markers take inaccessible antecedents) that thinking of particles as presupposition triggers has no explanatory value. He therefore proposes that they are analyzed as markers of a relation of the content of the current sentence to the context. The markers are necessary for if the relations remained unmarked, misinterpretations would result. The relations for which Zeevat assumes such marking principles are the following:

- Old: the content is already suggested in the common ground.
- Adversativity: the content has been suggested to be false in the context.
- Correction: the content was denied in the common ground.
- Additive: the topic has been addressed before but the content gives an expansion of the earlier answer.
- Replacing additive: the topic has been addressed before, but this contribution needs to be replaced.
- Contrast: the new content addresses the old topic with its polarity inverted.

Zeevat assumes the following convention to hold with respect to particles: if the relation *R* exists between context parameters and the current utterance, add the particle *P* to the utterance. This convention can be obtained by an Optimality Theoretical constraint MAX(R), which overrules the economy constraint against special devices *PARTICLE. With these two constraints, a speaker will only add a particle if a relation *R* holds. For the hearer, the presence of a particle is an indication for the presence of the relation *R*.

In this section I have introduced the term *particle* and discussed which functions particles can fulfill. In the next sections, it will become clear that my analysis of the particle *wel* has much in common with the approach by Zeevat. I also consider *wel* to be a marker of a relation between the utterance containing it and the previous discourse. But before we turn to my analysis of the meaning of *wel*, let us look at some previous work on this particular word.

3.2.3 Previous analyses of wel

Although the use of the particle *wel* has not received much attention, there is some literature available that concerns this particular particle. Abraham (1984) and Westheide (1985) compare the use of the Dutch *wel* to the use of German *wohl* and other German particles. The *Woordenboek der Nederlandse Taal* (Dictionary of the Dutch language) is a historical dictionary that describes Dutch words from the sixteenth century onwards. This dictionary discusses the word *wel* in a large amount of expressions and constructions, in combinations with certain verbs or other words and in numerous compounds. Sassen (1985) explores the possibility of the word *wel* representing a double denial. I will go into this hypothesis in 3.2.5.1. In the present section I will discuss the work of Abraham (1984) and Westheide (1985), who both list a number of ways in which *wel* is used.

First, Abraham (1984) discusses *wel* as a modal particle. According to Abraham the modal particle *wel* can appear in sentences that express the confidence of the speaker that a desired situation will occur. In this case *wel* has a comforting effect:

(9) *Dat lukt me **wel***
that be successful me WEL
'(Don't worry) I will manage'

(10) *Ik zal **wel** voor hem zorgen*
I will WEL for him take care
'(Don't worry) I will take care of him'

Next, Abraham compares *wel* in interrogative sentences with the German particle *schon.* When a speaker uses *schon* in a question she is convinced the answer will be either very positive or very negative. The Dutch *wel,* used in questions, has a slightly milder effect. In (11), for example, the speaker indicates she expects a lot, and it could very well be really positive.

(11) *Wat zou mij daar* ***wel*** *te wachten staan?*
what will me there WEL to wait stand
'I wonder what will happen to me there'

Wel used in questions can also indicate that the speaker knows the answer is going to be negative.

(12) *Wat voor kansen zouden de Afghanen* ***wel*** *tegen de Russen hebben?*
what for chances will the Afghans WEL against the Russians have
'What kind of chance would the Afghans stand against the Russians?'

According to Abraham all these uses of the modal particle *wel* share the same base meaning, namely one of 'perfection' and 'completeness'. The same meaning is expressed in German with the word *schon.* Another function of *wel* in questions is to point the listener to something important, as in (13).

(13) *Denkt u er* ***wel*** *aan de hond te voeren?*
think you there WEL of the dog to feed
'Won't you forget to feed the dog?'

Wel implies that the speaker assumes the hearer won't forget such an important duty. Sentences like (13) are in between questions and declaratives. *Wel* in interrogative sentences can also indicate that the speaker doubts whether the hearer has carried out the actions mentioned in the remaining of the sentence.

(14) *Hebt u* ***wel*** *handschoenen meegenomen?*
have you WEL gloves brought
'Did you bring hand gloves?'

Wel is also used when the speaker wants to bring a sense of indignation to the sentence, as in (15). Here the meaning of *wel* also has to do with completeness and perfection, Abraham argues, in the sense that the hearer has completely misunderstood a certain idea of the speaker.

(15) *Wat denkt u* ***wel****?*
what think you WEL
'What do you think of me?'

When *wel* is used in yes/no-questions, the speaker indicates she expects the answer to be negative.

(16) *Had je dat* ***wel*** *van hem gedacht?*
had you that WEL of him thought
'Had you expected that of him?'

Abraham also discusses *wel* as what he calls a *cognitive modal adverb*. By *cognitive modality* he refers to the type of modality that is usually named *epistemic modality*. According to Abraham *wel* decreases the truthfulness of the proposition:.

(17) *Hij zal het* ***wel*** *gezien hebben.*
he will it WEL seen have
'He has (probably) seen it'

Furthermore, the use of stressed *wel* is discussed. *Wel* with main stress occurs as an answering particle, as in (18), a particle of contradiction, an interjection and a conjunction.

(18) a. *Wil niemand meer iets drinken?*
want nobody more something to drink
'Nobody wants a drink anymore?'
b. *Ik* ***wél.***
I WEL
'I do'

Wel as a particle of contradiction can be used after a negative declarative, as in example (19).

(19) a. *Hans mag jou niet*
Hanslikes you not
'Hans doesn't like you'
b. *Hij mag mij* ***wel***
he likes me WEL
'He does like me'

Wel as an interjection can be placed after an independent negative sentence. This is called a tag-question. The speaker uses it to check whether what she stated in the main proposition is correct.

(20) *Apen zijn geen mensen,* ***wel****?*
monkeys are no people WEL
'Monkeys are not people, right?'

Furthermore, *wel* can be placed in front of a main sentence. This is especially customary in the south of the language area. It functions as an introducer to the discourse.

(21) ***Wel****, hoe gaat het?*
WEL how goes it
'Well, how are you?'

Wel as a conjunction is used in three ways. First, it can be used in the first member of a bipartite conjunction.

(22) *Dat is* ***wel*** *een goede, maar geen nieuwe gedachte.*
that is WEL a good but no new thought
'That is a good, though not a new thought'

Second, *wel* as an independent conjunction indicates a concessive opposition, comparable with the *wel-maar* construction in (23).

(23) *De meeste dieren werden gered,* ***wel*** *bleven er twee katten over.*
the most animals became saved,WEL remained there two cats left
'Most animals were saved, but two cats remained'

Third, *wel* as a coordinating conjunction in combination with *en* 'and' indicates an explanation or specification of the foregoing:

(24) *Hij kwamte laat, en* ***wel*** *twee uur.*
he cametoo late and WEL two hours
'He was late, two hours'

Abraham formulates a couple of interesting questions concerning the fact that the Dutch *wel* has different German translations. Two of those questions are: What do the German particles have in common since they can all be translated by the Dutch *wel*? What differences are there between the uses of *wel* seeing that German uses different lexical items to express these functions? As a partial answer to this question, Abraham concludes that all uses of *wel* share two components: a reaction to the foregoing and stressing the affirmative assertion. The differentiation is due to, among other things, the difference in sentence structure, type of speech act and stress.

Westheide (1985) sums up a number of functions of *wel* in comparison to the German particle *wohl.* He bases his article on the aforementioned work of Abraham but he also adds some other uses of *wel*. I will discuss those uses of *wel* that were not already mentioned by Abraham. First, Westheide discusses the use of *wel* as an adverb. *Wel* as an adverb has the meaning 'good' or 'physically or mentally in good condition'. Westheide compares examples with *wel* to examples with the German *wohl.* Sentences (25), (26) and (27) are some of the Dutch examples.

(25) *Dat is* ***wel*** *gezegd,* ***wel*** *te verstaan*
that is WEL said, WEL to understand
'That's well said; for good understanding

(26) *Hij maakt het er* ***wel***
he makes it there WEL
'He is doing well over there'

(27) *Ik ben niet* ***wel***
I am not WEL
'I'm not feeling well'

Westheide correctly states that the use of *wel* as an adverb usually creates quite archaic phrases.

Furthermore, Westheide discusses *wel* as a *Gradpartikel*, a 'scalar particle'. He quotes the Dutch dictionary Van Dale which says that *wel* in this use has the meaning 'that no less than the amount mentioned is the case'. He gives the following example:

(28) *Dat zijn er* ***wel*** *tweehonderd!*
that are there WEL two hundred
'That is no less then an amount of two hundred!'

Westheide notes that the use of *wel* in this sense adds an element of surprise to what is said. Furthermore, he mentions the fact that this type of particle is sometimes called a *scalar particle* or a *focus particle.*

Westheide also discusses *wel* as a *Gliederungspartikel*. He states that this use of *wel* has become a bit archaic as well. It can function as an introduction to the conversation:

(29) ***Wel***, *hoe denk je erover?*
WEL how think you about it
'Well, what do you think?'

Or it can function as an 'abtönende Gliederungspartikel' and give a sense of surprise:

(30) ***Wel***! ***Wel***! *Wat je zegt*
WEL WEL what you say
'Well, well! I agree'

Abraham and Westheide discuss the meaning of the particle in very specific environments. They do not attempt to classify the different uses into general classes. What I want to achieve is a more unitary account of *wel.* Furthermore, I want to study the use of *wel* in actual discourse.

The Spoken Dutch Corpus provides the possibility to perform search operations within nine million words of contemporary spoken Dutch. Because I examine a fair-sized number of utterances from this corpus of spoken Dutch, I expect to include the most common uses of the particle *wel* in contemporary spoken Dutch. Instead of listing the very particular effects *wel* has in certain sentences, I want to see whether it is possible to group together occurrences of *wel* that have a similar effect on the discourse. This approach entails that I might miss out on the more infrequent uses of *wel.* It also means that not all the particular environments that are listed in the Dictionary of the Dutch language will be discussed.

In the following section I will examine the different ways in which *wel* is used. I assume *wel* to be a polysemous word, i.e. it has a set of different meanings or uses that are related to each other. In the next section I also want to address the nature of this relation. Dik (1988) distinguishes two different models for the relation between the meanings of polysemous words. In one model all the meanings of a word share a core meaning. In the other model each member of the set of meanings shares at least one aspect of meaning with another member, but two nonadjacent members do not

necessarily share any such aspect. I will show that the first model applies to the different uses of *wel*.

3.2.4 The Spoken Dutch Corpus

The Spoken Dutch Corpus contains about nine million words. The data are a balanced sample of contemporary standard Dutch as spoken by adults in the Netherlands and Flanders. The corpus includes several types of speech which are listed in Table 1. All data are orthographically transcribed and provided with lemmas and Part-of-Speech tags. About one million words of the corpus are additionally provided with phonetic transcription as well as syntactic and prosodic annotation.

225 h, (2.626.000 w)	Spontaneous conversation ('face-to-face')
51 h, (565.000 w)	Interviews with teachers of Dutch
92 h, (1.209.000 w)	Telephone dialogues (recorded by a telephone exchange)
64 h, (853.000 w)	Telephone dialogues (recorded on MD with local interface)
11 h, (136.000 w)	Simulated business negotiations
64 h, (790.000 w)	Interviews/discussions/debates (broadcasted on radio/television)
36 h, (360.000 w)	(Political) discussions/debates/meetings (non-broadcast)
44 h, (405.000 w)	Lessons (recorded in the classroom)
21 h, (208.000 w)	Spontaneous (sport) commentaries (broadcasted on radio/television)
17 h, (186.000 w)	Current affairs programs/reportages (broadcasted on radio/television)
36 h, (368.000 w)	News bulletins (broadcasted on radio/television)
15 h, (146.000 w)	Commentaries/columns (broadcasted on radio/television)
2 h, (18.000 w)	Official speeches/masses/lectures
16 h, (141.000 w)	Lectures/readings/colleges
104 h, (903.000 w)	Read texts (from books)

Table 1: speech types within the Spoken Dutch Corpus (information taken from the website of the Spoken Dutch Corpus)

In the corpus I made a selection within the recording units (sessions) picking out one session every 200. Within those sessions I searched with the help of the orthographical transcription for occurrences of the word *wel.* The query produced about 350 hits (the word *wel* with the sentence containing it). In analyzing the results I looked at what *wel* added to the meaning of the sentence. I brought together the sentences in which *wel* was used in a similar way and had a similar effect. Certain groups arose out of different uses of *wel*. Next I explored those different groups by analyzing the effect of *wel* in the sentence more precisely and determining the contexts in which that use of *wel* is felicitous. This way I came to several classes of *wel* which I will discuss in the next section.

3.2.5 Wel *in the Spoken Dutch Corpus*

3.2.5.1 Introduction

In this section, I will discuss the different uses of *wel*. At first sight they are very diverse. However, I will argue that a core-meaning can be identified that connects the different uses of *wel*. I will show that the uses have in common that they are a denial of an implicit or explicit previous negation. This property is most obvious when *wel* is used to contradict a previous denial as was exemplified in (2), repeated here as (31).

(31) a. *Jij heet echt geen Jan-Peter!*
you name+have really no Jan-Peter
'Your name isn't Jan-Peter!'
*b. Ik heet **wel** Jan-Peter!*
I name+have WEL Jan-Peter
'My name *is* Jan-Peter!'

In this section I argue that all uses of the Dutch particle *wel* share a core meaning, namely that they mark a denial of a previous negation. To substantiate this claim I will analyze the different uses in Layered Discourse Representation Theory (Geurts & Maier 2003) in section 3.3. Spenader and Maier (2009) show that this model allows denial and contrast to be analyzed in similar terms, which makes it very suitable for my purpose.

The idea of *wel* being a denial of a negation is not new. Sassen (1985) mentions the possibility of *wel* being the lexical representative of a double denial. As a first argument for this, Sassen mentions the similarities between a sentence containing a negation and a sentence containing an occurrence of

the stressed *wel*. The same similarity is found in English sentences like (32a). The emphasized *did* in the second conjunct is connected with the presence of the auxiliary of denial in the parallel conjunct.

(32) a. You didn't see me, but Peter did
b. *Jij zag me niet, maar Peter* ***wel***
you saw me not but Peter WEL

Another argument for his hypothesis is the fact that sentence (33) is felicitous for some speakers of Dutch while every speaker of Dutch finds sentence (34) ungrammatical:

(33) *Jan werd tot 10 uur niet wakker, maar Piet* ***wel***
Jan became until 10 o'clock not awake but Piet WEL
'Jan did not wake up until 10 o'clock, but Piet did'

(34) **Piet werd tot 10 uur wakker*
Piet became until 10 o'clock awake
'Piet woke up until 10 o'clock'

Example (34) is ungrammatical because the verb phrase *wakker worden* 'wake up' can only be combined with a prepositional phrase like *tot tien uur* 'until 10 o'clock' when it is combined with a negation. In (33) the elliptical second part of the sentence can be combined with *wel.* Because of this, Sassen concludes that the stressed *wel* in (33) represents a double denial and sentence (33) should be read as:

(35) *Jan werd tot 10 uur niet wakker, maar Piet werd*
Jan became untill 10 o'clock not awake but Piet became
niet tot 10 uur niet wakker
not until 10 o'clock not awake
'John didn't awake until 10 o'clock, but Peter did not not wake up until 10 o'clock'

According to Sassen, another sign of *wel* being the representative of a double denial is the well formedness of (36b), in which *wel* is combined with the negative polarity item *hoeven*. *Hoeven* can only occur in a negative environment. The fact that it can occur with *wel* is an argument that *wel* functions as a double denial.

(36) a. **Hoeft dat eigenlijk?*
b. *Hoeft dat eigenlijk* ***wel****?*
must that actually WEL
'Is that really necessary?'

Additional evidence is found in the next example:

(37) *Daarom blijven ze* ***wel***
therefore stay they WEL
'That is why they will stay.'

Example (37) is ambiguous. It can mean 'that is a reason for them to stay' or 'therefore they do stay', but with emphasis on *blijven* it means 'that is no reason for them not to stay'. In the latter reading *wel* functions as a representative of the double denial again.

The examples of *wel,* discussed by Sassen (1985) are all stressed uses of *wel* and are occurrences of what I will call 'correction' or 'explicit contrast'. Sassen argues that the occurrences of *wel* represent a double negation. In a similar fashion, Zeevat (2004) argues that, in general, *wel p* presupposes $\neg p$. Zeevat focuses on the stressed uses that are uttered as a correction of a negative statement made by the other party. He argues that in the unaccented cases this presupposition may still be present, but that a case by case analysis should provide more insight in this. This is precisely what I will do in the coming sections: I will show that every use of *wel* is a reaction to a negation in the context. The nature and the strength of that negation vary for the different uses of *wel.* It can be a literal negation in a previous utterance, as in example (31) above. It can also be an implicit denial that is suggested by our general world knowledge. In the next section I will first informally describe the different uses of *wel* and illustrate them with examples from the corpus. In the subsequent section I will make explicit how the meanings of *wel* are a denial of a negation in the framework of Layered Discourse Representation Theory (Geurts & Maier 2003). Then I will argue that the different readings can be ordered according to their strength.

3.2.5.2 Corrective *wel*

In some occurrences *wel* was used to correct a previous utterance, as was also illustrated in (31).

Prior to utterance (38) a boy said to his brother over the telephone that he tried to call him at Floor's but he was not there. Then the brother says:

(38) Ik zit **wel** bij Floor
I sit WEL at Floor
'I *am* at Floor's'

In (39) *wel* is also used to correct the assertion made in the previous utterance. The speaker of the first sentence states that he does not look down on students. The speaker of the second utterance does not agree; according to him he and the first speaker do look down on students. He stresses his disagreement even more with adding *jawel*. *Ja* 'yes' is a confirmative answering particle. Together with *wel* it can be used as an affirmative answer to a negative question (similar to for example *si* in French). Or, as in this example, to indicate that you disagree with a previous negative utterance.

(39) a. *Ik kijk niet neer op studenten helemaal niet nee*
I look not down on students totally not no
'I don't look down on students, not at all, no'
b. *Ja wij kijken **wel** neer **jawel***
yes we look WEL down JAWEL
'Yes we do look down, yes we do'

In (38) and (39) *wel* is used to contradict a previously uttered denial of a certain fact. The speakers use *wel* to mark the incompatibility of their utterances with the current state of information brought about by the preceding utterances. *Wel* in this sense is clearly a denial of a negation. The negation in the context of the corrective *wel* is explicitly present in a previous utterance.

3.2.5.3 *Wel* indicating explicit contrast

Wel is also used to mark an explicit relation of contrast between two items. Contrast is a discourse relation between two items which are similar in many ways and different in some ways, and a comparison is made between those items with respect to one of the differences. The next utterance was part of a news item about a flood in Poland and it was preceded by the information that in Warsaw the situation was not that bad.

(40) *In het zuiden van Polen is de toestand **wel** zorgelijk*
in the south of Poland is the situation WEL alarming
'In the south of Poland the situation *is* alarming'

In (40) *wel* is uttered to mark the contrastive relation between Warsaw where the situation is not that bad and the current utterance that states that in the south of Poland the situation *is* alarming. In (41) *wel* marks a contrastive relation between *wij* 'we' who don't know and professor Hoksbergen who does seem to know how important it is for a child to know his father.

(41) *Wij weten niet uh professor Hoksbergen schijnt dat **wel** te*
we know not uh professor Hoksbergen seems that WEL to
weten, wij weten niet hoe belangrijk het is voor een kind om te
know we know not how important it is for a child for to
weten wie zijn biologische vader is.
know who his biological father is
'We don't know uhm, professor Hoksbergen does seem to know that, we don't know how important it is for a child to know its biological father'

The conversation prior to the utterance of *wel* in (40) and (41) contains an explicit negation. However, in contrast to the relation *correction*, the content of (40) and (41) is not in conflict with the previous utterances.

3.2.5.4 *Wel* indicating implicit contrast

Wel is also used to mark a possible discrepancy between the common ground brought about by the preceding utterances, and the current utterance. In this case, *wel* is not used to contradict an explicit denial of a certain fact but to respond to an assumption that could be inferred from the conversation thus far. Example (42) is part of a conversation between a mother and a daughter about a paper the daughter handed in for school. The daughter was not satisfied with the quality of her paper and she lists a number of things that she could have done better. After that she utters (42).

(42) *Ik had **wel** best wel veel bronnen*
I have WEL quite WEL many sources
'I did have quite a lot of sources'

In (42) the first occurrence of *wel* is used to mark the inconsistency with the previous utterances and the current utterance. The aforementioned quality of the paper could suggest that she did not have a lot of sources. At least it makes that a more plausible option than the contrary. *Wel* is used as a reaction to that expectation. In the same conversation the daughter wonders

whether she did a good thing by adding a couple of articles to the paper. She doubts whether it was a good decision because she did not write the articles herself. Then her mother says:

(43) *Je laat natuurlijk* ***wel*** *zien dat je er onderzoek*
you let of course WEL see that you there research
naar gedaan hebt.
at done have
'You do show of course that you looked into it'

The previous utterances all pointed to a negative evaluation of the addition of the articles. In contrast to that, utterance (43) is an argument in favor of the addition. The use of *wel* marks the inconsistency between the current utterance and the previous utterances.

Often *wel* occurs in one conjunct of a coordination and is a response to a suggestion brought about in the other conjunct, like in (44). In such cases *wel* often co-occurs with *maar* 'but', either preceding or following it.

(44) *Ik zorg dat de zaadgevende man* ***wel*** *bekend blijft*
I take care that the seed-giving man WEL known stays
maar een afstandsverklaring kan doen
but an abdicate-declaration can do
'I will see to it that the identity of the sperm donor remains known but that he can give up his paternal rights'

(45) *Ja maar ik vond* ***wel*** *dat ze wanneer de camera*
yes but I found WEL that she when the camera
draaide was ze heel spontaan en aardig maar
turned was she very spontaneous and nice but
daarbuiten was ze toch ***wel*** *minder hoor*
outside of that was she PRT WEL less PRT
'yeah, but I did think when the cameras were on she was really spontaneous and nice but outside of that not that much'

When *wel* is present in the first conjunct, as it is in (44), the relation of contrast is often indirect, which means that there are two conjuncts expressing the propositions p and q and there is a proposition r such that p implies r and q implies $\neg r$. In (44) the first conjunct p (the identity of the sperm donor remains known) implicates something like 'the sperm donor could be expected to act as a father to the child at some point in time', r. The

second conjunct *q* (the father gives up his paternal rights) implicates that a sperm donor will not be expected to act as the father to the child, so *q* implies ¬*r*. When *wel* is present in the second conjunct, as in (45) the contrastive relation is often direct, which means that *p* directly implies *not q*. The fact that she was nice when the cameras were on (*p*) could lead you to believe that she is nice without the cameras too (¬*q*) but in fact she is not (*q*).

As a subclass of this use, we can distinguish *wel* with a comforting effect, as was also shown by Abraham (1984) (see section 3.2.3). *Wel* can be used in a sentence to reassure the hearer that a certain desired situation will occur. *Wel* in (46) exemplifies this use. Some preceding lines are given to understand the background of the utterance (46)[3].

> Toen de laatste roller uit haar haar was kreeg Régine een kleine spiegel. Ze bracht hem langzaam omhoog en keek naar haar spiegelbeeld. Wat ze te zien kreeg was veel erger dan ze zich had kunnen voorstellen. Ze hield de spiegel op armlengte voor zich om wat meer te kunnen zien maar het werd er niet beter op. Met haar vrije hand pakte ze haar haar vast. De krullen waren zo stijf dat ze er niet met haar hand door heen kon strijken. Maak je maar niet ongerust zei madame Bernard.
> 'When the last curler was removed from her hair, Régine got a small mirror. She took it up slowly and looked at her reflection. What showed up was much worse than she could have imagined. She brought the mirror at arm's length to see some more but that didn't help. With her free hand she took a hold of her hair. The curls were that stiff she couldn't stroke through it. Don't worry about it, madam Bernard said.'

(46) *Dat wordt **wel** beter.*
that becomes WEL better
That will become better'

In (46) Madame Bernard probably reads from the expression on Régine's face that she is not happy with the result of the curling. She then reassures her that it will not stay this way and that it will change for the better. In (47) *wel* is used for reassurance as well. The speaker indicates the hearer should not worry, for things will become clear in the future.

[3] This example is taken from the part of the Spoken Dutch Corpus that contains texts read aloud.

(47) Bezig zijn ja gewoon ja uh dat zien we nog **wel** in
busy are yes just yes uh that see we PRT WEL in
de toekomst
the future
'Are busy yes just yes uh, we'll see in the future'

To summarize, *wel* can be used to contradict a negative inference from the context. In coordinating clauses the indication for this inference is found in the other conjunct. Sometimes it is not one particular sentence from which the inference can be drawn. *Wel* in example (43), for example, is a reaction to a sequence of utterances or perhaps even the whole conversation.

3.2.5.5 Surprise!!!

In the corpus sample there were occurrences of *wel* that seemed to bring about a sense of surprise. In general, the uses of *wel* I grouped under 'surprise' occur in a context in which the contrary of the sentence containing *wel* is considered more plausible or normal. This context is often very general, meaning not brought about by the previous conversation or the current surroundings. The occurrences can be subdivided into three classes. The first class consists of occurrences of *wel* that co-occur with the verb *lijken* 'look like/seem':

(48) Het lijkt **wel** een sollicitatiegesprek
it looks like WEL a job interview
'It looks like a job interview'

In (48) *wel* adds an element of surprise or a sense that the situation is extraordinary. Note that using *wel* is only appropriate if the situation described is in actual fact not the case. Utterance (48) is part of a radio interview. This was obviously not a job interview but at some point it appeared to have become one to the person who uttered (48). The effect that this use of *wel* brings about can be clearly illustrated by the following (constructed) sentence pair.

(49) Dat kind lijkt **wel** een beetje op mijn buurman
that child looks like WEL a little at my neighbor
'That child looks a little like my neighbor'

(50) #Dat kind lijkt **wel** een beetje op zijn moeder
that child looks like WEL a little at his mother
'That child looks a little like its mother'

The utterance of *wel* in (50) is strange because it is very normal for children to look like their mother. *Wel* can be uttered in (49) because it is not normal or usual for children to look like people they are not related to. An occurrence of *wel* with *lijken* 'look like/seem' is a reaction to a negation that is very implicitly present in the context. The situation in which (48) is uttered is in fact a radio interview. Because from world knowledge we know radio interviews are normally not like job interviews, the speaker utters his surprise with (48) over the fact that this one does.

In conclusion, the negation this type of *wel* contradicts is not explicitly present in the context. We only know from a very broad non-linguistic context that the negative counterpart is more likely than the situation expressed by the sentence containing *wel.*

In (51), the focus particle *wel* occurs in front of a numeral and it indicates that the speaker considers the quantity to be higher than expected. This *wel* also adds an element of surprise to the sentence or a sense that the situation is extraordinary.

(51) *Heel breed inzetbaar want die speelde* ***wel*** *vijf rollen*
very broadly employable because he played WEL five parts
'Very versatile because he played (no less than) five parts'

One uses *wel* if the amount is higher than expected or higher than usual. In (51) for example *wel* is uttered because it does not happen often that one actor plays five parts in one play. The corpus also contains utterances in which *wel* is directly followed by *niet* 'not'.

(52) Hoe hard fiets jij **wel** niet
how fast bike you WEL not
'(Gee) how fast do you bike?!'

Sentences with the particles *wel* and *niet* used adjacent to each other always contain an interrogative word of degree. In (52) the speaker asks how fast the hearer rides his bike and expresses her surprise over the already assumed speed. One uses *wel* with a quantificational element when one thinks the quantificational element is bigger than usual. From world knowledge we know that actors mostly play just one part in a play or a

couple of smaller parts. We do not expect an actor to play five parts. In this line of reasoning it should also be possible to use *wel* when a number is exceptionally low. Normally people do not have just one arm. But it is not felicitous to utter (53).

(53) *#Die man heeft **wel** één arm*
That man has WEL one arm

I argue that this is due to the fact that *wel* functions as a denial of a negation. It has been argued that 'not' means 'less than' (e.g. Jespersen 1924). When someone utters *John does not read three books a year* it means John reads less than three books a year. When someone utters *it is not a good book,* it means it is a less than a good book, an inferior book. This property of negation is reflected in the use of *wel. Wel* negates 'less than' and its meaning indeed corresponds to the English expression *no less than.*

The negation in the context of this use of *wel* is similar to the one in the context of *wel* with *lijken.* A broad non-linguistic context suggests that the negative situation is more plausible than its positive counterpart.

Wel also occurs with the word *misschien* 'maybe':

(54) Misschien komen die ook nog **wel**
maybe come they also PRT WEL
'Maybe they will come too'

Adding *wel* brings about the meaning that the situation expressed in the sentence is not likely to happen or to be the case but 'you never know'. Sentence (54) without *wel* would be uttered if one had for instance spoken to the people in question and they had said they might come. When *wel* is added this indicates that the speaker has no indication they will come but 'you never know'. The effect is strengthened by the use of *nog,* in general best translatable by 'yet', before *wel.* In (55) *wel* is used because children normally do not have three parents. The effect is again strengthened by the use of *nog,* before *wel*.

(55) *Een kind heeft een moeder en een ouder een tweede*
a child has a mother and a parent a second
*ouder en misschien nog **wel** een derde voor mijn part*
parent and maybe PRT WEL a third for my part
'A child has a mother and a parent and another parent and maybe even a third as far as I'm concerned'

These examples show that this use of *wel* is again a reaction to a context which suggests the negation of the proposition expressed in the sentence containing *wel*.

3.2.5.6 *Moderating* wel

Wel is also used before adjectives or adverbs, as was previously exemplified in (4). This use of *wel* has the effect that it decreases the positivity of the modifier.

(56) *Ja 't was **wel** leuk*
yes it was WEL nice
'Yes, it was OK

(57) *Dus ja dat uh loopt allemaal **wel** lekker*
so yes that uh runs all WEL nice
'So yes, uh everything is going (quite) well'

This use of *wel* and the uses of *wel* I will discuss in the remainder of this section differ from the previously discussed ones. They do not occur in a context in which the opposite of the sentence containing *wel* is stated or implicated or just more plausible. Sentence (56), for example, does not require a context that suggests that what *it* refers to was not nice neither is it the case that world knowledge tells us that things are normally not nice. I argue that in this case *wel* denies an internal negation. The effect *wel* brings about is similar to the effect of litotes. Logically, two negations cancel each other out. Yet, the phrase *John is not unhappy*, for example, is not equivalent in meaning to the phrase *John is happy*. It rather means something like 'John is moderately happy'. Let me further clarify this effect with the help of example (56).

Let us assume the scale of "nice-ness" includes three states; *nice*, *neutral* and a state for which I will use the term *un-nice* (to avoid confusion with the negation of the state *nice*). When the phrase *not nice* is used in a contradictory opposition to *nice,* the literal meaning covers the range *neutral* and *un-nice* on the nice-ness scale. However, the phrase *not nice* often implicates a contrary opposition to nice, which results in the interpretation *un-nice*. This effect is visualized in Figure 1.

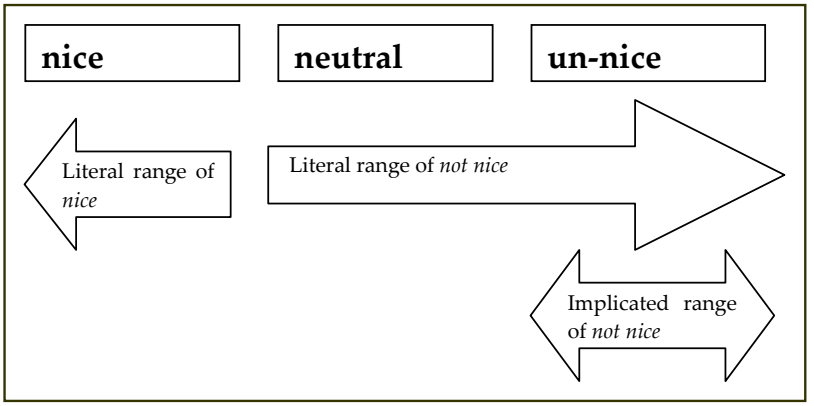


Figure 1: literal and implicated meaning of *not nice*

When a double negative like *not un-nice* is used, a different effect emerges. What is literally expressed by *not un-nice* encloses the states *nice* and *neutral*. However, what is implicated by that utterance is mainly covered by the neutral state, as is visualized in figure 2 (Blutner 2004).

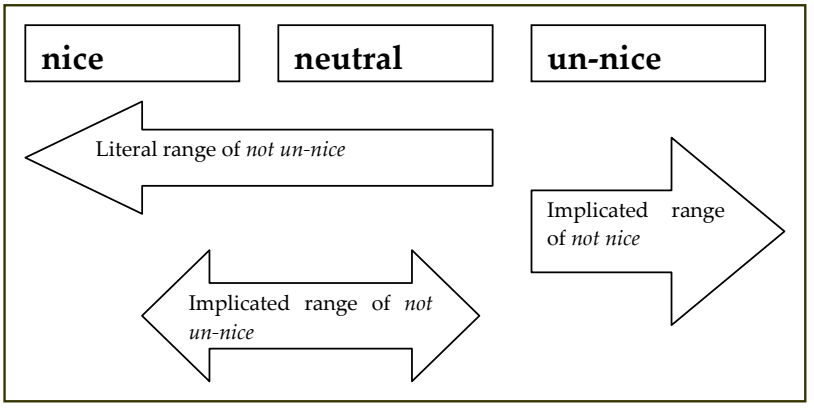


Figure 2: literal and implicated meaning of *not un-nice*

When *wel* precedes an adjective or an adverb, this has an effect similar to the use of a double negative. The phrase *the party was 'wel' nice* implicates that

the party was somewhere in between *neutral* and *a little bit nice.* Strikingly, moderating *wel* can only be used adjacent to positive modifiers.

(58) *#Het was **wel** saai*
it was WEL boring
'It was boring'

This same restriction holds for the use of a double negative. The effect described in Figure 1 and 2 does not emerge when the two negations are placed in front of a negative modifier like *stupid, sad* or *ugly*. The phrases *he is not not stupid* and *he is not not sad* do not lead to the interpretation that is he moderately stupid or moderately sad. Related to this restriction is the impossibility to attach an affixal negation to a negative modifier. It has been observed that affixal negation is only possible with positive concepts: *unhappy, unfriendly, unhealthy, uninteresting* vs. **unsad, *unhostile, *unsick, *unboring* (Horn 1989). The question arises: what causes the impossibility to use *wel* and a double negation in front of a negative modifier and why do we interpret a double negative the way we do? Several linguists have formulated more or less the same answer to this question, namely that special meanings are expressed in a special way. Horn formulated it as follows: "there is a correlation between the stylistic naturalness of a given form, its relative brevity and simplicity, and its use in stereotypical situations […] The corresponding periphrastic forms, stylistically less natural, longer, and more complex, are restricted […] to those situations outside the stereotype, for which the unmarked expression could not have been used appropriately." (Horn 1989, p. 304). Levinson (2000) articulated this idea in the M(anner)-principle: "what is said in an abnormal way, isn't normal; or marked message indicates marked situation". This idea is formalized in Bidirectional Optimality Theory (Blutner 2000). The basic idea of Bidirectional Optimality Theory is that a hearer can only arrive at the optimal interpretation of an utterance if she takes into account the alternative forms the speaker could have used to express this meaning. To put it very simple: if the speaker utters a marked form, the hearer interprets that utterance as having a marked meaning. After all, if the speaker would have wanted to utter the unmarked meaning, she would have used the unmarked form. Negative concepts are (in general) more marked than positive concepts. This can be shown (among others) by the fact that the positive term is used to question whether something has or lacks a certain quality. You ask someone *how good was the play* and not *how bad was the play* (unless you already have an indication it was bad). Similarly you ask the

question *how happy are you* and not *how unhappy are you* in neutral circumstances. An utterance containing a negation is also formally marked in comparison with an affirmative utterance. These two facts are responsible for the impossibility to attach an affixal negation to a negative concept, turning it into a positive concept. An unmarked meaning (a positive meaning) would then be expressed by a marked form (a form containing a negation). This also explains why *litotes* does not occur when it concerns a double negation in front of a negative adjective or adverb. A negated negative modifier does not implicate the contrary (which was illustrated in Figure 1), while a negated positive modifier does (as was illustrated in Figure 2). The contrary of a negated negative modifier would be a positive modifier. A positive adjective or adverb denotes an unmarked concept that cannot be expressed by a marked form (a form carrying a negation). Therefore the contradictory reading emerges. That contradictory reading of the modifier covers the whole range of the scale besides the state denoted by the modifier itself. Adding another denial can therefore bring about no other meaning than the one denoted by the adjective or adverb itself again, as is shown in Figure 3.

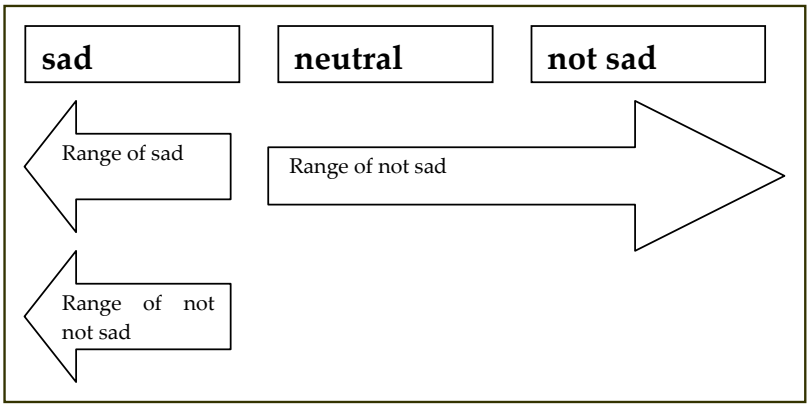


Figure 3: literal and implicated meaning of *not not sad*

In conclusion, a negated positive modifier brings about the contradictory reading. If another negation is added, the literal interpretation includes the whole range minus the state denoted by the negated positive modifier. However, we interpret *not unhappy* as *neutral* or *a little happy* because the unmarked concept 'happy' must be, and is, expressed by an unmarked term,

the word *happy*. The neutral concept, in between *happy* and *unhappy* is the most marked concept and is therefore expressed by the most marked expression (an expression carrying two negations). Remarkably, the restrictions that hold for a double negative also hold for the use of *wel.* They bring about the same effect; they weaken the positivity of the modifier.

3.2.5.7 Wel *with* eens *'once'*

Wel also occurs with *eens* 'once'. Together the two words mean 'once (in a while)' or 'ever':

(59) *Heb jij 'm* ***wel*** *eens gezien in Goede Tijden Slechte Tijden?*
have you him WEL once seen in goede tijden slechte tijden
'Have you ever seen him in (the Dutch soap opera) *Goede Tijden Slechte Tijden?*'

(60) *De helft van de mensen werkt ook* ***wel*** *eens op zaterdag of zondag*
The half of the people works also WEL once on Saturday or Sunday
'Half of the people work on Saturdays and Sundays once in a while'

Wel and *eens* are a fixed combination, sometimes they are even written as one word, *weleens.* When *wel eens* is used in combination with the Present Perfect it means 'at least once'. The question in (59) can be answered affirmatively if you have seen him once in *Goede Tijden Slechte Tijden* (meaning 'Good times, bad times' a (once) very popular soap opera in the Netherlands). When they are used in combination with a Simple Present or Simple Past the words mean 'once in a while'. In (60) *wel eens* indicates that half of the people work on Saturday or Sunday once in a while. In both cases, however, the frequency that is expressed by *wel eens*, is less than the frequency expressed by *soms* 'sometimes'. When *wel* is used in combination with *eens* 'once' there is nothing in the context that indicates the opposite either. Take example (59). There does not have to be anything from which the speaker infers that the hearer has not seen 'him' in *Goede Tijden Slechte Tijden.* Here *wel* has a similar effect as the previous use. *Wel* denies the possibility of *not once.* On a (simplified) frequency scale this leaves open the ranges *once, sometimes, often* and *always*. *Wel eens* indicates that the frequency lies just above *not once,* namely *once* or *sometimes.* This can again be ascribed

to the mechanism I described in the previous subsection, illustrated in Figure 4.

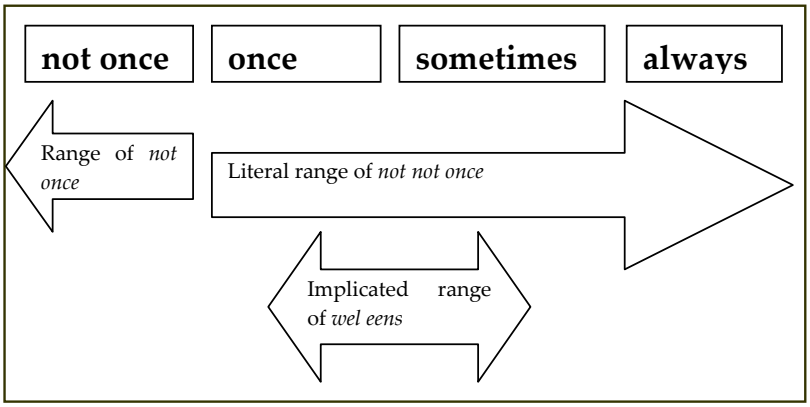


Figure 4: the meaning of *wel eens*

3.2.5.8 Wel *with* zullen *'will'* indicating probability.

In some occurrences, *wel* is used to indicate that the speaker considers the content of her utterance very plausible but that she cannot be totally sure about its truth. On such occasions *wel* is combined with the verb *zullen* 'will'. With *zal wel* the speaker seems to indicate that based on the information available to her, she can draw a certain conclusion, but that she is aware of the fact that the available information is not sufficient to be certain. In (61) and (62) the reasoning that leads to the conclusion introduced by *zal wel* is (partly) mentioned in the same sentence.

(61) *'t Is woensdag en het is voor kerstmis dus zal* ***wel***
it is Wednesday and it is before Christmas so will WEL
koopavond uh zijn
late-night-shopping uh be
'It's Wednesday and it is before Christmas so there will probably be late night shopping today'

(62) *Marijke zei die dame praatte zo keurig en zo adequaat*
Marijke said that lady talked so neatly and so adequately
en zo goeie zinnen en ik dacht dat zal ***wel*** *een*
and so good sentences and I thought that will WEL a
bezoekster zijn waarom zit die met tante Carolien te praten
visitor be why sits she with aunt Carolien to talk
maar dat was helemaal geen bezoekster
but that was totally no visitor
'Marijke said that lady talked so neatly and so adequately and such good sentences and I thought she is probably a visitor and why is she talking to aunt Carolien but she wasn't a visitor at all'

The speaker of (61) concludes from the fact that it is Wednesday and that it is almost Christmas that the shops must be open this evening. Usually the shops are closed at night except for one evening a week. Only close to the holidays the shops may be opened on additional evenings. The speaker has no conclusive proof of it though, which would have been the case, had she seen an announcement of extended openings hours for example. When *wel* is used in combination with *zullen* 'will' again there is nothing in the context from which the contrary can be inferred. Example (61) does not require a context in which the reverse is stated or more plausible. This use of *wel* is similar to the previous two uses. In this case however there are only two points on the scale. Either the lady in (62) is a visitor or she is not. She cannot be neither or somewhere in between. Taking the available evidence into consideration the speaker chooses for the option of her being a visitor. *Wel* seems to indicate that the contrary was taken into consideration. Since the contrary did not seem a plausible option and there is nothing in between, the speaker decided that the lady must be a visitor.

The uses of *wel* as a moderator, in combination with *eens* 'once' and in combination with *zullen* 'will', form the weakest group of uses to which I will refer with '*wel* as a modifier' in the remainder of this chapter.

3.2.5.9 Conclusions

I have listed the different uses of *wel* I found in the corpus sample. Because I examined a fair-sized number of utterances coming from a corpus of spoken Dutch, I expect to have included the most common uses of the particle *wel* in contemporary spoken Dutch. Furthermore, I have shown that the different uses of *wel* have in common that that they function as a denial of a negation in the context. To substantiate this claim I will analyze the functions in a

formal model that can handle both monotonic as well as non-monotonic effects on a discourse, namely Layered Discourse Representation Theory (LDRT). Spenader and Maier (2009) show that, adopting an LDRT framework, contrast and denial can be analyzed as being similar phenomena. I will therefore start by discussing their analysis in LDRT in section 3.3 after which I will use their theory for my analysis of *wel* in section 3.3.3.

3.3 *Wel* as a denial of a negation in Layered Discourse Representation Theory

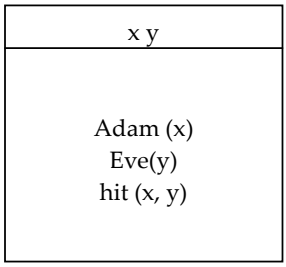
In this section I will expand on my suggestion of the previous section, namely that all uses of *wel* function as a denial of a negation. To substantiate this claim I will analyze the different uses in the model of Layered Discourse Representation Theory (Geurts & Maier 2003). Spenader and Maier (2009) show that this model allows denial and contrast to be analyzed in similar terms, which makes it very suitable for my purpose. Layered Discourse Representation Theory (LDRT) is a variant of the more generally adopted Discourse Representation Theory (DRT). I will first briefly outline the basic characteristics of DRT with the sole purpose of providing sufficient background information to enable comprehension of the framework of LDRT.

3.3.1 Discourse Representation Theory

Discourse Representation Theory (Kamp 1981) was the first theory in the relatively new school of *dynamic semantics*. Where traditional semantics focuses primarily on truth conditions and reference, dynamic semantics acknowledges the importance of the context dependent nature of natural language. Discourse Representation Theory (DRT) is a framework that models representations of the discourse in order to analyze contextually dependent expressions such as anaphora and presuppositions.

A discourse is represented in a Discourse Representation Structure (DRS). A DRS is an ordered pair of discourse referents (e.g. x, y, z), which forms the universe of the DRS, and a set of DRS conditions. A DRS can be represented as a box with two parts, the universe on top and the conditions beneath it. An example of a DRS is given in (63).

(63) Adam hit Eve.

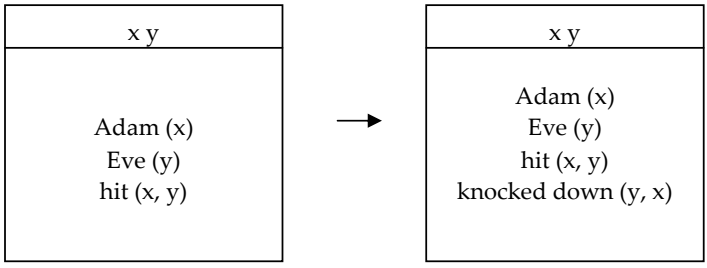


The same DRS can also be represented in the following way.

(64) [x, y | Adam(x), Eve (y), hit (x, y)]

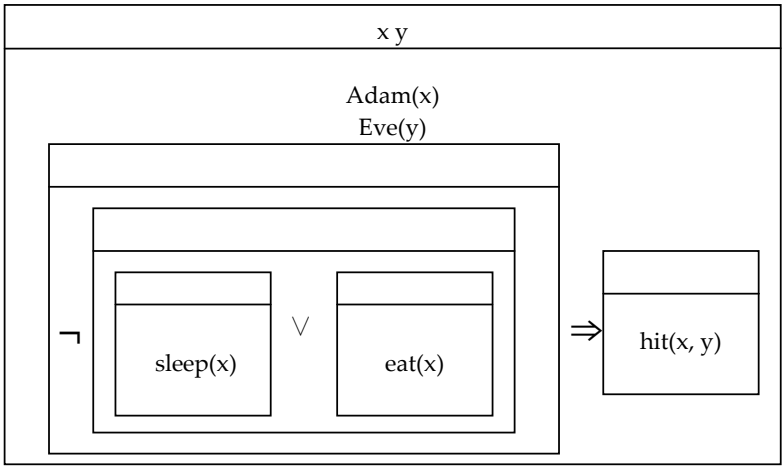
New information can be represented by adding new discourse referents and conditions to the DRS. Adding the utterance in (65) to the discourse would yield the following DRS.

(65) Adam hit Eve. She knocked him down.



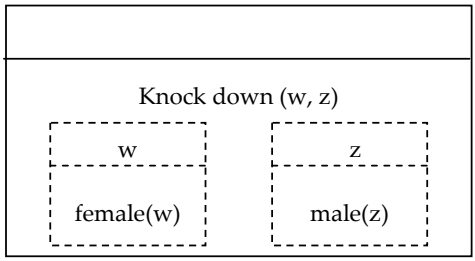
The condition part of the DRS can itself also contain a DRS. This is the case when negation, implication or disjunction is involved. The three operators are exemplified in (66).

(66) If Adam didn't sleep or eat, he hit Eve.



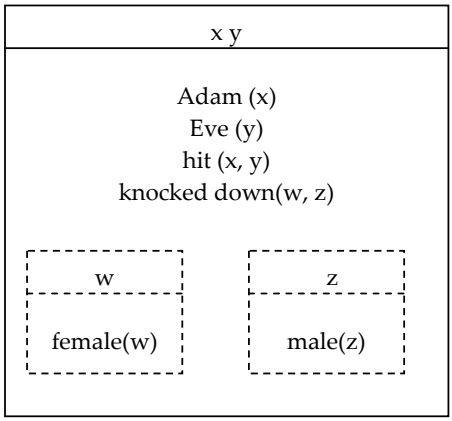
A particular aspect of DRT that is interesting for the issues discussed in this chapter, is the treatment if presuppositions. To model presupposition, interpretation is analyzed as a two-step process in DRT. First a preliminary DRS is built of a particular utterance, after which the context is incremented with the new information. An anaphor is only bound after the second part of the process. Let us look at the example (65) again. The preliminary DRS of the second sentence looks as follows.

(67) She knocked him down.



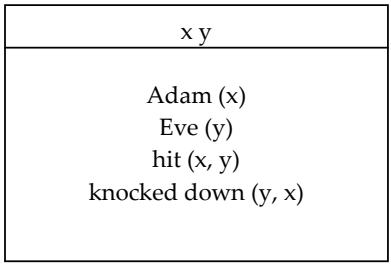
The DRS indicates that a *w* knocks down a *z* and that we should find a representation of a female entity and of a male entity. The two entities are presupposed and the dashed boxes indicates that the interpreter should look for suitable antecedents. The next step is to merge the DRS with the context. The context is the DRS of the first sentence of (65). If we merge (63) with the second part we get (68).

(68)



Now, the hearer can identify the matching antecedents and bind the presupposition to it. This last step results in an interpretable, closed DRS in which every presupposition is resolved (Van der Sandt 1992).

(69)



If (and only if) no suitable antecedent is present in the context, the interpreter can resort to accommodation. The presupposed information is added to the context in order to create accessible antecedents.

Now that I have given the basic ingredients of DRT, let us turn to the analysis of contrast and denial in LDRT by Spenader and Maier (2009).

3.3.2 Contrast as denial in Layered Discourse Representation Theory

Spenader and Maier (2009) analyze contrast and denial as similar phenomena within Layered Discourse Representation Theory (Geurts & Maier 2003). They build on Maier and van der Sandt's (2003) treatment of denial. In Maier and van der Sandt (2003) denial is analyzed as a non-monotonic mechanism on the discourse structure previously established. Parts of the contribution of the previous utterance are removed from the main DRS and end up under the scope of a negation introduced by the denial. This mechanism is called *Reverse Anaphora.* Note that a denial is not the same as a negation. The term denial is used when a rejection of a previous utterance is involved. Positive sentences can function as a denial as well. A denial can be used (amongst others) to reject a proposition, as in (70), a presupposition, as in (71) or an implicature, as in (72) (Maier and van der Sandt 2003).

(70) a. Mary is not happy (as a reaction to the utterance 'Mary is happy')
b. Mary is happy (as a reaction to the utterance that 'Mary is not happy')

(71) The king of France is not bald, France doesn't have a king

(72) It is not possible, it is necessary that the pope is right

In order to model the fact that denials can target different kinds of content Maier and van der Sandt (2003) adopt a Layered DRT framework where these different types of informational content are all stored in separate but interconnected layers of a single representational structure. There is a layer for asserted information, which is called the *Fregean* layer, a layer for implicatures and a layer for (accommodated) presuppositions. Furthermore there is a separate layer for the content of proper names and indexicals, named *k* after Kripke/Kaplan. The syntax of LDRT is similar to that of regular DRT except for the fact that in LDRT every discourse referent and every DRS condition comes with a label, specifying what kind of information it encodes. With these labels, there can be *directed reverse anaphora*, which only removes the offensive material, that is, the material that is contradictory and needs to be removed from the LDRS.

While denial is usually treated as a non-monotonic phenomenon, contrast is normally not analyzed as causing a revision of the common ground. However, Spenader and Maier (2009) argue that contrast and denial

should be analyzed along the same lines. Spenader and Maier assume that speakers and hearers maintain a representation of the discourse in which they are involved that with each new utterance can be 'updated' (information is added) or 'downdated', a slight modification of Maier and van der Sandt's (2003) Reverse Anaphora mechanism used to retract information. A denial is analyzed as having three steps (Spenader and Maier 2009).

Issue: the common ground representation is incremented with the first speaker's utterance.
Concession: the second speaker optionally concedes that part of the informational content conveyed (or suggested) by the first speaker's utterance is true and this information is added to the representation as well.
Correction: the actual denial, usually consisting of some negative particle or negated echo of the utterance to be corrected, or if there were a concession, a *but* or *however*, etc. Normal update with the correction would result in an inconsistent representation, so we apply a downdate, throwing out as much of the earlier information as needed to restore consistency. The informational content of the correction (apart from any echoes which make no semantic contribution) and of the concession always remain untouched by the downdate.

A denial always operates on something already given in the discourse. Upon recognizing the speaker's intention to deny, the hearer starts looking for information in the context that conflicts with the content of the denial. Spenader and Maier see a contrastive conjunction as an operator that triggers revision of the discourse representation. The semantic relationship holding between the different parts of contrastive relationships must fulfill certain criteria. The main criterion on the semantic relationship for the use of a contrastive marker is that there is some unspecified implication derived from the second conjunct that contradicts with the first conjunct or an inference derived from this first conjunct. This inference is called *Tertium Comparationis* (TC) by Spenader and Maier. In case of direct contrast, the inference is the negation of the first conjunct. In case of indirect contrast the identification of the inference requires world knowledge. In sum, contrast involves a denial of a hidden implication of the first conjunct (either directly or indirectly) and it involves the same three steps as denial:

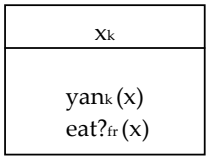
Issue: the topic under discussion, the context
Concession: the information contributed by the first conjunct, a partial answer to a contextual question, a confirmation of some information.
Correction: the information contributed by the second conjunct. It initiates a search process for conflicting implications, a TC. This TC is likely an implication of the first conjunct, interpreted with respect to the issue.

Spenader and Maier formalize their view on contrast in LDRT. Their analysis requires four layers: a Fregean layer (*fr*), a layer for (generalized) implicatures (*imp*), a layer for accommodated presuppositions (*pr*) and a layer for contextual information (*k*). To be able to explain contrast they introduce an additional layer: *inf* for pragmatic/relevance-based inferences. The concession together with the issue brings about such a pragmatic inference. Consider sentence (73) (Spenader and Maier 2009, p. 1720):

(73) I was hungry, but the restaurants were closed.

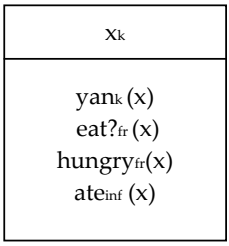
Say this sentence was uttered by Yan and there is an implicit issue *Did you (Yan) eat?* The issue can be represented as follows:

(74)



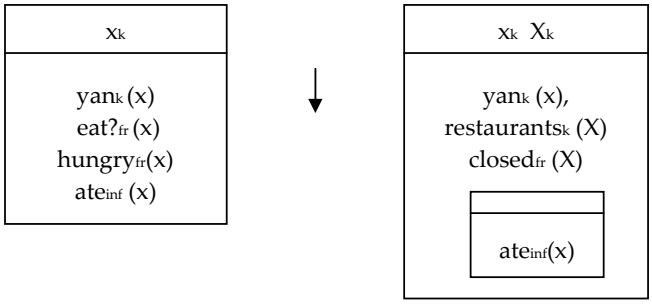
Now, Yan utters the first conjunct of (73), which is the concession. This partial answer (against the background of the issue and the assumption of a cooperative speaker) evokes the pragmatic inference that Yan ate. The DRS now looks as follows:

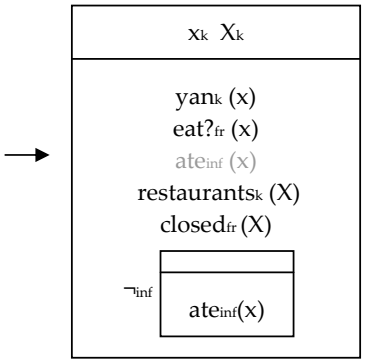
(75)



The second conjunct of (73), the correction, brings about the inference that Yan has not eaten. Updating the DRS with that assertion and its inference would lead to inconsistency. That's why a downdate is required (indicated by the symbol ↓). Note that while Maier and van der Sandt (2003) assume that the entire layer with the offensive material is removed, Spenader and Maier argue that only as much is removed as is needed to maintain a coherent common ground. Removed material is made grey ion the DRS's.

(76)





In conclusion, Spenader and Maier give a unifying account of contrast and denial by analyzing the first as a subtype of the latter. Contrast and denial have the same underlying structure and (non-monotonic) discourse effects, they only differ in the type of information they affect. While a denial removes information that has been asserted (*fr*), presupposed (*pr*) or implicated (*imp*), contrast involves removal of pragmatically inferred information (in the *inf* layer).

I have argued that all uses of *wel* share a core meaning, namely that they mark a denial of a previous negation. To substantiate this claim I will

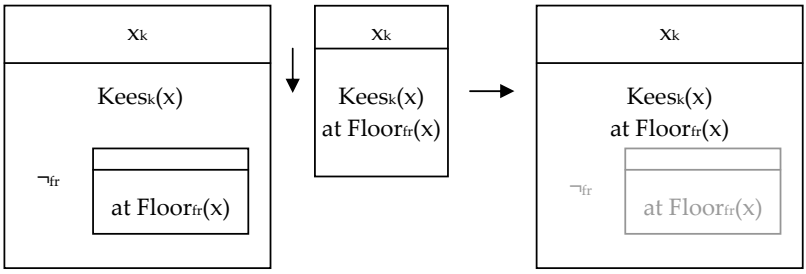
analyze the different uses in the LDRT model outlined above. Since this model allows correction and contrast to be analyzed in similar terms, it is very suitable for my analysis of the core meaning of *wel*.

3.3.3 The functions of wel *in LDRT*

3.3.3.1 Correction

The use of *wel* I called correction is identical to the operation of denial as defined by Maier and van der Sandt (2003). They argue that a denial does not have to include a negation. Indeed, *wel* marks that a previous (negative) statement must be removed from the common ground and must be replaced by its negation. This procedure is illustrated for example (38), repeated here as (77). Recall that prior to this utterance the brother of the speaker (let's call him Kees) of (77) said that he tried to call him at Floor's but he was not there.

(77) Ik zit **wel** bij Floor
I sit WEL at Floor
'I *am* at Floor's'



3.3.3.2 Explicit and implicit contrast

I argue that implicit contrast and explicit contrast constitute two different relations. The difference between explicit and implicit contrast corresponds to the distinction that is sometimes made between *semantic opposition* and *denial of expectation* (in the terminology of Lakoff 1971). I will therefore shortly discuss some of the literature that concerns the differences and similarities between these two discourse relations.

It has been argued that the two relations *semantic opposition* and *denial of expectation* should be differentiated. Kehler (2002), for example, makes a fundamental distinction between the two relations. Kehler argues that all coherence relations belong to three general categories: cause-effect relations, resemblance relations and contiguity relations. One of the cause-effect relations Kehler identifies is *violated expectation* which corresponds to *denial of expectation*.

> *Violated Expectation:* Infer P from the assertion of S_0 and Q from the assertion of S_1, where normally $P \rightarrow \neg Q$.

An example of a sentence pair between which this relation exists is:

(78) Bill was about to be impeached, but he didn't call his lawyer.

Kehler gives two definitions of contrast. In the first, exemplified in (79), the relations expressed by the utterances are contrasted. In the second definition, exemplified in (80), a set of parallel entities is contrasted.

(79) Gephardt supported Gore, but Armey opposed him

(80) Gephardt supported Gore, but Armey supported Bush

In Kehler's categorization of coherence relations between sentences *contrast* is a subtype of the resemblance relation, in contrast to *violated expectation* which is categorized as a cause-effect relation. Another advocate of distinguishing between the two relations is Malchukov (2004) who argues that there are languages that use different markers to express the different relations.

On the other hand, many scholars argue that the two relations can be captured by one definition (e.g. Winter and Rimon (1994), Foolen (1993), Spenader (2004)). Winter and Rimon (1994) argue that both types of the contrastive conjunction p *con* q are felicitous in a given context if there is a statement *r* such that p implies *not*(r) and q implies r (q denies *not*(r)). Spenader and Maier (2009) also consider both types to involve the same operation of removal of an inference from the common ground. Although they do state that semantic opposition examples usually depend more on the context than traditional denial of expectation examples.

I argue that my *explicit contrast* and *implicit contrast* share the underlying semantics that they remove information from the context. However, there is

a difference between the two relations. In the case of explicit contrast the concession *is* a partial positive or negative answer to the question or issue in the context, while in case of implicit contrast the concession evokes a pragmatic inference that is a positive or negative answer to the question in the context. To clarify this I will first elaborate somewhat on the notion *issue*.

Spenader and Maier (2009) argue that the context is very important in finding a *Tertium Comparationis.* The concession evokes a certain inference only with respect to the issue in the context. A similar restriction was argued for by Umbach (2005). Umbach too argues for one notion of contrast. However, she argues that accounts like that of Winter and Rimon, who see *but* as an indication of violated expectations (the expectation being based on default world knowledge) cannot be right. Umbach argues that a *but*-sentence is an appropriate answer to an implicit or explicit question that consists of two conjuncts of which one will be confirmed and the other one denied. Consider example (81) (Umbach 2005, p. 215).

(81) a. Adam: Did John clean up his room and wash the dishes?
b. Ben: [yes] John cleaned up his room and [yes] he washed the dishes.
c. #[yes] John cleaned up his room, but [yes] he washed the dishes.
d. #[no] John didn't clean up his room, but [no] he didn't wash the dishes.
e. [yes] John cleaned up his room, but [no] he didn't wash the dishes.
f. [yes] John cleaned up his room, but [no] he skipped the washing-up.
g. [no] John didn't clean up his room, but [yes] he did the washing-up.

If the answer to both conjuncts of the question in (81) is positive, as in (81c), using *but* instead of *and* is not felicitous. If the answers are both negative, as in (81d) *but* cannot be used either. Only if the answer to one of the conjuncts is positive, while the other is negative, *but* is perfectly acceptable. Umbach distinguishes between four classes of *but*-conjunctions: (i) the subjects of the conjuncts are the same and the predicates differ from each other, (ii) the predicates are the same and the subjects differ from each other, (iii) both subjects and predicates are different yet comparable and (iv) subjects and predicates are not comparable to each other, we have to compare entire propositions. In the last case, exemplified in (82), the entire propositions in the conjuncts are alternatives with respect to each other. Sentence (82a) and (82b) are answers to the question in (82c). In (82a) one part of the question is explicitly negated, in (82b) it has to be reconstructed (Umbach 2005, p. 219).

(82) a. It is raining but we are not going to stay at home
b. It is raining but we are going to go for a walk
c. Is it raining and are we going to stay at home?

Let us now return to the analysis of *wel*. While Umbach (2005) argues that a contrastive relation is established in answer to a twofold question[4], Spenader and Maier give a singular question as an example of an issue. I think the difference between a twofold question as an issue and a singular question as an issue is precisely what distinguishes between explicit and implicit contrast. Consider example (83).

(83) *Piet deed de afwas niet maar John* ***wel***
Piet did the dishes not but John WEL
'Piet didn't do the dishes but John did'

Can we analyze the explicit contrastive relation in the conjunction in (83) as an answer to the question: *Did John do the dishes*? In that case this question would be the issue, the first conjunct would be a concession and the second conjunct the denial. However, I think there are two distinct interpretations of this sentence, namely the explicit contrastive reading (when the sentence answers the question *Did Piet and John do the dishes?*) and the implicit contrastive reading (when the sentence answers the question *Did John do the dishes?*). Getting the implicit contrastive reading requires some effort and I think even a different intonation. I therefore assume that there are indeed two types of contrast, which share the property that they remove information from the context.

In line with Umbach (2005), I argue that two conjuncts that establish an explicit contrastive relation (with *wel*) are answers to a twofold question (*are Piet and John coming*) or one question that entails two questions (*Is your band coming?* entails *Is Piet coming?* and *Is John coming?*). However, then it cannot be the case that the first conjunct evokes some inference *r* and the second conjunct evokes or is the negation of *r*. If you ask: *Komt je band*? 'Is your band coming' and the answer is *Piet komt niet* 'Piet is not coming' *maar John komt wel* 'but John ís coming', you cannot argue that Piet's not coming raises the

[4] Here I should also mention Jasinskaja and Zeevat (2009) who analyze the relation I call explicit contrast as an answer to a question containing two *wh*-elements of which one is *whether*. The relation I call implicit contrast is analyzed as an answer to a question containing the *wh*-elements *why* and *whether*.

expectation that the band is *not* coming while John's coming implicates that the band *is* coming. That is, the overall answer to the question must still be: no, the band is not coming. This is similar for a twofold question: *Komen Piet en John?* 'are Piet and John coming?' with the answer *Piet komt niet maar John komt wel* 'Piet is not coming but John is'. The overall answer (if there is any) must still be that no, the couple Piet and John is not coming.

I argue that in the case of an explicit contrastive relation a question (an issue) like *Did Piet and John do the dishes?* suggests that Piet and John are similar with respect to the predicate *doing the dishes*[5]. There is a reason why something is questioned about a group of individuals simultaneously. A question *Are Piet and John coming?* is not felicitous if Jan en Piet have nothing in common that is relevant with respect to the question of their coming or not. The semantics of questions is often said to be the set of possible answers. This is defined by Krifka (1999) as follows:

(84) The meaning of a question […WH…] is the set of propositions denoted by […α…] where α ranges over the sort of the question constituent WH

In case of a polarity question the truth value of the proposition could be seen as the question constituent. Therefore, the meaning of the question *Did Piet and John do the dishes?* is the set of possible answers {*Piet did the dishes and John did the dishes, Piet did the dishes and John didn't do the dishes, Piet didn't do the dishes and John did the dishes, Piet and John didn't do the dishes*} but I think the implicated meaning is the set of the two answers {*Piet and John did the dishes, Piet and John didn't do the dishes*} because Piet and John are questioned together. If we assume a two-fold question as the issue of this contrastive relation, what should be considered the concession and the correction? One could argue that because of the first conjunct *Piet didn't do the dishes,* the expectation is evoked that John didn't do the dishes either, because they are assumed to be the same. However, in that case the first conjunct cannot be analyzed as a concession because it answers a different question (the first conjunct would then answer the question *Did Piet do the dishes?* whereas the second conjunct would answer the question *Did John do the dishes?).* The first conjunct can not function as the issue to the second conjunct either because

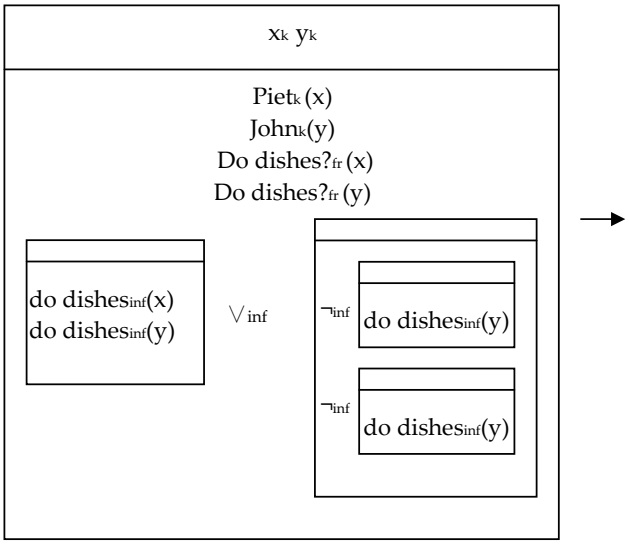
[5] Note that, although I use elements of the analysis of Umbach (2005) and Jasinskaja and Zeevat (2009), at this point my analysis crucially deviates from theirs since they do not assume such an inference.

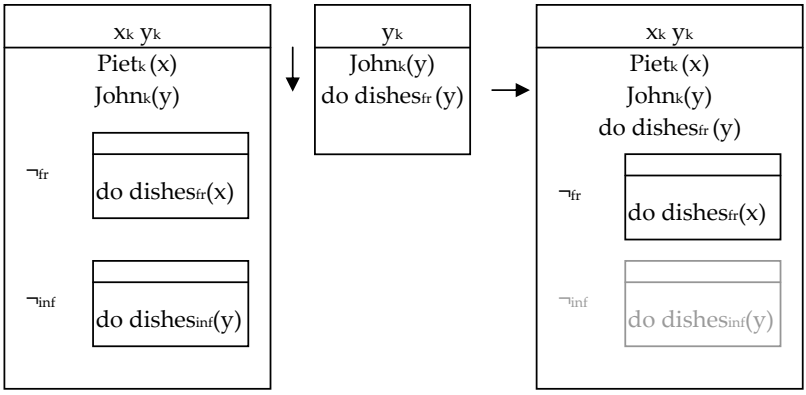
then there would be no issue against which the first conjunct evokes the negation of the second conjunct. If both conjuncts are analyzed as answers to the same question (*Did Piet and John do the dishes?*) the first conjunct can be analyzed as a concession to the assumption that Piet and John are similar (with respect to doing the dishes). That is, the first conjunct on its own does not suggest that Piet and John are similar but at this point it is still a possibility. Furthermore, the concession further specifies this suggestion. Whereas before the first conjunct two possible answers are suggested {*Piet and John did the dishes, Piet and John didn't do the dishes*}, after the first conjunct this is narrowed down to {*Piet and John didn't do the dishes*} and it is this suggestion that is removed from the inference layer by the use of *wel*. This procedure is illustrated in (85).

(85)

Piet	*deed*	*de*	*afwas*	*niet*	*maar*	*John*	***wel***
Piet	did	the	dishes	not	but	John	WEL

'Piet didn't do the dishes but John did'





In conclusion, the difference between explicit and implicit contrast is that in the case of implicit contrast, the issue is a singular question and the concession evokes an inference based on the issue and world-knowledge. In case of an explicit contrast, the issue suggests two possible situations which are narrowed down to one by the concession. Note that for explicit contrast the inference is not only suggested to be true it is also already partly confirmed. The inference *Piet and John didn't do the dishes* is already partly confirmed by the utterance that *Piet didn't do the dishes*. So part of it is already present in the Fregean layer. Note that the part in the Fregean layer does not have to be removed because the new information is not in conflict with just this part.

3.3.3.3 *Wel* as surprise

Wel indicating surprise marks that the speaker suspected the negation of the proposition expressed by the sentence containing *wel*. This suspicion is not based on the current discourse but rather on more general expectations about the world.

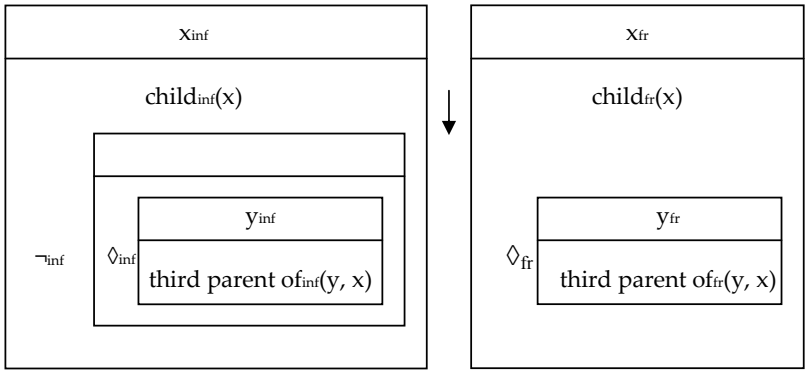
Zeevat (to appear) discusses *only* as a mirative particle. He argues that *only* indicates surprise by the speaker about the small size of a particular quantity. The semantics of mirativity is defined as a presupposed expectation that is asserted to be false. Zeevat argues that mirative markers

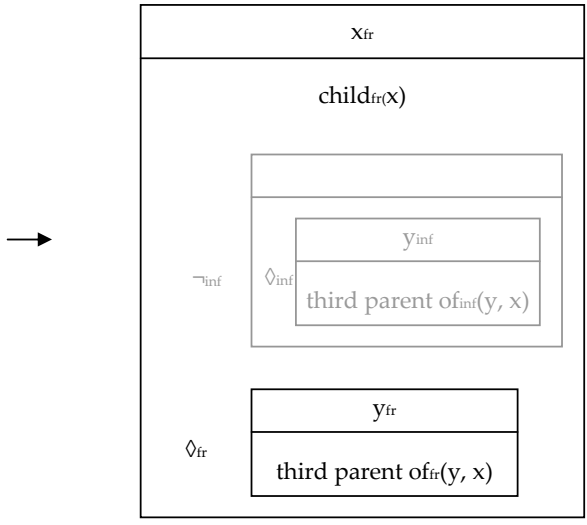
can be used for corrections but the expectation may also be much weaker than the belief of the speaker (or the common ground, or of a second speaker). Zeevat argues that *only* triggers a weak presupposition (p. 3): "The presupposed expectation can be common ground, it can be the speaker's or the hearer's or they can be the expectation of a third party or a possible third party. The weakest possible expectation is "there might be somebody who might think that A". The presupposition mechanism tries to find the weak presuppositions in the common ground and in the opinions of highly activated persons, but also allows suggestions and attitudes by other people as antecedents and can in the last resort just assume that there could be someone who accepts the weak presupposition".

According to Zeevat, the notion weak presupposition can be implemented by a variant of regular presupposition. When a weak presupposition occurs, the context is searched for accessible antecedents. Only now two additional possibilities for antecedents are added. The first new option is the possibility to find antecedents in subordinate contexts which are introduced by positive attitude and modal operators. The second option is that the antecedent can be inferred from the context. The hearer should search for a reason to think *not p* by looking for an *r* such that *if r then normally not p.* If even the last two options provide no suitable antecedent, the uncontroversial "it might be thought that p" might be added to the context, instead of normal accommodation or a failure of the update.

Wel also marks surprise and could therefore be classified as a weak presupposition trigger. We saw that *wel* as a marker of implicit contrast removes an inference from the LDRS and as such can also be classified as a weak presupposition trigger. *Wel* as a marker of surprise is weaker because the inference it denies is not caused by the discourse thus far but by more general knowledge about the world. Nonetheless, this information is part of the common ground. The nature of this common ground, however, is such that it is less dependent on the particular conversation. The same information may be common ground in all conversations of people who share the same world view or culture. I propose to formalize this type of presupposition as a default inference. Default inferences bear the same label as inferences made on the basis of a particular proposition. The difference lays in the fact that *wel* as surprise is not dependent on a certain issue, nor is there a concession. To illustrate this modification of the common ground, let us look at example (55), repeated here as (86).

(86) *Een kind heeft een moeder en een ouder een tweede*
A child has a mother and a parent a second
*ouder en misschien nog **wel** een derde voor mijn part*
parent and maybe PRT WEL a third for my part
'A child has a mother and a parent and another parent and maybe even a third as far as I'm concerned'





As we saw, for the contrastive relation, the immediate context (the issue) is very important. Furthermore, in case of contrast, a concession is present which suggests an *r* or a *Tertium Comparationis.* When *wel* marks surprise, these two requirements are not met. Therefore, it cannot be said to mark a contrastive relation. However, the fact that it does remove an inference shows that it bears family resemblance to this relation.

3.3.3.4 *Wel* as a modifier

The last use of *wel* differs fundamentally from the aforementioned uses since it does not involve retraction of any information from the context. The contribution containing this *wel* constitutes a monotonic update of the common ground. Nonetheless, I assume this use of *wel* shares the core-meaning of a denial of a negation because its pragmatic effect is similar to that of a double negation, or litotes (e.g. Horn 1989, Blutner 2004). Interestingly, in case of a double negation the first negation often functions as contradictory negation and the second as a contrary negation; (not unhappy = contradictory (contrary (happy))) (Horn 1989). A denial always forms a contradictory opposition with the proposition being denied. This indicates that this use of *wel* indeed constitutes a denial of a negation. I suggest this can be analyzed as having two negations in the Fregean layer, which then brings about the pragmatic effect as described in section 2.2.5.

3.3.3.5 Conclusion

I have argued that the different functions of the discourse particle *wel* share a core-meaning, namely that they are a denial of a negation. Adapting an LDRT framework, I showed that four of the five functions of *wel* involve retraction of some information from the context. Crucial to the use of *wel*, is that this information contains a negation. The last use of *wel* functions as a denial of a negation within one turn in conversation and has a pragmatic effect on the meaning of the utterance. In section 3.3.3.3, I referred to Zeevat's notion of weak presupposition. In the next section I will show that all the uses described in this section can be viewed as weaker versions of *wel* as correction marker.

3.3.4 Wel and semantic strength

Incidentally, I have used the terms weak and strong to describe the different uses of *wel*. Intuitively, it seems clear that the uses of *wel* differ in strength. The relation correction is more important for conversation than the use of

wel as a modifier. In this section I will show that the uses of *wel* differ with respect to their logical strength. Meaning A is logically stronger than meaning B, if meaning A entails meaning B where A entails B if B is true in every situation in which A is true. The notion semantic strength is among others used by Krifka (1995). Krifka uses $\subseteq$ to express the relation of semantic strength; $\alpha \subseteq \beta$ means that α is at least as strong (or specific) as β. This means for example that: *carrots* $\subseteq$ *vegetables* and *everyone who ate vegetables got sick* $\subseteq$ *Everyone who ate carrots got sick.* The strength of a use of *wel* depends on how much it presupposes. The more features there must be present in the context for *wel* to be uttered felicitously, the stronger this use of *wel*. I will make this explicit by showing that every element that is presupposed by a weaker use of *wel* is also presupposed by a stronger use of *wel*.

The weakest use of *wel* as a modifier presupposes nothing. The denial and the negation are introduced by the same utterance. The use of *wel* as a marker of surprise in *wel*(p), presupposes an inference $\neg p$. For *wel* as a marker of implicit contrast it also holds that an inference $\neg p$ is presupposed, but an additional requirement is that a proposition q can be found in the context such that $q \rightarrow \neg p$, where the arrow is used here to indicate a relation of inference (and not implication). *Wel* as a marker of explicit contrast is even more dependent on the context. Like *wel* indicating implicit contrast, it presupposes an inference that follows from the issue and a proposition q. Furthermore, the inference is partly confirmed by the proposition q. The utterance that expresses this proposition can be recognized by the fact that it either has the same subject as the utterance containing *wel* or it has a reversed predicate, that is, the same predicate but negated. The use of *wel* as a correction presupposes the proposition $\neg p$. Note that when a proposition $\neg p$ is present, this also trivially satisfies the requirement of an inference $\neg p$, since we can assume that any formalization of the inference relation will yield that $\neg p \rightarrow \neg p$. The utterance that expresses the proposition $\neg p$ has the same subject as the sentence containing *wel* and the reversed predicate.

Now, we can define the uses of *wel* as follows. Note that every stronger use of *wel* has an extra feature compared to the next strongest use.

- *Wel* marks *correction* in an utterance U_1 which expresses the proposition Px if there is a previous utterance U_2 that expresses the proposition Qy such that P = ¬Q and x = y (and the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue).

- *Wel* marks *explicit contrast* in U_1 which expresses Px if there is a U_2 which expresses Qy, such that P = ¬Q or x = y and the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue

- *Wel* marks *implicit contrast* in U_1 if there is a U_2 such that the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue.

- *Wel* marks *surprise* in an utterance U_1 if the proposition expressed by U_1 denies a negative proposition that was inferred.

- *Wel* is used as a modifier if it functions as a denial of a negation within one utterance

With the definitions of the relations as given above, *correction* entails *explicit contrast* which entails *implicit contrast* which entails *surprise*. Every element that is presupposed for a use of *wel* is also presupposed for all stronger uses. In the next section I will show how this hierarchy in the uses of *wel* contributes to the interpretation of the particle.

3.3.5 Conclusions

In this section I have shown that the uses of *wel*, although very diverse at first sight, all function as a denial of a negation. Furthermore, the uses are organized in a hierarchical manner; each use of *wel* is constituted by a subset of the features of the strongest use of *wel*, the correction.

3.4 The interpretation of *wel*

In the previous sections I argued that there is a hierarchy in the different meanings of *wel*. In this section I will show that this hierarchy is of crucial importance for the interpretation of the word. It has been argued that people prefer to interpret words in the strongest possible way. I will begin this section by discussing some of the work in which this claim is advocated.

3.4.1 The role of strength in interpretation

It has been argued that when a form has multiple possible interpretations, hearers will choose the strongest interpretation that is consistent with the

context. This was formulated by Dalrymple, Kanazawa, Mchombo and Peters (1994) as the Strongest Meaning Hypothesis, which accounts for the interpretation of reciprocals:

> (SMH) The Strongest Meaning Hypothesis
>
> A reciprocal sentence is interpreted as expressing the logically strongest candidate truth conditions which are not contradicted by known properties of the relation expressed by the reciprocal scope when restricted to the group argument.

To fully understand this principle I think it is necessary to say more about the analysis of reciprocals by Dalrymple et al. (1994). Dalrymple et al. assume that reciprocals express a single polyadic quantifier that binds two variables in its scope, both variables ranging over one set, the restricted domain of the quantification. This means that the sentence *Tom, Dick and Harry saw each other* expresses a proposition that might be symbolized as:

$\text{RECIP}^{\{\text{Tom, Dick, Harry}\}}$x, y saw(x, y)

The meaning of a quantifier is a relation between sets *A* of members of the universe of discourse and two place relations *R* on the universe of discourse. Dalrymple et al. distinguish three possible meanings of reciprocals (based on Langendoen 1978 and Kański 1987).

> **Strong reciprocity**: every member of A is related directly by R to every other member ($\forall x, y \in A$ ($x \neq y \rightarrow Rxy$)). For example: *Willow School's fifth graders know each other*.
>
> **Intermediate reciprocity**: every member of A is related directly or indirectly to every other member via the relation R ($\forall x, y \in A$ ($x \neq y \rightarrow$ for some sequence $z_0, \ldots, z_m \in A$ (x= $z_0 \wedge$R $z_0\ z_1 \wedge \ldots \wedge$R $z_{m-1} z_m \wedge\ z_m$ = y)). For example*: the telephone poles are spaced five hundred feet from each other*.
>
> **Inclusive alternative ordering**: every member *x* of the set *A* participates with some other member in the relation *R* as the first or as the second argument, but not necessarily in both roles ($\forall x \in A\ \exists y \in A$ ($x \neq y \wedge$ ($Rxy \vee Ryx$)). For example: *Mrs. Smith's third-grade students gave each other measles.*

Following from these descriptions, the following is true with respect to the three meanings: Strong reciprocity ⊆ intermediate reciprocity ⊆ inclusive alternative ordering. This means that conditions under which the first meaning is true are stricter than the conditions under which the second meaning is true which are stricter than the conditions under which the third meaning is true. According to the SMH, the hearer interprets a reciprocal with the strongest meaning that is compatible with the context.

Winter (2001) extends the SMH to cases of plural predication that do not involve reciprocity to account for the difference in interpretation of (87) and (88) (Winter 2001, p. 338-340):

(87) a. The birds are flying above the house and below the cloud
b. Every bird is flying above the house and below the cloud

(88) a. The birds are flying above the cloud and below the cloud
b. #Every bird is flying above the cloud and below the cloud

While (88a) can be roughly paraphrased as *some birds are above the cloud and others are below it*, in (87a) such a reading is not available. Therefore, the strong reading evoked by *every* in (87b) is similar to the meaning in (87a), whereas (88a) clearly makes a weaker claim than (88b). Winter argues that plural predicates get a strong interpretation when this is possible with respect to world knowledge. Where a strong interpretation is not possible, the meaning is weakened. Winter proposes the Extended Strongest Meaning Hypothesis (Winter 2001, p. 342):

> A plural predicate whose meaning is derived from one or more singular predicates is interpreted using the logically strongest truth conditions that are generated from one basic meaning and that are not contradicted by known properties of the singular predicates(s).

Both Dalrymple et al. and Winter admit there are some loose ends with respect to the SMH. For example, the SMH would predict that the reciprocal in sentence (89) would mean Inclusive Alternative Ordering but instead it means Strong Reciprocity and is necessarily false (Dalrymple et al., 1994)

(89) #Those two people are each other's mother

Another problem is sentence (90):

(90) The boys are tickling each other.

This sentence does not necessarily mean that every boy tickles every other boy, although this is possible with respect to our world knowledge. Winter suggests this is due to a gap in our world knowledge with respect to predicates like *to tickle*; although it can happen that a boy tickles more than one object, this might not be the default assumption about the predicate. Despite these complications, I agree with Dalrymple (1994) et al. and Winter (2001) that the SMH is more plausible than the suggestion by for example Langendoen (1987) that there is a weak basic meaning that may be strengthened by context due to general processes of conversational implicatures. The best argument against strengthening and for a weakening approach is given by Dalrymple et al. (1994). Conversational implicatures are highly ad hoc but there are only a couple of possible stronger interpretations of a reciprocal sentence. It is not clear how pragmatic principles could function in such a way that they always yield one of this set of possible stronger interpretations.

3.4.2 Presupposition and strength

Recall the description of presupposition: A sentence A presupposes sentence B if the speaker of A automatically commits herself to the truth of B. A sentence will only have a truth value if all the propositions it presupposes are true. If the presupposed information can be found in the context, the presupposition is said to be bound by an antecedent. Otherwise, the hearer must resort to *accommodation*. Geurts (1995) formulates the following principles with respect to anaphor resolution.

(i) If a presupposition can both be bound or accommodated, there will in general be a preference for the first option, and
(ii) If a presupposition can be accommodated at two different sites, one of which is subordinate to the other, the higher site will, ceteris paribus, be preferred.
(Geurts 1995, cited in Blutner 2000: 14)

Based on principles proposed by Geurts, Blutner (2000) proposes two constraints for a (Bidirectional) OT treatment of presupposition. The constraints reflect the preference for binding over accommodation of presuppositions and the idea that speakers prefer stronger information over weaker information. Here as well, the notion of strength is based on an

entailment relation. The constraints are AVOID ACCOMMODATION (AVOIDA), which counts the number of discourse markers that are involved in accommodation and BE STRONG, which evaluates input-output pairs with stronger outputs higher than pairs with weaker ones. Their ranking is AVOIDA >> BE STRONG.

Zeevat (2002) makes use of the same constraints to analyze the interpretation of discourse particles. Recall from section 3.2.2 that Zeevat (2002) analyzes discourse particles as a specific set of presupposition triggers. However, discourse markers are not prototypical presupposition triggers because they do not accommodate, they take unexpected antecedents and they cannot be omitted. Zeevat therefore proposes three adaptations to the existing theories on presupposition. The first is to liberalize the set of allowed antecedents. The second is to assume a generation constraint and the third is to embed this in Bidirectional Optimality Theory. I will now discuss the second and the third proposal.

Generation constraints are constraints that the human generator tries to optimally satisfy when constructing a sentence on the basis of its semantics. Zeevat argues that for *too* a generation constraint PARSEOTHER is needed that forces the marking of the presence of an entity of the same type in the context. A similar constraint is PARSEOLD, a constraint that forces the marking of material already in the context as old material. *Indeed* is an example of an element that does this. In a Bidirectional Optimality Theoretic framework the generation constraints are combined with the two constraints proposed by Blutner (2000), AVOID ACCOMMODATION and BE STRONG. The combination of the constraints on production and the constraints on interpretation results in the following principle:

> If a presupposing expression has simple non-presupposing alternatives, it does not accommodate.

In this situation, the impossibility of *too* to accommodate is a consequence of the existence of the simpler expression alternative where *too* is omitted. Recall example (7) repeated here as (91) (Zeevat 2002, p.3).

(91) John is having dinner in New York too.

The simpler alternative would be the same sentence without *too*. *Too* therefore behaves differently from a presupposition trigger like *regret*, as in (92).

(92) Bill regrets that John is having dinner in New York.

Sentence (92) does not have simple expression alternatives without *regret* because in contrast to *too*, *regret* does make a strong semantic contribution to an utterance.

In the next section I will address the question how hearers come to an interpretation when they encounter an occurrence of *wel*. In line with the literature discussed in this section, I will argue that hearers interpret an occurrence of *wel* with the strongest interpretation that is compatible with the context.

3.4.3 The interpretation of wel

In the previous sections I described the range of possible meanings that *wel* can express. We saw that the strongest meaning of *wel* can be described by a set of features (*wel* marks *correction* in an utterance U_1 which expresses the proposition Px if there is a previous utterance U_2 that expresses the proposition Qy such that P= ¬Q and x = y and the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue). The weaker uses of *wel* are all constituted by a subset of these features. In this section I will discuss the interpretation of *wel*. It should be noted that the interpretation of *wel* can also be influenced by the stress it is pronounced with. Hogeweg (2009) indicates that the stronger meanings of *wel* are expressed with more stress than the weaker uses of *wel*. However, in this section I will ignore the contribution of stress and simply assume that the stress is in accordance with the context. I will argue that the set of features that forms the interpretation of a particular occurrence of *wel*, is also determined by two possibly conflicting sources of information, formalized as two constraints in Optimality Theory.

My analysis concerns OT Semantics, first described by Hendriks and de Hoop (2001) and de Hoop and de Swart (2000). In OT semantics the input is an utterance and the output is an interpretation of that utterance. Zwarts (2004) was one of the first to apply this mechanism to the field of lexical semantics. Zwarts (2004) argues that a mechanism similar to the Strongest Meaning Hypothesis plays a role in the interpretation of the polysemous preposition *(a)round*. Zwarts models the different meanings in terms of sets of paths. A path is defined as a sequence of *vectors* located with their starting point in one common origin. The prototypical meaning of *(a)round* is a set of paths that have certain properties. This set of paths is labeled Circle. The features that characterize a prototypical, circular path are the following:

Completeness: A path is complete if it has a vector pointing in every direction in a plane

Constancy: A path is constant if all the vectors are of the same length

Uniqueness: A path is unique if every vector is unique with respect to its direction

However, often *(a)round* does not describe a perfectly circular path. Sometimes *(a)round* describes the properties Inversion or Orthogonality:

Inversion: Two of the path's vectors point in *opposite* directions, the path is at least a half-circle

Orthogonality: Two of the path's vectors point in *perpendicular* directions, the path is at least a quarter-circle

Note that circular paths also have the features Inversion and Orthogonality. The properties Inversion and Orthogonality are weaker versions of the property Completeness. Other uses of *(a)round* can be described by the property Detour:

Detour: The direct distance between a path's starting point and end point is smaller than the length of the path measured along the path

Another characteristic is Loop, which follows from the property Detour.

Loop: The path's starting point and end point are identical

The prototypical meaning of *(a)round* has all the above properties. Note that some properties are weaker or implied by others. When only paths with the property Constancy are considered, the ordering of the properties is as follows, from stricter to weaker or from longer to shorter paths along a circle.

Loop = Completeness > Inversion > Orthogonality > Detour

Zwarts argues that the meaning of *(a)round* that is chosen is preferably the strongest, the most prototypical meaning that is compatible with the context

in which it is used. He formalizes this idea by means of two constraints in Optimality Theory, FIT and STRENGTH.

> FIT: Interpretations should not conflict with the (linguistic) context.

FIT is a markedness constraint that favors interpretations that do not conflict with the (linguistic) context over ones that do. If a possible interpretation does not fit the conversation or the context, according to this constraint it will not emerge as the optimal interpretation for the given utterance.

> STRENGTH: Stronger interpretations are better than weaker interpretations.

STRENGTH expresses that we should interpret utterances in the strongest way (also compare Blutner 2000, Zeevat 2004). STRENGTH could be seen as a faithfulness constraint that favors more prototypical meanings over less prototypical meanings. The following Tableau visualizes the optimization process of the interpretation of *(a)round* for the input *round the door*. The candidates are ordered according to their strength. The weakest candidate Detour violates STRENGTH three times because there are three possible stronger interpretations. Completeness or Loop does not violate STRENGTH because there is no stronger candidate. Completeness or Loop does violate FIT. The other candidates do not violate FIT. Note that when a candidate is compatible with the context, all weaker candidates will not violate FIT either. Because FIT is ranked higher than STRENGTH, the second candidate is the optimal output interpretation for the input *round the door*.

Input: *round the door*	FIT	STRENGTH
Loop or Completeness	*	
☞ Inversion		*
Orthogonality		**
Detour		***

Tableau 1: Optimization of the interpretation of *(a)round*

3.4.4 Wel and the interaction of STRENGTH and FIT

Similar to the preposition *(a)round,* the particle *wel* has several related meanings that can be ordered according to their strength. I therefore argue

that the same two constraints determine the interpretation of *wel*. In the previous section I described how the various uses of *wel* differ in strength. Regarding that strength the following hierarchy exists in the interpretation of *wel*.

> Correction >> Explicit contrast >> Implicit contrast >> Surprise >> Modifier

Consider sentence (93).

(93) *Het feestje was* ***wel*** *leuk*
the party was WEL nice
'The party was fun/OK'

According to STRENGTH, the hearer of (93) must interpret *wel* with the strongest interpretation, 'correction'. However, the candidate interpretation 'correction' will violate FIT if in the context of (93) no contradictory information is asserted, namely that the party was not fun. After 'correction', 'contrast' is the strongest interpretation. If there is statement that something else (e.g. the dinner) was not fun, interpreting *wel* as creating contrast would be compatible with the context and therefore would not lead to a violation of FIT. In that case, 'contrast' would be the optimal interpretation, as is illustrated in Tableau 2.

'Het feestje was *wel* leuk'	FIT	STRENGTH
Correction	*	
☞ Contrast		*
Implicit contrast		**
Surprise		***
Modifier		****

Tableau 2: The optimization of the interpretation of *wel*

Note that the interpretations 'implicit contrast', 'surprise' and 'modifier' are not in conflict with the context either, since the information that is presupposed by the use of *wel* indicating 'contrast' entails the information that is presupposed by the uses 'implicit contrast', 'surprise' and 'modifier'.

However, the lower ranked interpretations violate the constraint STRENGTH more often.

Let us now return to the Willem Oltmans-example from the beginning of this chapter, repeated here as (94):

(94) *Willem Oltmans zal **wel** in stilte begraven worden*
Willem Oltmans will WEL in silence buried become
'Willem Oltmans will be buried in silence'

The discussants did not interpret *wel* as a correction because there was no previous sentence in the article that stated that Willem Oltmans would not be buried in silence. The forum members tried to find a fitting context for the contrastive reading. One discussant put forward the idea that the word indicated that Willem Oltmans would *not* be put on display in the Arena stadium, in contrast with André Hazes. Another person suggested that the way he would be buried was contrasted with his rather turbulent life. Finally someone suggested that the word *wel* indicated a contrast between the fact that he would be buried in silence and the fact mentioned in the previous sentence that a public website had been created where people could offer their condolences. The discussion nicely illustrates the interaction of STRENGTH and FIT. The discussants tried to create a fitting context for the contrastive interpretation. The discussants who considered a previous utterance suitable to form a contrastive relation with (94), interpreted *wel* as a marker of that contrast. This interpretation is visualized in Tableau 3.

'Willem Oltmans'	FIT	STRENGTH
Correction	*	
☞ Contrast		*
Implicit contrast		**
Surprise		***
Modifier		****

Tableau 3: The optimal interpretation of the Willem Oltmans-example

For a discussant who found none of the previous sentences suitable to form a contrastive relation with (94), 'contrast' is in conflict with the context. This discussant would be forced to adopt a weaker interpretation. The interpretation of *wel* as indicating probability seems a plausible option in

this case, because of the presence of the verb *zullen* 'will'. This would result in an interpretation like 'Willem Oltmans will probably be buried in silence'. This is illustrated in Tableau 4.

'Willem Oltmans'	FIT	STRENGTH
Correction	*	
Contrast	*	*
Implicit contrast	*	**
Surprise	*	***
☞ Modifier		****

Tableau 4: The optimal interpretation of the Willem Oltmans-example 2

3.4.5 Conclusions

Despite the variation in the meaning of *wel* I discussed in the previous section, the interpretation of *wel* in a context causes no problem (most of the time). In the previous section we saw that the different uses of *wel* vary in strength according to the nature of negation they react on. Regarding that strength a hierarchy exists in the interpretation of *wel*. The constraints STRENGTH and FIT make hearers pick the right interpretation within that hierarchy. STRENGTH favors strong interpretations over weak interpretations and FIT favors interpretations that fit the context over interpretations that are in conflict with the context. FIT is ranked higher than STRENGTH, due to which a weaker non-contradictory meaning wins over a stronger contradictory meaning.

3.5 Reconsidering STRENGTH and the connectionist connection

In the previous section we saw that the outcome of an interpretation process is the result of the interaction between STRENGTH and FIT. A candidate interpretation violates the constraint STRENGTH with as many violations as there are stronger candidates. What is not explicit in the definition of this constraint is that the strongest meaning is preferred *of the set of meanings that are normally associated with the form*. Consider again Tableau 1, repeated here as Tableau 5.

Input: *round the door*	FIT	STRENGTH
Loop or Completeness	*	
☞ Inversion		*
Orthogonality		**
Detour		***

Tableau 5: The optimization of the preopsosition *round*

In Tableau 5, only those candidates are represented that are possible interpretations of the preposition *round*. However, in chapter 2 we saw that in Optimality Theory, GEN generates an unlimited amount of candidates. The set of candidates therefore also includes meanings which are not normally associated with *a(round),* for example 'completeness or loop at a height of two meters'. This interpretation of *round* is compatible with the context in a sentence like *the bird flew round the tree*. Since this meaning is also stronger than just loop or completeness, the constraints as defined in the previous sections predict that the interpretation 'loop or completeness at a height of 2 meters' will be optimal in this situation.

Input: *the bird flew round the tree*	FIT	STRENGTH
☞ Loop or completeness at two meters		
Loop or Completeness		*
Inversion		**
Orthogonality		***
Detour		****

Tableau 6: reconsidering STRENGTH

One way to solve this issue is by introducing an additional constraint that penalizes candidate interpretations that are not normally associated with the form under consideration. However, I think this problem is naturally resolved when we think of form meaning relations as associations between words and semantic features, as was argued for in Chapter 1 and 2. The semantic features that are associated with *(a)round* are defined by Zwarts (2004) as: LOOP (= COMPLETENESS), INVERSION, ORTHOGONALITY and DETOUR. I propose to reformulate STRENGTH in such a way that it pertains only to the set of features that are associated with the form under consideration.

STRENGTH: interpret features that are associated with a form

The constraint STRENGTH now combines to well-known faithfulness constraints from phonology: MAX, which requires all input segments to have output correspondence, and DEP, which prohibits output segments with no input correspondence.

Now let us look again at the optimization process that was illustrated in Tableau 6. For the candidate interpretations that are linked to the form *a(round),* the violation pattern stays the same. The candidate INVERSION lacks one feature that is associated with the form in the input and hence this candidate violates STRENGTH once. ORTHOGONALITY and DETOUR lack respectively two and three features and hence violate STRENGTH two and three times. The first candidate does express all features associated with *(a)round* but it also expresses a feature that has no relation to it and therefore it violates STRENGTH once. Note that nothing has changed with respect to the candidates that are relevant given a certain form. However, now the same constraint that determines the optimal candidate within this relevant set, also rules out features that are not associated with a form.

Input: *the bird flew round the tree*	FIT	STRENGTH
Loop or Completeness at two meters		*
☞ Loop or Completeness		
Inversion		*
Orthogonality		**
Detour		***

Tableau 7: reconsidering Tableau 6

This formulation of STRENGTH naturally relates to connectionism, as described in chapter 2. As we have seen in chapter 2, Sharkey (1988) presents 'knowing a word' as associating a set of features (say, 'has wings' and 'flies') with a word label (*bird*). He argues that when there are more features present in the world, there can be more confidence with respect to the correctness of the label. The constraint STRENGTH works in the other direction, the label *bird* is given and the output is an interpretation. The form

wel and the form *(a)round* are associated with a set of features. Hearing the word will activate these features. This leads to a particular activation vector. I argue that the interpretation of a word used in a particular context is represented as the tensor product of the vector realizing the context and the vector representing the features that are activated by the form. Taking the tensor product of a vector **v** with *n* elements and a vector **w** with *m* elements creates a new factor **v** ⊗ **w** with *n* times *m* elements, which have labels of two tags *i* and *j*. The elements are all possible products $v_i w_j$ of an element of **v** and an element **w**. In general, the realization of a binding of a filler **f** to a role *r* is the tensor product of the vectors **f** and **r f/r= f** ⊗ **r**. The filler is realized as a pattern of activity f over a set of filler units $\{\sim f_\phi\}$ and the role is realized as a pattern of activity r over a set of role units $\{\sim r_\varrho\}$. The binding of the filler and role unit is realized by a pattern of activity **f/r** over a set of binding units $\{\sim b_{\phi\varrho}\}$. The activity of the binding unit is the activity of the filler unit times the activity of the role unit. So we can say that if $\sim b_{\phi\varrho}$ is active, the interpretation is that the feature represented by $\sim f_\phi$ is present in a filler of a role that possesses the feature $\sim r_\varrho$. This means that the activation of a node in a vector realizing the binding of two other vectors may indicate the presence of an identifiable feature in the entity being represented (Smolensky 2006).

Translated to the case of *wel* and *(a)round,* a semantic feature will only be interpreted if it is activated in the vector that realizes the binding of the vector realizing the context and the vector realizing the semantic features that are associated with the form. This means that the representation of the interpretation of *wel* and *(a)round* receives input from two sources, the context and the semantic features that are activated by the form. The form will always activate all features associated with it. So if this were the only source of information, the strongest meaning would always be optimal. However, if a corresponding feature is not present in the context, the feature will not be present in the output vector. This outcome is predicted by the interaction of STRENGTH and FIT. Optimality Theory is based on connectionist mechanism. By showing that the OT-constraint STRENGTH is compatible with or maybe even follows from a connectionist architecture, the argument for its existence is strengthened.

3.6 Conclusions

I began this chapter with a report of a forum discussion about the meaning of *wel*. The discussants argue about the function of *wel* in a particular sentence. In this chapter I described the range of possible interpretations of

wel. Although they seem very diverse at first sight, they have in common that they all function as a denial of a negation. In contrast to what the forum discussion may suggest, the interpretation of *wel* is normally unproblematic. How do hearers know which of the possible meanings was meant by the speaker? In this chapter, I showed that there is a hierarchical relationship between the interpretations of *wel.* The uses of *wel* differ in strength and hearers have a preference for stronger over weaker interpretations. However, hearers also prefer a coherent discourse. Therefore, a weaker meaning that fits the context wins over a stronger meaning which is in contradiction with the context.

The two forces are represented by two constraints in Optimality Theory: STRENGTH and FIT. FIT expresses that interpretations may not be in conflict with the (linguistic) context. STRENGTH expresses that stronger meanings are better than weaker meanings. I reconsidered STRENGTH by seeing this constraint as representing a connection between forms and semantic features.

Chapter 4
Making the link between form and meaning

4.1 Introduction

In chapter 3, I distinguished several meanings that *wel* can express. The job of a hearer of an occurrence of *wel* is to choose between the possible interpretations. Of course, language users are not born with a list of possible interpretations of a word. This knowledge has to be acquired. In this chapter I will examine how language learners create a link between a form and the appropriate semantic features and what role the input and the context play in this process.[1]

Children acquiring language have to build up the lexicon by mapping the words they hear to the appropriate meaning. In this chapter, I look into the factors that play a role in the acquisition of the different uses of the particle *wel,* which I distinguished in chapter 3. The content of the lexicon depends on the input children get. After all, if a child never encounters a certain word, she can never relate it to a meaning. This may suggest that the frequency with which a particular use of *wel* occurs in the input influences the order of acquisition. However, the hierarchical relation between the several uses, as discussed in chapter 3, may influence the pattern of acquisition too since the stronger uses are more informative and more prominent than the weaker uses. By comparing the use of the particle *wel* by children with the use of *wel* by adults I will investigate which factors determine the acquisition of the range of meanings expressed by *wel*.

I will begin this chapter by discussing different views on how children acquire the lexicon of their language. What strategies do children bring into action in figuring out the meanings of the words they hear around them? And what determines the order of the acquisition of the words in a lexicon? What problems arise for the acquisition of polysemous words? I section 4.2, I will address these questions and the answers that have been proposed in the literature. In section 4.3, I discuss the pattern with which *wel* is used by adults and children. I will show that there is a striking difference between

[1] This chapter is partly based on work reported on in Hogeweg and van Gerrevink, (2008). Whenever I use *we* in this chapter, I refer to van Gerrevink and myself.

the two patterns, which raises a number of questions. Those questions are addressed in section 4.4. In this section, I will propose an analysis within the framework of Harmonic Grammar that can account for the data.

4.2 The acquisition of meaning

Which words children learn depends on which words children hear. The nature of the input is therefore an important factor in the acquisition of the lexicon. This does not mean, however, that the most frequent words in adult speech are automatically acquired first. Tomasello (2003) notes that the words *the* and *a* are among the most frequent words adults produce, yet they are not acquired particularly early. This means that other factors play a role in the acquisition of word meaning as well. This section presents a (partial) overview of those factors. In 4.2.1, I discuss a number of principles that have been claimed to guide word learning. Section 4.2.2 discusses two opposing views on language acquisition. The two theories each propose one basic principle that underlies the different constraints discussed in section 4.2.1. The two principles are *association* and *social-pragmatic behavior*. In section 4.2.3, I discuss the connectionist view on language acquisition, which is very much related to the associationist view. Section 4.2.4 discusses a relatively new insight in the field of language acquisition, namely that words are learned cross-situationally. I will end this section by discussing the specific problems that may rise in acquisition of polysemous words.

4.2.1 Constraints on word learning

Imagine a situation in which a linguist tries to learn a language by means of the interaction with native-speakers. One of the informants utters the word *gavagai* at the moment a rabbit passes by. The linguist hypothesizes that *gavagai* means 'rabbit'. However, other translations are possible too. The word *gavagai* could have been used to refer to the color of the animal, its position or some specific part of it. By hearing the word in other situations and questioning informants, the linguist can gain more certainty about the meaning of the word. However, she can never get conclusive evidence that she has learned the correct meaning.

The problem described above was introduced by Quine (1960) as the *indeterminacy of translation*. We could say that learners of a first language are faced with a similar problem. Presented with a novel word, children have, theoretically speaking, an infinite set of possible meanings to choose from. How are children able to know that *ball* refers to an object rather than to its

shape, the particular color of the ball or to its superordinate *toy*? Because children usually seem to figure out quite well what is meant by a word, it has been suggested that language learners have innate principles that guide the word-learning process. The most important of those principles will be discussed in the subsequent sections.

4.2.1.1 The noun advantage

It has been noted that children prefer to interpret novel words as objects and, related to this, that many of their earliest words are nouns. Several principles have been proposed to account for this observation. Gentner (1982) formulates the *Natural Partitions Hypothesis*. This hypothesis holds that the linguistic distinction between nouns and predicate terms is based on a pre-existing perceptual-conceptual distinction between on the one hand concrete concepts, such as persons or objects, and on the other hand concepts of activity, change of state or causal relations[2]. Consequently, the category of concepts expressed by nouns is simpler and more basic than the category expressed by predicate terms. Gentner argues that the child's task is to match 'the stream of perceptual-cognitive information in the world' to 'the stream of language being spoken'. Due to saliency or stability, concrete concepts are easier to separate from the stream of information in the world than concepts of activity, change of state or causal relations. Consequently, children learn the words for those concepts first.

Gentner's hypothesis goes against the *Linguistic Determinism Hypothesis* (Whorf 1956), which would argue that the conceptual difference between referents of nouns and predicates is the result and not the source of the linguistic distinction. In order to find evidence for her Natural Partitions Hypothesis, Gentner (1982) investigates the earliest words of an American-English learning boy, Tad. The words Tad uttered were divided into four categories according to their meaning: *nominal terms* (which refer to objects or persons), *predicate terms* (which refer to, amongst others, actions, properties and changes of states), *expressive terms* (which directly express a feeling, e.g. *ouch*, or which are part of a ritual, e.g. *bye bye*) and finally *indeterminate term*s (whose referents could not be determined unambiguously).

[2] Gentner (1982) makes a distinction between object reference and predication. Predicates can refer to states, actions, relationships or attributes. The corresponding syntactic contrast is between nouns and a composite predicate category composed of verbs, prepositions, adjectives and adverbs.

Gentner found that the set of words that were learned by Tad at 11 to 13 months consisted nearly completely of nominal terms. Only one word could be classified as a predicate referring to a property (*yuk*), but it might also have been used as an expressive term. The nouns that were learned by Tad were mostly names for specific objects or persons. At 18 and 19 months, Tad acquired two predicates referring to a property (*hot* and *happy*). The first predicates referring to a change of state (*down* and *up*) also appeared at 19 months. Based on these findings, Gentner claims that children learn nouns before other forms because their referents are more accessible. Object-reference terms have a highly transparent semantic mapping to the perceptual-conceptual world. Their referents are particularly coherent and stable. Verbs and other predicates are more difficult to acquire because they have a less-transparent relation to the perceptual world.

The preference for object reference terms has also been demonstrated in experimental settings. Markman and Wachtel (1988) conducted several experiments to test whether children use certain constraints to eliminate potential word meanings. Two of the experiments showed that children have a preference to interpret novel words as referring to objects, rather than to the material the objects were made of. In the first experiment, children of age 3;0 to 4;5 were taught a new substance term *pewter* for either a familiar or an unfamiliar (pewter) object. 92% of the children that were presented with a familiar object, a (pewter) cup, rejected *pewter* as the word for 'cup'. However, 58% of the children that were presented with the unfamiliar object, a (pewter) tong, interpreted *pewter* as referring to the object, despite the fact that an inappropriate form class was used (the article was omitted). In an additional experiment, children of age 3;3 to 4;1 were each taught two new substance terms, *rattan* and *chrome.* The children were asked e.g. "See this? This is rattan. Can you say rattan?" while being presented with an unfamiliar object (a rattan crescent-shaped container or a chrome pair of tongs) or a familiar object (a rattan hat or a chrome cup). It was tested whether children generalized the newly learned word to similar objects of a different material or to different objects of the same material. Again, Markman and Wachtel (1988) found that in the unfamiliar object condition, children were likely (75% of the time) to interpret *chrome* or *rattan* as referring to the object, despite the improper grammatical form. This bias for objects in word learning is referred to as the *Whole Object Assumption* by Markman (1992).

In addition to a preference for objects over properties in the acquisition of new words, children seem to realize from very early on that words denote taxonomical categories rather than thematic categories. Markman and

Hutchinson (1984) were puzzled by this observation because children younger than seven often group objects by thematic relationship in object sorting tasks. For example, children would rather group a dog and a bone together than a dog and a cat. Markman and Hutchinson therefore argue that we are faced with the following paradox: children seem to learn concrete nouns that refer to object categories (like "ball" or "dog") easily despite the fact that they tend to notice and remember thematic relations between objects more readily than categorical relations. As a solution to this paradox, Markman and Hutchinson (1984) propose that children have implicit hypotheses about the possible meanings of words. This means that, although young children have a preference for thematic relations in other circumstances, they shift their attention to a taxonomic organization of objects when they are learning new words. There is a weak and strong version of their proposal. The strong version entails that the hypothesis about possible word meanings helps children in the identification of new categories. Upon hearing a novel word children will look for a category to function as the meaning of the new word. If no previously unnamed category is available, children will form a new categorical relation to label. The weak version of their proposal holds that children use the hypothesis to link a word to a category they already know.

To test (especially) the weak version of their hypothesis, Markman and Hutchinson conducted four experiments. The first experiment tested whether children in the age of 2;5 to 3;11 would look for thematic relations between objects when no novel word was offered and for categorical relations when presented with a new word. The categories that were tested in the experiment were of a basic level (for example 'dog' or 'chair') rather than of a superordinate level (like 'animal' or 'furniture') In the no word condition, the children were shown a picture of an object and were asked to 'find another one that is the same as this' while being presented with a picture of a categorical related object and a thematic related object. In the novel word condition they were told the name of the object, a meaningless one-syllable word like *sud*, and were then asked to 'find another *sud*'. Markman and Hutchinson found that in the no-word condition children chose a categorically related member 59% of the time, which is not significantly different from chance. In the novel-word condition children chose the category member in 83% of the times, which is significantly different from chance and from the no word condition.

In a second experiment, older children were tested (age 4;4 to 5;3). In this experiment, the categories were of a superordinate level. For example, the children were shown a picture of a pig and a picture of a cow to form the

superordinate category 'animal'. The results were that in the no word condition, children chose the categorical related object in 49% of the trials. In the novel word condition, they chose the categorical related object in 69% of the cases. Experiments 3 and 4 were similar to 1 and 2 with some adjustments. While in experiment 2, the no word condition was designed to promote as much categorical choices as possible, in experiment 3 the choice was made more neutral. This change resulted in a lower percentage of categorical choices in the no word condition (25%). In the novel word condition this percentage was 65. Experiment 4 was designed to rule out one possible explanation for the data, namely that children simply translate the novel word into a word they already know. In order to test this, children were shown pictures of abstract objects and the experimenter described the categorical or thematic relations between the objects to the children. The results were similar to the result of experiments 2 and 3. The children selected the category member in 37% of the trials in the no word condition and in 63% of the trials in the novel word condition. Markman and Hutchinson argue that the results of the last experiment show that children use abstract knowledge about words rather than specific known meanings to facilitate taxonomic responding.

Based on the results of the four experiments Markman and Hutchinson (1984) conclude that children indeed have implicit hypotheses about the possible meanings of words. Furthermore, they suggest that linguistic input may help the child in organizing her conceptual structure.

The studies discussed in this section suggest that the infinite list of possible word meanings is constrained by the initial assumption that a word refers to an object or rather to an object category. An additional constraint on the acquisition of word meaning that is discussed in the literature is known as the *Principle of Contrast*.

4.2.1.2 The Principle of Contrast

It is sometimes argued that children implicitly assume that there is one word for every concept. Clark (1987) formulates this as the *Principle of Contrast*. The Principle of Contrast entails that whenever there is a difference in form in a language, there is a difference in meaning. This principle is stated by Clark (1987) as follows (p. 2):

> *The Principle of Contrast*: every two forms contrast in meaning

In Clark's view, this principle is a property of language. It is an essential principle because it helps maintain the *Principle of Conventionality* (Clark 1987, p. 2).

> *The Principle of Conventionality*: for certain meanings, there is a conventional form that speakers expect to be used in the language community.

The Principle of Contrast makes the following three predictions concerning language acquisition (Clark 1987, p. 10).

1. Children assume words contrast in meaning.
2. Children give priority to known words.
3. Children assign novel words that they hear to gaps in their lexicon, and, to fill such gaps, they coin new words to themselves.

Clark puts forward several types of evidence to support the three hypotheses. Evidence for the first prediction is found in the narrowing down of over-extensions. Sometimes children over-extend words by for example using *dog* to refer to cats or other animals. However, as soon as the child acquires the word *cat,* she will stop using the word *dog* to refer to this animal. Evidence for the second prediction is found in the rejection of multiple labels for the same concept. Children are often unwilling to accept a second word for something, even if this second label is a superordinate or a subordinate of the first. For example, children might reject the word *animal* for a dog because they have already learned the label *dog*. Evidence for the third prediction comes from several experiments that show that children interpret a novel form as referring to something they do not have a label for yet. Furthermore, Clark argues that children invent words when they want to express a concept for which they have not yet acquired the conventional form.

A constraint similar to the Principle of Contrast was also tested in the aforementioned experiments by Markman and Wachtel (1988). Markman and Wachtel performed a series of experiments to find out whether children make use of a constraint called *Mutual Exclusivity*. This constraint holds that each object has only one label and each label can refer to only one category of objects. Parts of the results of the experiments were already discussed in the previous section: the children rejected a novel form for an object if they were already familiar with the appropriate word for it. The series of experiments also tested whether children (age 3;0 to 4;3) would reject a novel

term as the name for an object for which they already new the right word (for example a telephone) in a situation where there is no other obvious object around to label. Furthermore, Markman and Wachtel wondered whether this situation would motivate children to search for a salient part of the object to label (for example the receiver of the telephone). They found that when a novel word is presented in the context of a previously unlabeled object, children often linked the new term to this object (80%). However, if no previously unlabeled object was around, children understood the word as referring to a salient part of the familiar object in 57% of the cases.

Markman and Wachtel (1988) conclude that the principle of Mutual Exclusivity is a helpful constraint for children in acquiring a lexicon but that they eventually learn the correct exceptions. In an early period children may reject the word *vehicle* for a car but later they will learn that *vehicle* is a superordinate term. The Mutual Exclusivity principle thus differs from the Principle of Contrast in that the former is a temporary assumption about language made by children while the latter is property of language itself. Furthermore, the existence of subordinate and superordinate terms is a violation of Markman and Wachtel's principle of Mutual Exclusivity but it is not a violation of Clark's Principle of Contrast. Similar (but slightly different) principles have also been proposed by Slobin (1973) as the *Principle of One-to-One Mapping* and Pinker (1984) as the *Uniqueness Principle*.

In this section, I discussed a number of principles that constrain the interpretation of novel words. What may have become apparent is that one's view on acquisition is partly dependent on one's perspective with respect to a basic matter, namely the order of development in word learning. Is it the case that first a concept is created upon which the appropriate word for it is learned? Or is it the case that children hear a new word upon which they create a concept? Explicit adherents of both views can be found. I will lay out their argumentations in the next section.

4.2.1.3 The order of linguistic and conceptual development

Johnston and Slobin (1979) clearly choose the position that language follows cognition. They argue that there is always a temporal gap between the emergence of a concept in a child and her command of the proper means of expressing this concept. The duration of this lag depends on the complexity of the form to be acquired and may therefore differ cross-linguistically. To support their claim they investigated the acquisition of seven basic locative relations among English, Italian, Serbo-Croatian and Turkish children. The relations that were tested were 'in', 'on', 'under', 'beside', 'between', 'back'

and 'front', with 'back' and 'front' subdivided into two types, denoted $back_f$/$front_f$ (used for reference objects with inherent fronts and backs, such as people and cars) and back/front (for reference objects with no inherent fronts and backs such as trees and drinking glasses). Based on the conceptual complexity of the relations, Johnston and Slobin expected the following order of conceptual development:

In/on/under < beside < $back_f$/$front_f$ < between < back/front

However, another aspect that is of influence on the order of acquisition is the relative saliency of the concepts. A child is more likely to explore and communicate about some aspects of the world than about others. For example, 'back' may be a more salient notion than 'front' because children tend to focus on disappearing and inaccessible objects. On this basis, Johnston and Slobin further specified the predicted order of conceptual development.

In/on/under < beside < $back_f$ < $front_f$ < between < back < front

The languages under consideration use different strategies to denote the spatial relations. While English, Italian and Serbo-Croatian use prepositions, Turkish uses postpositions. Furthermore, the languages differ with respect to the degree to which there is one-to-one mapping between forms and the seven spatial meanings. To see whether these cross-linguistic differences affect the order of acquisition, English, Italian, Serbo-Croatian and Turkish children were examined for their use of terms expressing the seven locative meanings. Thirty-six children in the age range of 2;0 to 4;4 were tested twice with an interval of four months. Johnston and Slobin (1979) found that the order of acquisition included both cross-linguistic differences and similarities. The exact order of acquisition was language specific but there was also a general order, which was found in each of the languages. This order was the following.

In/on/under/beside < $back_f$ < $front_f$ /between < back/front.

Furthermore, Johnston and Slobin found that the correct use of an adposition is often preceded by a period in which an old form is used to express the new meaning. According to Johnston and Slobin, this shows that children first develop a concept and only later learn the appropriate way of encoding it. They illustrate this procedure by their *waiting room metaphor*. Children first

develop a concept based on their cognitive development, rather than on linguistic grounds. This concept then enters the 'waiting room' where the task of the child is to tackle semantic and morphologic-syntactic problems in finding out the language-specific way of expressing this concept.

A different position is taken by Smith (2003, 2005). Smith stresses that learning a lexicon is not just a matter of mapping the right word to one of a set of predefined meanings. An important part in the acquisition of a language is the construction of meaning. Smith (2005) puts forward a computational model of language acquisition in which agents learn the meaning of signals through cross-situational statistical learning. The model consists of three levels of representation, namely an external environment (which provides the motivation for and source of meaning creation), an agent specific internal representation of meaning (which is not accessible by others) and a set of signals which can be transmitted between agents. The interaction between agents starts with an agent choosing an object from the environment to be the target of the discrimination game. The agent searches its sensory channels to find a *distinctive category*, that is, a semantic representation that describes the target but not any other object in the context. This process of meaning creation is carried out by each agent individually, so agents may create different, but mostly equally successful representations of the world. To communicate about the environment an agent utters a signal to express one of the meanings that were created. The hearer interprets the signal, and learns its meaning based on the current context and his previous experience with the form.

A similar model was tested in the talking heads experiment (Steels 1999). In this experiment agents built up a lexicon by playing guessing games. During the game agents alternately play the role of the speaker and the hearer. The speaking agent moves around in a room and chooses a particular context (a part of the room), thereby restricting the objects it can talk about. The speaking agent thereupon chooses an object to which it refers with a sound. The hearing agent who is informed about the context then points to the object it thinks the speaker is referring to. The game succeeds if this is the object the speaker intended. Note that the agents do not get explicit information about the meanings of words; they only know whether a signal leads to the selection of the same object. Based on this guessing game Lenaerts and de Vylder (2006) speak of a semiotic triangle, illustrated in Figure 1.

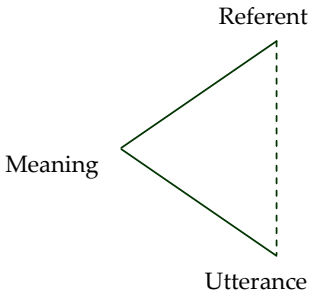


Figure 1: semiotic triangle (Lenaerts and de Vylder 2006, p. 266)

An interaction between a speaker and a hearer is called a semiotic cycle by Lenaerts and de Vylder. The speaker starts from an object and associates a meaning with it, upon which this meaning is expressed by a word. The hearer takes the opposite direction. The hearer starts with the word and associates a meaning with it. The meaning, together with the context determines the choice for an object.

In sum, where the waiting room metaphor puts emphasis on children's desire to find expressions for concepts they have learned, Smith (2005) and Steels (1999) assign more importance to the action of interpreting forms in a context. The wish to interpret words in a given context may lead to the creation of meaning.

Recall from the experiments by Markman and Hutchinson (1984) that children generalize a novel word to objects that are similar in some way rather than to objects that occur in the same event or context. Based on their findings, Markman and Hutchington hypothesized that children have implicit knowledge about the meanings of words. They distinguished between a weak and a strong version of their hypothesis. The strong version entails that coming across a new word leads children to create a new category if no previously unlabeled category is available. The weak version of the hypothesis holds that children link a new word to a category they already know. If no familiar, unlabeled category is available, nothing happens. Markman and Hutchinson suggested that the results of their experiments may support the strong version and speculate that young children may create categories to fit new words. The experiments discussed

in Markman and Wachtel (1988) are related to the experiments by Markman and Hutchington. Recall that Markman and Wachtel carried out a series of experiments to find out whether children can use the Mutual Exclusivity constraint to reject a novel term as a name for an already labeled object. Furthermore, they tested whether this would motivate children to search for another salient aspect of the object when there is no other obvious object around to label. They found that when a novel word is presented in the context of a previously unlabeled object, children linked the new term to this object. However, if no previously unlabeled object was around, children searched for other ways of interpreting the word. They understood the word as referring to a salient part of a familiar object or to a salient property of it.

The experiments by Markman and Hutchinson (1984) and Markman and Wachtel (1988) show that children make effort to interpret the language they hear. Furthermore, their wish to interpret words sometimes motivates learners to create new meanings. However, this does not mean that every word-meaning pair is acquired in this order. Tomasello (2003) argues that the relation between language and cognition is a 'two-way street'. On the one hand, children must be able to conceptualize aspects of their perceptual experience to recognize the appropriate way of referring to those aspects. On the other hand, linguistic forms may focus children's attention on certain aspects of experience that they would not have focused on otherwise. Gentner and Boroditsky (2001) suggest a *Division of Dominance*. They speak of cognitive dominance when 'aspects of perceptual experience form inevitable conflations that are conceptualized and lexicalized as unified concepts'. Linguistic dominance means that 'the world presents perceptual bits whose clumping is not pre-ordained and language has a say in how the bits get conflated into concepts'. Gentner and Boroditsky propose that both types of dominance apply, but to different kinds of words. They suggest a Division of Dominance, a continuum with on one edge proper names and concrete nouns, which follow cognitive dominance and on the other edge function words such as determiners and conjunctions, which follow linguistic dominance. The continuum relates to the distinction between open and closed class categories. Open class-forms mainly have denotational functions whereas closed-class-forms primarily have grammatical or relational roles. Closed-class forms are typically high frequent and polysemous and are not easily translated into another language. The division of dominance is illustrated in Figure 2.

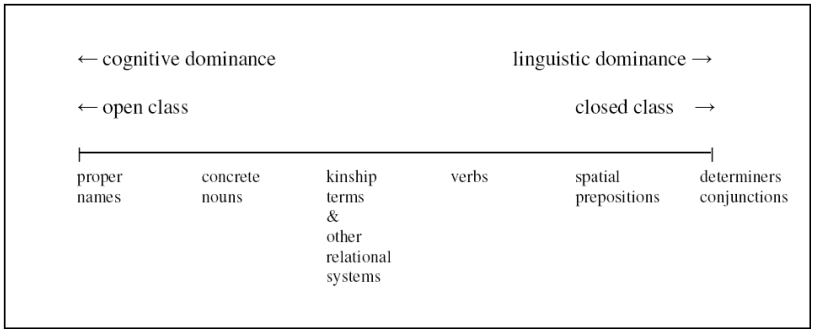


Figure 2: The Division of Dominance (Gentner and Boroditsky 2001, p. 216)

Two hypotheses follow from the Division of Dominance. The first is the aforementioned Natural Partitions Hypothesis which states that some concepts are more easily abstracted from perceptual experience than others. The second is *Relational Relativity* which states that there is much more cross-linguistic diversity in the naming of relations between entities or between names for actions than there is in the naming of objects. For verbs and other relational terms, children must therefore discover how their language combines and lexicalizes elements of perceptual experience. A schematic overview of the different hypotheses is given in Figure 3.

In conclusion, linguistic development is inextricably bound up with cognitive development and they influence each other. Certain cognitive abilities are prerequisite to be able to learn language but at the same time linguistic conventions may influence the categorization of concepts.

In this section, I have discussed several principles that are claimed to guide word learning. The views on the nature of these constraints differ. They are presented as properties of the language (Principle of Contrast) or properties of the world (Natural Partitions Hypothesis) or as basic assumptions of word-learning children (Whole Object Constraint, Assumption of Taxonomic Organization). The origin of the constraints is not always clear. Markman (1992) argues that the Whole Object Constraint, the Assumption of Taxonomic Organization and the principle of Mutual Exclusivity are not based on generalizations from language input but she does not suggest an alternative source either. She argues that the innate-versus-learned issue is much too complicated to simply choose for one or the other.

In recent years more emphasis is put on language as a component of more general cognitive abilities. In the next section I will discuss two opposing views on language acquisition that both propose one basic mechanism that underlies the acquisition of words and in terms of which constraints like those mentioned in this section can be explained.

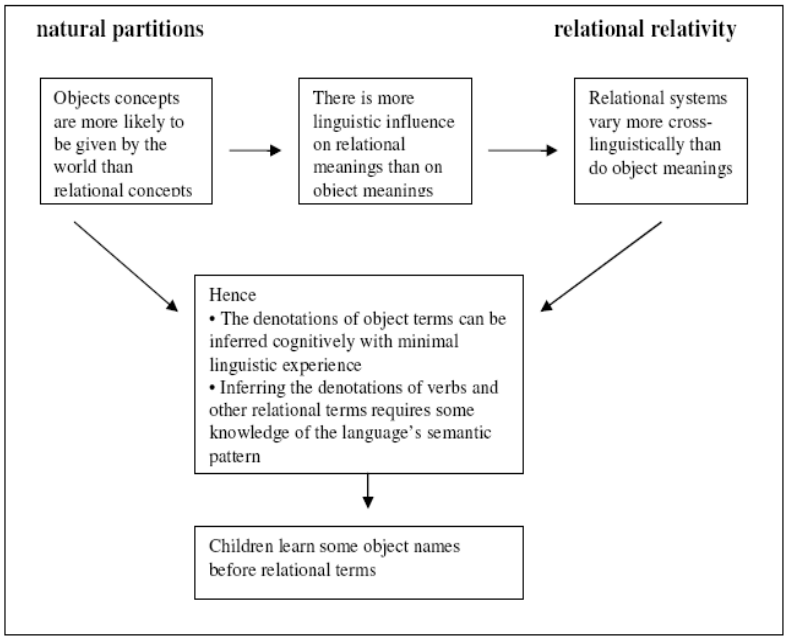


Figure 3: Natural Partitions and Relational Relativity (Gentner and Boroditsky 2001, p. 218)

4.2.2 Association versus social pragmatic behavior

In this section, two views on acquisition are introduced that regard constraints like the ones discussed in the previous sections as corollaries of a more basic cognitive mechanism. The first view on language acquisition I will discuss looks upon language as a kind of by-product of social interaction. I will call this the social-pragmatic view. The second theory claims that language acquisition occurs through a general cognitive mechanism called associative learning. Interestingly, the views on language

acquisition stand in apparent opposition. Adherents of the two views have explicitly argued against each other's explanation of certain experimental data. In this section, I will discuss both theories and their disagreements and I will show that the two positions are not entirely mutually exclusive.

4.2.2.1 A social-pragmatic view on language acquisition

Tomasello (2003) adopts a social-pragmatic view on word learning. In line with the studies I discussed in the previous section, Tomasello argues that children must be constrained in the hypotheses they consider when searching for a referent for a word. However, Tomasello argues that the majority of the information that is needed can be found in the social-interactive environments in which children learn language. To be more precise, Tomasello argues that there are two inherently constraining aspects of the word learning process: "(1) the structured social world into which children are born - full of scripts, routines, social games and other patterned cultural interactions; and (2) children's social cognitive capacities for tuning into and participating in this structural social world - especially joint attention and intention-reading (with the resulting cultural learning)" (Tomasello 2003, p.87). The first aspect entails that the presence of routines and recurring events is a prerequisite for language acquisition. If a child never saw the same object or experience the same event twice, or ever heard the same language be used in similar context, she would not be able to learn a natural language. The second aspect concerns the cognitive abilities of the child. To participate in the routines and events in her environment, the child requires the ability to focus on other people as well as on the objects they interact with and sometimes even to take another person's perspective. According to Tomasello, words are learned in so called *joint attentional frames*. Within such frames, adults often make linguistic utterances to incite children to attend to certain aspects of the shared situation. The child's effort to interpret what the adult says is based on the pragmatic assumption that the utterance is somehow relevant to the social interaction.

Note that Tomasello does not dispute principles like the Whole Object Constraint and the Mutual Exclusivity constraint but he argues that such principles cannot account for all aspects of acquisition. For instance, some of the words that are learned early lack a concrete reference. Among them are personal-social words like *hello, goodbye, please, thank you* and nouns with a more abstract reference like *breakfast, lunch, night* or *party*. Furthermore, Tomasello argues that children are equally capable of learning new verbs as learning new nouns in ambiguous referential situations. He refers to an

experiment conducted by Tomasello and Akthar (1995), which tested children's ability to determine the type of reference (an action or an object) an adult refers to with an utterance. In the experiment children saw an adult perform a nameless action with a nameless object on a special apparatus. The experiment was designed to have two experimental conditions and two corresponding control conditions. In one of the experimental conditions, the action-highlighted condition, the adults paid extra attention to the apparatus by preparing it and looking at it just before uttering a nonce word (*widget*). In the object highlighted condition the adult did not pay attention to the apparatus but looked at the object just before uttering *widget*. The two control conditions were similar to the corresponding experimental conditions except for the fact that no novel name was introduced. 36 children of age 2;0.9 to 2;6.21 participated in the experiment. In the action highlighted condition, 9 of 12 children showed comprehension of the word *widget* for the target action by performing the target action in the comprehension test (opposed to 0 children in the control condition). In the object highlighted condition, 7 of 12 children comprehended or used *widget* in association with the target object (opposed to 3 children in the control condition). According to Tomasello and Akhtar, this shows that the Whole Object Constraint can not be a strict rule for word learning children. Furthermore, they suspect, based on their findings, that if there is an object bias in language acquisition, this is the result of pragmatic reasons; objects are the focal point of much adult-infant interaction. Tomasello (2003) therefore suggests a social-pragmatic modification to the Natural Partitions Hypothesis. This modification entails that children learn new words most readily in situations in which it is easiest to read the adult's communicative intention.

The most important claim made by Tomasello (2003) is that no external-linguistic constraints are needed to explain acquisition because word learning follows from more general, foundational social-cognitive skills. Tomasello (2003) therefore argues that language is a kind of by-product of social interaction.

Tomasello contrasts his social pragmatic view with Smith's (2000) and Hockema and Smith's (2009) theory of language acquisition, which entails that the essence of word learning is associating sounds with salient aspects of perceptual experience. I call this theory the associative view and will discuss it in the next section.

4.2.2.2 An associative view on word learning

Smith (2000) and Hockema and Smith (2009) argue that children start the word learning process with no knowledge about how to categorize or link words to concepts or any knowledge that relates language to social interaction. Instead, they argue that associative learning is the fundamental mechanism that underlies language acquisition. Associative learning entails that when one perceptual cue is regularly associated with another cue, the presence of the first will automatically draw attention to the second. Because such a general basic mechanism is the driving force behind language acquisition, there is no need to postulate a special language module or a language specific acquisition device. Instead, language can be seen as an *emergent* property of the cognitive system as a whole. The term *emergence* denotes 'the creation of interesting, beautiful and/or complex higher level or 'global' patterns from systems with constituents whose behavior is governed by simple, lower-level or local rules' (Hockema and Smith 2009, p. 456).

From this view on language acquisition it follows that biases in word learning are not innate principles but are themselves the result of a learning process, based on associative mechanisms. Several experimental studies show that children can build learning biases based on statistical regularities in the input. For example, it has been shown that children tend to generalize new names to objects similar in shape rather than texture or color (e.g. Landau, Smith and Jones 1988). Smith, Jones, Landau, Gershkoff-Stow and Samuelson (2002) performed a longitudinal study among sixteen seventeen months-old children to test whether this tendency is influenced by experience. The children took part in a weekly training session for a period of seven weeks. In the training session, the children were taught four novel words *wif, zup, dax* and *log*. Each word was associated with two unique objects that differed for all properties except for their shape. There was also a control group that did not undergo any training. In week eight, it was tested whether children would perform *first-order generalizations*. The experimenter showed one of the objects the child was trained with, while saying (for example) 'this is a zup'. Thereupon the experimenter asked the child to find another 'zup', letting him choose between three objects, each of which was either similar in shape, texture or color. In week nine, the children were tested for their ability to perform *higher-order generalizations*. In this test the experimenter used the same procedure, only now unfamiliar objects and new novel words were used. In addition to the tests, the parents of the children completed a vocabulary checklist in week one and week eight of the study. The results were that children in the training condition extended the

trained names to objects similar in shape in 88% of the cases, opposed to 36% of the control group. Furthermore, the children generalized novel names to unfamiliar objects by shape in 70% of the time, while this percentage was 34% in the control condition. Strikingly, the children in the testing condition showed an increase of 166% in the amounts of words they had learned outside of the laboratory, whereas children in the control condition showed an increase of only 73%. Smith et al. (2002) claim that their experimental set up mimics natural learning. Therefore, the results show not only that a bias in word learning is the result of a learning process but also that such a bias is helpful for the acquisition of the lexicon. As such, Smith et al. reason, the results offer a different approach to the *gavagai* problem, which I discussed in section 4.2.1. Instead of assuming built-in constraints on possible word meanings, Smith et al. argue that the attested biases in interpretation are the result of training or experience.

As for the interpretation of novel words, Samuelson and Smith (1998) argue that children find a referent for a new word based on general processes of perceiving, remembering and attending. Samuelson and Smith (1998) dispute the conclusions that Akhtar, Carpenter and Tomasello (1996) drew based on their experimental findings. In Akhtar et al. (1996) the role of discourse novelty in early word learning is investigated by means of two experiments. 32 children participated in the first experiment, ranging in age from 2;08 to 2;1.6. Four novel objects were used in the experiment: a lid timer, a novelty yo-yo, a small kalimba and an object that made noises when buttons on it were pressed. In the first session of the experiment, the children played with three of the novel objects. Next, the fourth novel object, the target object, was put in a transparent box together with the three objects that were played with. In the experimental condition, one of the experimenters and the parent uttered 'Look I see a modi! A modi! I see a modi in there!', while looking at the box. The control condition was the same except that no novel word was uttered (instead the experimenter uttered: 'Look! Look at that!'). In the last session of the experiment, the children played with all four objects. In the testing procedure, the children were presented with the four objects and were asked to show or give the *modi*. Furthermore, an elicitation test was carried out, asking the children 'What is this called?' while showing them the target object. The results were that 8 children out of 16 children of the experimental group showed comprehension of the novel word, against 2 children in the control group. Furthermore, five children from the experimental group produced the word *modi* spontaneously or through elicitation, while this number was zero for the control group. Akhtar et al. argue that the results are an indication that

children use novelty to the discourse context as a cue in learning a new object label. There are two ways in which novelty may play a role. The *egocentric account* would be that the children's attention was drawn to the object at the same time as they heard the novel word, and they associated the two as a result. The *non-egocentric account* would be that children understood something about how adults use words. The children understood that if the adult wanted to label one of the other objects, it would have done so during the playing session. Or the child knew that people generally get excited about new things, which would also lead her to the target object as the referent of the novel word. To rule out the egocentric account a second experiment was conducted.

48 children in the age range from 2;0.5 to 2;1.20 participated in the second experiment. There were four sessions in which each child played with one novel object (a brightly colored wooden ratchet, a novelty top, a set of connected blocks with bells inside and a wooden toy that wobbled when rolled on the floor). During the fourth session one of the experimenters and the parent left the room. After the fourth period the experimenter and the parent returned and looked at the four objects while uttering a novel word ('Look, I see a gazzer! A gazzer!'). The control condition was again the same except for the fact that no novel word was uttered. Thereupon the child played with all four objects and in the last session of the experiment the objects were put together again and the child was asked to 'get the gazzer'. In this experiment, an additional elicitation test was carried out as well. Akhtar et al. found that reliably more children from the experimental group picked the object that was played with in the fourth session than children from the control group (10 out of 24 against 4 out of 24). Seven children produced the novel name in the experimental condition against zero in the control condition. Akhtar et al. argue that an egocentric explanation cannot account for the results of the second experiment. The children interpreted *gazzer* as referring to the fourth object because the child believes that an adult will name a novel object for a child when they first jointly encounter it. In this case the child knew that the speakers had not previously seen the fourth object because they had left the room before it was introduced. Therefore, Akthar et al. argue that this experiment shows that the children took into account the novelty to the discourse from the point of view of the speaker.

Samuelson and Smith (1998) dispute the conclusions drawn by Akhtar et al. based on the results of the experiment described above. Samuelson and Smith argue that it is not necessary to ascribe knowledge about referential intentions to children because the results can be explained by the contextual

nature of memory and attention. Remembering is largely dependent on the context in which the event is encoded and in which the event is retrieved. Attention is generally caught by novel events that are not predicted by and do not match events in the memory. Samuelson and Smith therefore argue that the results as reported by Akhtar et al. (1996) were caused by the fact that the fourth object was made more salient by a change in the context. In order to substantiate this claim, Samuelson and Smith replicated the second experiment of Akhtar et al. with some crucial differences. 48 children ranging in age from 18.2 months to 28.2 months participated in the experiment. Four novel objects were used: hardened clay painted purple in an irregular pipe-like shape, wood covered with orange plastic grating roughly in a ladle-like shape, a hollow cardboard cone with irregular cut-outs painted with glittery green sand and yellow cotton batting formed into a tunnel-like shape. In the first part of the experiment, the child played with three of the objects on the floor. Next, the experimenter invited the child over to a table covered with a glittery blue tablecloth, where the child played with the fourth object. Thereupon, the four objects were put in a box and the experimenter looked at the child while saying 'There's a gazzer in there. A gazzer.' Then, the child played with the four objects on the ground for a short period, before the experimenter put all objects in a transparent box, held it out to the child and uttered 'One of these is a gazzer. Can you give me the gazzer?'. For the control condition, the procedure was identical except that the initial naming event did not occur. So, the set-up was very similar to that of Akthar et al. The target object was made more salient than the other three objects by changing the context in which it occurred. However, in the experiment by Samuelson and Smith the experimenter that performed the testing had never left the room. The results of this experiment were nearly identical to results of Akhtar et al. In the experimental condition, 13 of the 24 children picked the target object in the comprehension task (opposed to five children in the control group). There was no elicitation task performed but one of the children in the experimental group spontaneously used *gazzer* to label the target object.

Samuelson and Smith argue that their results show that a shift in context is enough to create higher attention to the target object at the moment of naming. As a result the target object is easier to retrieve when hearing the name again. Furthermore, they argue that the social-pragmatic explanation is circular and unconstrained: 'the only evidence that children might believe that earlier distinctive play with an object, makes that object the later intended referent by the speaker is the finding that children pick the distinctively played with object as the intended referent' (p. 100).

Furthermore, the processes Samuelson and Smith claim to be responsible for the results have been shown independently to influence memory and attention. In contrast, the intention reading skills that Akhtar et al propose are questionable according to the literature that concerns the theory of mind.

In response to the claims made by Samuelson and Smith (1998), Diesendruck, Markson, Akhtar and Reudor (2004) performed an experiment to explicitly test and compare the account of Akthar et al. (1996) to the account of Samuelson and Smith (1998). Seventy children ranging from 22 months to 28 months participated in the study. The set up of the experiment was similar to the setup in the experiment of Samuelson and Smith. However, two extra variables were manipulated. The first variable was whether the object ended up at the special place on purpose or accidentally. In one of the conditions of this experiment the object to be named was "accidentally" dropped so that it rolled to the special location where the child played with it. The second variable was the involvement of the speaker doing the naming. In one condition, a puppet, which had not been present during the playing sessions, performed the initial naming session and the actual testing instead of the experimenter. In total, there were three conditions, one in which the target object was placed at the special location intentionally and in which the experimenter did the naming. The second condition was one in which the object ended up at the special location accidentally and in which the experimenter did the naming. In the third condition, the object was placed at the special location on purpose but the puppet did the naming. The results were as follows: in the experimenter/intentional condition, 10 out of 24 children picked the object that was played with at the special location. In the experimenter/accidental condition 3 out of 24 children chose the target object. Finally, in the puppet/intentional condition 1 out of 24 children picked the target object. This means that children did not infer that the novel word referred to the object played with at the special location if it ended up there accidentally or if the person naming the object did not know about the special location. The children knew that in those cases there was no pragmatic reason to single out this particular object.

Tomasello (2003) also argues against Samuelson and Smith's (1998) explanation of the aforementioned experiments. He claims that saliency cannot be considered to be the crucial factor in language acquisition if saliency is purely thought of as an inherent property of referents. Tomasello refers (amongst others) to a study by Moore, Angelopoulos and Bennet (1999). In this study they directly tested the influence of the inherent saliency of an object in comparison to a social cue. An adult looked at and labeled a

toy while another was made more salient at the same time (by being lit up or by letting it move). When asked to retrieve the object with the novel name, the 24 months old children consistently chose the object the adult was looking at and not the object that was made more salient.

Although the account I will propose is more in line with the associationist approach than with the social-pragmatic approach, I think that the two views are not necessarily incompatible. Rather, they function at a different level. Samuelson and Smith (1998) make a similar observation. They claim that the social-pragmatic view on language acquisition is incomplete. It specifies the knowledge children use in word learning but it does not specify the ways in which this knowledge comes about. Samuelson and Smith argue that a social-pragmatic account must also be explicit about how children perceive and remember complex events, for example how they know that an object encountered earlier is the same as the one encountered later. In contrast, I think a higher-level explanation for certain data can be valuable on itself. The results of the study by Diesendruck, Markson, Akhtar and Reudor (2004) make quite clear that children make use of social and interactive cues in the acquisition of word meaning. However, this knowledge can very well be the result of a learning process itself. Tomasello (2003) refers to Moore, Angelopoulos and Bennet (1999) who found that 24 months old children consistently chose the object the adult was looking at over an inherently more salient object in word-learning tasks. However, he does not mention that in this same experiment, younger children (of 18 months) only consistently chose the toy the adult was looking at, if this was also the more salient object. If there was a mismatch between the two conditions, the children were as likely to learn the word for the more salient toy as for the toy toward which the adult had turned. This indicates that children have to acquire the knowledge that relates language to social interaction.

Associative learning theories and connectionist models are tightly interwoven. Associative learning entails that when one perceptual cue is regularly associated with another cue, the presence of the first will automatically draw attention to the second. In connectionist models, a connection is formed between two processing units that are activated simultaneously, or 'neurons that fire together, wire together'. In the next section I will outline the basic connectionist mechanisms involved in acquisition.

4.2.3 Connectionism and language acquisition

Recall from the previous chapters that processing in connectionist models occurs through the propagation of activation through networks of simple processing units. In a connectionist network input is provided by activating the input units. The activation propagates along the connections until some activation emerges on the output units. The way the activation flows through the network and which output units are eventually activated depends on the strength or the weight of the connections between the units. The weights can be seen as representing the knowledge of the system and they can change driven by experience.

4.2.3.1 Neurons that fire together, wire together

One of the first learning techniques which is still influential, is the learning rule introduced by Hebb (1949). In short, this rule entails that 'neurons that fire together, wire together'. This means that if an input and output unit are activated at the same time, the weight on the link from one to the other is incremented by some value which strengthens their connection. The connection causes one neuron, if active, to activate the other. The weight adjustment can be calculated by the outer product rule. The change in a weight matrix needed for associating **i** with **o** is given by $\Delta W = \mathbf{o}\mathbf{i}^T$ (Sharkey 1988).

To get some insight into the working of this mechanism, let us see how the Hebbian learning rule works with respect to the bird-example in Chapter 2. In the example the input was a meaning and the output was a label or a word expressing this meaning. In chapter 2 we saw that the concept 'bird' was represented by two features: 'flies' and 'has-wings'. The input vector **i** contained three values that each represented a feature i.e. 'has seeds', 'has feathered wings' and 'fly'. If the features 'has-wings' and 'flies' were part of the input, the vector looked as follows.

$$\mathbf{i} = \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}$$

The output vector contained three units each representing a word label, say *bird, fruit* and *dog*. In this case, only the unit representing the word *bird* was active:

$$\mathbf{o} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

We saw that the knowledge of the relation between features in the world or concepts and word labels exists in the form of weighed connections between processing units. One set of weights that enables the association between the conceptual features 'has wings' and 'flies' and the word *bird,* is:

$$W = \begin{pmatrix} 0 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

The input pattern of features produces as an output the form *bird* with an activation level of 2.0 (Sharkey 1988).

The question that we should ask with respect to learning is: how is this matrix derived? Hebb (1949) assumed that if two cells or systems of cells are repeatedly activated simultaneously, the two become associated so that activation of one of the cells or systems will cause activation of the other. This association occurs through an increase of the weight of the connections between the cells. The weight between two processing units will increase if the two units activate simultaneously and it is reduced if they activate separately.

The weights of the connections between units that are activated simultaneously can be computed by the outer product rule (Sharkey 1988). The outer product is obtained by multiplying the output vector by the transposed input vector. An example is given below.

$$\Delta W = \mathbf{o}\mathbf{i}^T = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 1 \end{pmatrix}$$

The delta sign before the weight matrix indicates that the values represent changes in the connection weights. In more detail, the outer product is obtained as follows (Sharkey 1988):

1: set up two vectors as shown in the example above, with the output vector **o**, first and the transposed input vector $\mathbf{i}^T$ beside it to the right.

2: to create the first row of the weight matrix we take the first element of **o** and use it to multiply each of the elements of $\mathbf{i}^T$ in turn.
3: To create the second row of the weight matrix, move to the second element of **o** and go through multiplying all of the elements of $\mathbf{i}^T$ and place each product in turn in the second row of the matrix *W*.
4: Repeat the procedure until all of the elements of **o** have been used and all of the rows of the weight matrix have been created.

Every time the two patterns are activated together, the weights between them increase by the values obtained by the outer product or by a number that is obtained by multiplying the product by a small constant which causes the weight of the connections to increase more slowly (Sharkey 1988). Following the Hebbian learning rule, more complex connectionist learning mechanisms have been proposed. Some of them are self-organizing; they are variants of the Hebbian learning rule. However, systems can also be error-driven whereby feedback signals lead to weight adjustments (Munakata and McClelland 2003).

It is important to note that, whereas the associative view on language acquisition assumes language is acquired through experience only, this is not a necessary property of all connectionist models. Smolensky (1994) argues that connectionist models are characterized by the interaction of innate learning rules, innate architectural features and modification of connection strengths with experience. The relative importance of innate features and experience may differ. Nonetheless, experience is a necessary factor in the acquisition of word meanings. The association between a concept and a word becomes stronger each time they are experienced in combination. This property of acquisition is not reflected in the experiments discussed in the previous sections. In most of the experiments, a novel word was taught in a particular experimental setting. However, in recent years a line of research originated that focuses on the acquisition of language *across situations.* It is argued that children do not unambiguously interpret a novel word after the first encounter, but they use statistical evidence gained in different situations.

4.2.4 Cross-situational learning

In the previous sections, I discussed a number of constraints or mechanisms that children apply in finding the referent for a word they hear for the first time. Most of the evidence came from observations in experimental settings. However, situations in which children actually learn language are much

more complex. Usually, words are not singled out but are part of a speech stream. Furthermore, there are much more possible referents to consider in natural situations. Yu and Smith (2007) and Smith and Yu (2008) therefore argue that learning the meaning of a word happens cross-situationally. That is, words are not learned after a single encounter but across multiple encounters and learning trials. Smith and Yu argue that in every day word-learning there are typically many words, many potential referents for a word and limited cues about which word goes with which referent. In an experiment, Smith and Yu tested whether children can use statistical information to disambiguate word forms. In the experiment, 12 and 14 month old infants were taught six word referent pairs in a set of trials. In each trial, two forms and two potential referents were presented with no information about which word went with which referent. However, across trials the word-referent pairs could be defined unambiguously because every word was assigned a particular referent that was always present when the word occurred. After the training, the subjects were tested by presenting them a single word form and two potential referents, the assigned referent and a distracter. They found that the children looked significantly longer at the target referent than at the distracter. They therefore conclude that infants keep track of multiple word-reference co-occurrences. A similar result was found for adults by Yu and Smith (2007). In this study two experiments were conducted with adult word learners. Yu and Smith tried to capture the complexity and ambiguity of real word learning by presenting the adults multiple labels and multiple referents with no information about which label went with which referent. There were three learning conditions, which differed in the number of words and referents presented on each training trial (2x2, 3x3 and 4x4). Yu and Smith found that in only six minutes training time per condition, the subjects were able to discover 16 out of 18 label-referent pairs in the 2x2 condition, 13 out of 18 pairs in the 3x3 condition and 10 out of 18 pairs in the 4x4 condition. From this Yu and Smith conclude that learners use knowledge about cross-trial co-occurrences to figure out the meaning of a word. In a second experiment Yu and Smith presented subjects only with the 4x4 condition but manipulated the total number of word-reference pairs to be learned (9, 9 and 18) and the number of repetitions of each word-referent pair (12, 8 and 6 respectively). Subjects were better at the 18 word-referent condition than at the 9 word-referent condition, even though this condition had the same in-trial ambiguity, more word-reference pairs and fewer repetitions. Yu and Smith claim that the advantage lays in the fact that this trial had fewer spurious correlations, that is, fewer co-occurrences of wrong word-referent pairs. They argue that herein lays the

power of the system: "even when the referent of a word cannot be determined on any single trial, across trials involving many different words and many different potential referents, the word and the referent will occur more systematically than others" (p. 12). As a possible underlying mechanism for this cross-situational learning Yu and Smith suggest three options: 1) a simple associative process that counts the number of co-occurrences on test trials and chooses the object most strongly associated with the test word, 2) a more complicated associative model that includes competition and inhibition of competing associations and 3) statistical learning that explicitly compares alternative hypotheses and rules out wrong hypotheses. Yu and Smith conclude that more research is needed to determine which one of the three models is most accurate.

Cross-situational learning has also been applied in several simulations of the acquisition or evolution of language, like the aforementioned model of Smith (2003, 2005). Smith (2003, 2005) puts forward a computational model of language acquisition in which agents learn the meaning of signals through cross-situational statistical learning. A crucial property of this model is that meanings are not predefined, but they are to be inferred from the context. The model consists of three levels of representation, namely an external environment (which provides the motivation and source for meaning creation), an agent specific internal representation of meaning (which is not accessible by others) and a set of signals which can be transmitted between agents. The agents in the model create a semantic representation of the world, which in their case consists of a set of objects which can be objectively described in terms of a set of feature values. A speaking agent uses a signal to refer to one of the objects. The hearing agent interprets the signal on the basis of the current context and its previous experience with the signal in other contexts. The lexicon of the agents in the model consists of a count of co-occurrences of signal-meaning pairs <s, m>. Based on the number of co-occurrences the probability P(m|s) can be computed. Each time an agent encounters a signal, it builds a hypothesis set based on the current context. By comparing the hypothesis sets from different occurrences, agents can eventually determine the unique referent of the signal.

In this section, I discussed some studies that point at the importance of experience with words in different situations. The studies show that, in determining the referent of a novel form, both infants and adults make use of the experience they have with previous encounters of the word in other contexts. Furthermore, Smith (2003, 2005) shows that artificial agents can be taught to communicate by making them use statistical knowledge obtained

in different situations. Although it may not be clear how statistical knowledge is used precisely, we can conclude that humans are able to use and compare information provided by the current context and information from previous experience.

So far I have discussed word learning in situations in which there is a one-to-one mapping between forms and meanings. However, in the previous chapters we saw that this is not always the case. The absence of a simple one-to-one mapping between word and meaning may complicate the acquisition of the meaning of a word. I would therefore like to end this section with a discussion about the acquisition of polysemous words.

4.2.5 The acquisition of polysemous words

The studies I discussed so far in this chapter are mainly about the acquisition of words with unambiguous referents. As discussed in Chapter 3, the particle *wel* is polysemous. Does the fact that there is no simple one-to-one mapping between word and meaning complicate the acquisition of the meaning of a word? Many of the studies on polysemous words have focused on prepositions. I will discuss the results of these studies in this domain below.

For some reason, the acquisition of the multiple senses of the preposition *with* has been the subject of much investigation. The first to investigate this was Tomasello (1986). He investigated the acquisition of several prepositions of one child, his daughter Travis. Travis' parents kept a diary of her language from age 1;00 until her second birthday. From the material that was gathered, all prepositions were extracted. Tomasello distinguishes 7 relations that are expressed by prepositions (p. 82):

> **Locative**: designation of spatial relationship e.g. one object being on or over another, or an object being at a location
> **Directional**: designation of spatial relationship between a source and a goal e.g. a car headed to Mexico or for Mexico
> **Comitative**: designation of relationship of accompaniment in an activity e.g. someone going with someone to the store
> **Dative**: designation of relationship between an action or transfer and an animate goal e.g. someone giving something to someone
> **Benefactive**: designation of relationship of 'for the sake of' e.g. to do something for posterity or for Frank
> **Instrumental**: designation of relationship of instrumental support e.g. doing something with a knife or by memory

Genitive: designation of relationship of possession or 'belongingness' e.g. the day of the festival

Travis started using prepositions from age 1;5. The first prepositions that were learned by Travis were four pairs of spatial oppositions: *up-down, on-off, in-out, over-under.* The prepositions were first used in holophrastic combinations. For example, Travis started to use *down* at age 1;5.15 in combination with the verb *fall*. *Up* was first used by Travis at age 1;5 in the phrase *up-here*. *On* and *off* were first used as holophrastic requests for putting clothes on and taking them off. The prepositions were mostly used in a verb-like manner, which means that they were used to request or comment on an activity (like being picked up) or as adverb-like location words. The other prepositions that Travis used during her second year of life were: *with, by, to, for, at* and *of*. They were generally used after the spatial oppositions, although some of them have spatial senses as well.

Tomasello argues that this head start of spatial prepositions is not due to their cognitive simplicity relative to other concepts that are expressed by prepositions. Recall the waiting room metaphor by Johnston and Slobin (1979), from section 4.2.1.3. This metaphor entails that a linguistic form might appear later relative to other forms, either because the concept it denotes develops earlier (cognitive development) or because some characteristics of adult use makes acquisition more difficult for the child (linguistic factors). Tomasello argues that the cognitive hypothesis is very hard to prove. Furthermore, several prepositions denoting spatial concepts were acquired late despite their apparent relative cognitive simplicity. Therefore, Tomasello argues that the reason for the early acquisition of the spatial prepositions is the fact that they were used in a particular manner by the adults from which Travis received the input. They were used as one-word utterances or in highly stressed and salient sentence positions, as for example in: *do you want up/down/in/out?* Travis learned these as action or location words and initially used them as single-word utterances. Other prepositions were typically used without stress and embedded in complex sentences and phrases. For Travis to recognize them as independent lexical items must have cost more effort and required more experience over several contexts.

The acquisition of *with* takes in a special place in the study by Tomasello. Despite the fact that *with* does not denote a spatial concept, Travis' early use of it resembled the acquisition pattern of the spatial prepositions. Travis used *with* first holophrastically and later prepositionally and she never omitted or misused it. Tomasello takes this as extra evidence for his input-

based model since the parents used *with* much the same way as they used the spatial oppositions; it often occurred in salient sentence positions as in *Will you come with me?*

Clark and Carpenter (1989) investigate the acquisition of several prepositions in order to examine the development of the concept 'source' in language acquisition. Clark and Carpenter hypothesize that children have a category of source that encompasses not only locations but also agents, causes, possessors, standards of comparison and prior events. To investigate this, they looked at the acquisition of the prepositions *from, with* and *by. From with* and *by* have some overlapping functions, which are related to the notion of source. Clark and Carpenter investigated the acquisition of the prepositions by means of data from a diary on the language of Damon and by means of the CHILDES database. From the CHILDES database, the data of 6 children were examined. The two sources together resulted in 618 uses of *from*, 1835 uses of *with* and 302 uses of *by*.

The first occurrences of *from* were all locative but they were quickly followed by uses outside the locative domain, such as the temporal domain (for example *when I wake up from my nap*), to indicate a natural force or an agent (as for example in *some woman were arrested from the soldiers*), to indicate cause (*who gets sick from eating seeds?*), instrumentation (*I drawed the lines from my pencil),* possession (*that's a finger from him*) and comparison (*this seat is getting to small from me*). Furthermore there were some non-conventional uses labeled *cessation*, which means that the current event either puts an end to the earlier one or forestalls its occurrence. Adults use this type of *from* only after a limited set of verbs such as keep (as in *Jack kept the door from opening*) or prevent (as in *they prevented the dogs from getting out*). Before children learned to use these combinations correctly they used *from* for example after *get* (*I'm going to dive in and get people from getting into trouble*) or fix (*I can't fix it from breaking*). The order in which the different applications of *from* were used was quite consistent. Locative *from* always appeared before all other uses. Agent *from* and causal *from* appeared before *from* indicating possession, comparison and the cessation constructions. The nonconventional uses to indicate agents, natural forces and causes became rare after age 4;0.

With had three main uses in the data under consideration: *comitative, instrumental* and *attributive*. Comitative uses express accompaniment, as in *Damon take doll with you*. The comitative uses of *with* were first used at about the same age as the earliest uses of *from*. Instrumental uses of *with* introduced an instrument involved in a certain action, as in *I paint with my arms*. Attributive uses of *with* introduce characteristics that serve to describe

or identify referents, as in *that man with a pipe*. Other uses of *with* included mainly idioms. The order of appearance of the different uses was again quite stable across the children. Five out of seven children produced the comitative or instrumental use first. The other two children first produced what was probably an unanalyzed form, namely *play with.* The attributive uses generally emerged after both other forms.

Five of the children first used *by* to indicate proximity as in *man by 'frigerator*. The other two children used *by* first in some version of *by myself*. Four children used *by* to introduce a natural force (as for example in *the branches came off by the wind*), an instrument (for example *I tied in by my hand*), a cause (as in *I feel tired by running*), means (for example *I hanged by one leg*) or an agent (as in *he'll get killed by the dragon*).

The majority of the uses of *with* and *by* were conventional, in contrast with the use of *from* by children. To find out whether the parental input could explain this pattern, Clark and Carpenter (1989) compared the order of acquisition and frequency of use by children to the pattern of usage by adults. Adults used *from* mostly with a locative meaning (82% on average). They used it in the temporal domain as well (8%). Adults used *from* to indicate cause and in comparative constructions sporadically and they never used it to introduce an agent or to indicate possession. Finally, adult uses of *from* for cessation were all conventional. The correlation between adult frequency and child order of acquisition for *from* was quite low (r = .36).

The adult use of *with* mostly fell into three categories: comitative (21%), instrumental (16%) and attributive (10%). Most other uses were idiomatic. *With* indicating means and cause was rare in adult speech, as it was in the children's speech. For *with,* the correlation between adult frequency and child order of acquisition was not so high (.70), but higher than for *by* and *from*.

The two most frequent categories of *by* in adult speech were locative uses and variants of *my self*. *By* was also used to indicate means, temporality and to introduce an agent. The correlation between adult frequency and order of acquisition was .59.

Based on the input data, Clark and Carpenter consider it to be unlikely that children's nonconventional uses are based on the input since all adult uses were conventional. They used the three prepositions for conventional categories that were also represented in the children's speech as well as for categories that were not represented in the children's speech. Only in the case of *with,* child and adult usage matched. *From* was used a lot by children in unconventional ways and *by* was often not used where it was expected. Clark and Carpenter (1989) argue that the children's use of the prepositions

can only be explained by their conceptual notion of source and their reliance on this notion to mark sources with *from* despite the conventional uses they hear around them. An additional elicitation test among children between 2;5 and 6;1 showed that the two-year-olds used *from* to indicate locative sources and used it more often to introduce agents than *by*. They used *with* to mark instruments. Older children used *from* for locative sources, *with* for instruments and *by* for agents.

Clark and Carpenter (1989) conclude that children have emergent categories, that is, they have initial concepts on which they build as they select grammatical devices to encode meanings. Children take the input they get from their environment and generalize instances of the prepositions to unconventional uses according to the category they have formed. The emergent categories may fit the conventions of a language, but if this is not the case children must eventually replace non-conventional uses with conventional ones. In this case, the children had formed a category 'source' and used *from* to mark this category. Due to the Principle of Contrast the children assumed that *with* and *by* expressed different meanings: *with* introduced instruments and *by* indicated location, independence and later agency.

McKercher (2001) also investigates the acquisition of the preposition *with*. McKercher distinguishes the following uses of with:

Instrument (e.g., *He broke the window with a rock*)
Accompaniment (e.g., *She arrived at the party with her friend*)
Manner (e.g., *He attended the party with reluctance*)
Attribute (e.g., *She prefers cookies with milk chocolate chips*)
Absolute (e.g., *With their parents away, the twins threw a party*).
Opposition (e.g., *The twins fought with each other*)
Proximity (e.g., *She's with her mother right now*)
Reference (e.g., *He's unpopular with his teachers*)
Cause (e.g., *He's unhappy with his teachers*)
Locatum (e.g., *She covered the wall with post-it notes*)

McKercher tries to answer the question how, given the range of different meanings, children learn to use *with* correctly by (among others) analyzing data from the CHILDES database. McKercher distinguishes two possible approaches to the acquisition of *with*. It could be the case that children initially assign multiple meanings to *with* or it could be the case that they learn one single meaning that is general enough to capture the aforementioned uses. The two approaches raise different expectations with

respect to the data. McKercher expects that if a child treats *with* as having several distinct meanings, the different types of uses corresponding to these meanings would not necessarily emerge at the same age in that child's productive vocabulary. If a child were to take the one-meaning-approach, she would be more likely to over-extend the use of *with* and use it in unconventional ways. McKercher looks at the meaning of the first 20 occurrences of *with* uttered by the children and the first occurrences uttered by adults and compares them to each other. To be able to make a comparison between different polysemous words he performs the same activities for the preposition *for*.

The earliest occurrences of *with* include several different uses of the preposition. The earliest uses of *for*, on the other hand, are mainly of two types, despite the fact that the input to the children contains more types. Using a chi-square test McKercher shows that the pattern of usage by children differs significantly from the pattern produced by adult for both *with* and *for*. However, an additional Spearman rank-order correlation measurement shows that the rankings of the different meanings according to the frequencies with which they are used by adults and children correlate significantly for *with* but not for *for*. Based on these findings, McKercher argues that children start off with a general representation for *with* that captures the different meanings that were distinguished. For the proposition *for*, on the other hand, children initially acquire a smaller number of meanings. It seems that they form multiple representations for the different senses of *for*. McKercher predicts that children's earliest uses of inherently less specific words will be more likely to show the adult range of uses than inherently more specific words.

Kidd & Cameron-Faulkner (2008) perform a study that closely resembles that of McKercher. They dispute the conclusions drawn by McKercher based on his corpus data. McKercher found a difference in the general pattern of usage by adults and children for *with.* However, only for one meaning of *with* the frequencies differed substantially. Kidd & Cameron-Faulkner argue that this meaning is an idiomatic usage. Kidd & Cameron-Faulkner (2008) present the results of a longitudinal study of one child, Brian. Brian was recorded for about five hours a week from age 2;0.12 to 3;1.30 and then five hours a month until age 4;11.20. All utterances containing *with* were extracted from the corpus. This resulted in 346 *with*-phrases in Brian's data (of which 113 were removed because they were repetitions or idiomatic or frozen phrases) and 3513 *with*-phrases in the input sample. The relative frequency with which the several senses of *with* were used, was very similar

for Brian and his mother (a Spearman rank-order correlation was significant (r = .916, p= .001)).

Kidd & Cameron-Faulkner perform a construction-based analysis to investigate whether there are systematic differences between the contexts in which the three most frequent senses of *with* (attribute, instrument and accompaniment) occur in the input data. They find that the three uses each occurred in their own prototypical construction. Brian's first 10 uses of *with* also consists of the three most frequent senses: attribute, instrument and accompaniment. He used them in combination with only three verbs: *share*, *be* and *play*. Kidd & Cameron-Faulkner claim on the basis of this analysis of the first 10 occurrences of *with*, that Brian initially formed a restricted representation of the meaning of *with.* This is in contrast with the claim made by McKercher (2001) that children's first utterances containing *with* encode a wide range of adult semantic roles. Kidd & Cameron-Faulkner argue that Brian's first uses of *with* encode a spatial relation between two NP referents. 'Spatial proximity' is the core meaning from which Brian could build up differentiated senses, rather than an abstracted sense based on the extraction of core features. This analysis is supported by the fact that Brian produced some overgeneralizations, for example to mark a location, as in *that man with the spaceship* (meaning 'that man in/from the spaceship').

To sum up, several studies on the acquisition of prepositions compare the order of acquisition and the frequency of use of the several meanings by children with the pattern of usage by adults. Some studies show the importance of the input (Tomasello 1986, Kidd & Cameron-Faulkner 2008). This is not to say that children acquire the most frequently used function first. The quality of the input is of importance too. Clark and Carpenter (1989) and Kidd & Cameron-Faulkner (2008) argue that children have a specific initial representation of the meaning of a word which changes as the experience with the form grows. McKercher (2001) on the other hand claims that children have a general representation for *with* that captures the different meanings that are used by adults. For the proposition *for*, on the other hand, it seems that children initially form multiple representations.

Tomasello (1986) considers the fact that *with* often occurred in salient sentence position as the main cause of the relatively 'smooth' acquisition of this preposition and not its cognitive simplicity. However, semantic and formal aspects are related. Usually, words with a prominent meaning have a more prominent pronunciation. This also holds for the particle *wel*. Hogeweg (2009) indicates that there is a relation between the strength of the meaning of *wel*, the stress with which it is expressed and its syntactic autonomy. When *wel* is used to express a stronger meaning, it is uttered with

more stress than when it is used to express a weaker meaning. Furthermore, *wel* used as a correction can constitute an utterance on its own. *Wel* used to mark contrast needs at least an additional word to be interpretable and *wel* marking implicit contrast needs a whole proposition.

In the remainder of this chapter, I will look for a semantic explanation for the pattern of acquisition of *wel*. Recall Gentner's (1982) characterization of the child's task in language acquisition; it is to match 'the stream of perceptual-cognitive information in the world' to 'the stream of language being spoken'. Where Tomasello focuses on the unscrambling of 'the stream of language being spoken', I will concentrate on unscrambling 'the stream of perceptual-cognitive information in the world'.

4.2.6 Conclusions

The general conclusion that we can draw from the information in this section is that children learn the meaning of words by hearing them being used in a context repeatedly. When children hear a novel form they use contextual information to determine its referent. Saliency is a crucial factor in the acquisition of word meaning. Upon hearing a new word, children will look for a prominent aspect of the context to function as a referent. However, the studies Tomasello (2003) refers to, show that not only the inherent saliency of a referent is of importance. Having the attention of an adult can make an object very salient in a context.

Section 4.2.4 showed that to determine the referent of a form, infants make use of the experience they have with previous encounters of the word. A child will use the knowledge about the previous referents of a form together with information from the current context to determine the meaning of a word.

In the next section, I will present the data from a study I performed together with Richard van Gerrevink. The results of this study are also reported on in Hogeweg and van Gerrevink (2009). In line with the studies on the acquisition of prepositions, I will compare the usage of *wel* by children to the pattern of usage by adults.

4.3 *Wel* as used by adults and children

In this section I will examine the acquisition of *wel* by seven children in the CHILDES database. I will focus on the three strongest uses of wel: correction, contrast and implicit contrast. The other uses of *wel*, as described in Chapter 3, all depend on the presence of an additional word (for example

misschien 'maybe', *zullen* 'will' or *eens* 'once'). Since it is not clear how the presence of this additional word influences the acquisition, I left them out of this analysis. In the next subsections I will describe the methodology and the results of the study.

4.3.1 Methodology

In order to construct as coherent a sample of Dutch child speech as possible, we used data from the Groningen part of the corpus (Bol 1995), since all data in this sub-corpus were produced by 'normally developing' children. Other Dutch sources of CHILDES data contained for instance speech of SLI children. Because these children may have different patterns of acquisition, we did not want to include their data. The Groningen corpus consists of data from a longitudinal study of six Dutch boys and one girl between 1;05 and 3;07. The data were recorded in over 107 hours.

We selected the first 35 valid occurrences of *wel* of each of the 7 children in the Groningen corpus in the CHILDES database. Occurrences were considered valid if they were not a literal repeat of the child's own utterance or an adult's utterance. We hence ended up with 245 occurrences of *wel.* Some were dropped later on because they turned out to be repetitions after all. For the children we eventually had 238 valid tokens of *wel*.

We categorized the occurrences of *wel* according to its meaning in the context. There are 11 categories (the construction specific occurrences of *wel* were divided into subtypes but this division will not be discussed in this chapter). We used 99 occurrences of *wel* to practice the categorization and to sharpen the definitions of the categories. Then we categorized the 139 remaining occurrences individually in sets of 15 or 20 occurrences and compared the outcomes. We discussed these occurrences that were classified differently until we reached agreement on how to categorize them.

For the adults we selected the first 35 utterances of *wel* that were uttered by one of the parents of each of the 7 children of the Groningen corpus. We only selected the utterances of *wel* that were actually directed to the child. This resulted in 246 utterances (one line turned out to contain 2 instances of *wel*, which we counted both individually). We used 95 occurrences of *wel* to train and sharpen the definitions. The 151 remaining utterances we classified individually comparing the outcomes after sets of 15 or 20 occurrences. We discussed the occurrences that were classified differently until we reached agreement on how to categorize them.

In total, there was an agreement of 78% in classifying the occurrences of *wel*. Cohen's Kappa computed over the four relevant categories is .70, which

is usually considered adequate. The agreement is especially satisfactory if you take into account the pragmatic nature of the meanings.

The eleven categories into which the occurrences of *wel* were classified were the following (see Chapter 3 for a description of the categories):

1. Correction
2. Explicit contrast
3. Implicit contrast
4. Construction specific 1 (*wel* with *misschien* 'maybe')
5. Construction specific 2 (*wel* with a quantifier)
6. Construction specific 3 (*wel* with *lijken* 'look like/seem')
7. Construction specific 4 (*wel* with *zullen* 'will')
9. Construction specific 5 (*wel* with *eens* 'once')
10. Construction specific 6 (*wel* with a modifier)
11. Unclassifiable

An occurrence of *wel* was categorized as 'unclassifiable' (category 11) in two circumstances. Sometimes the context in which an instance of *wel* occurred did not give enough information to unambiguously determine its function. This was especially the case for the child data. Most of the time, the children were not engaged in a real conversation. The utterances they produced consisted mostly of comments on the actions or playing event during the recording, in which we had no insights. The second situation in which we categorized an instance as unclassifiable was when an utterance of *wel* was not adult-like. One child used *wel* consistently to answer affirmatively to a positively stated question. At a certain point the investigator that is recording the speech even mentions the fact that Peter answers every question with *wel* instead of *ja* 'yes'. Using *wel* to answer a positive question is not a conventional way of using the particle; *wel* can only function as an answer to a negative question. An example of *wel* as an affirmative answer is the following:

(1) (pet20203.cha: line 1314, CHI = Peter (child), FRA = Frank (investigator))
CHI: [%act: dives on top of teddy bear] .
FRA: *is Bob lief ?*
'Is Bob cute?'
CHI: ***wel*** .
wel

To allow some insight in how we classified the occurrences of *wel*, three examples are given below with an explanation of how we classified them.

(2) (tom20600.cha: line 1245, CHI = Tomas (child), CAR = Caroline (investigator))
CHI: *die auto's op ə auto .*
'those cars on cars'
CAR: *nee, dit zijn geen auto's, dat zijn muzieknootjes.*
'no, these are not cars, these are music notes'
CHI: *nee,* ***wel*** *auto's.*
'no, *wel* cars'
CAR: *ja, waar zie je dan (ee)n auto?*
'yes, where do you see a car then?'
CHI: *hier.*
'here'
CAR: *nee, dat zijn muzieknootjes.*
'no, those are music notes'
CHI: ***wel****.*
'*wel*'
CAR: *als je muziek maakt.*
'when you make music'

(3) (tom20507.cha: line 265, CHI = Tomas (child), NIE = Nienke (mother))
NIE: *he, dat is jouw schriftje helemaal niet.*
'he, that is not your notebook'
CHI: ***wel****.*
'wel'
NIE: *dat is Hildes schriftje.*
'no, that's Hilde's notebook'

Wel in (2) and (3) is clearly used as a correction. The child in (2) (Tomas) indicates that he does not agree with the previous negative statement that 'there is no car'. The same holds for the child in (3) (again Tomas). He indicates that he does not agree 'that is not his notebook'.

In (4) and (5) *wel* is used to mark a relation of contrast.

(4) (daa20525.cha: line 1086, CHI = Daan (child), JOS = Josje (mother))[3]
CHI: *di(t) (i)s ook geit.*
'this is also goat'
JOS: *nou dat is nou net weer (ee)n paard.*
'well, that's actually a horse'
CHI: *paard.*
'horse'
JOS: *ja.*
'yes'
CHI: *deze niet <dez we> deez* ***wel*** *paard.*
'this not, this *wel* horse'
JOS: *ja.*
'yes'

(5) (mat20723.cha": line 252, CHI = Matthias (child), eve = Evelien (investigator))
CHI: *die kan niet meer # rijden.*
'that one cannot drive anymore'
EVE: *kan die niet meer rijden?*
'that one cannot drive anymore?'
CHI: *die kan* ***wel*** *[!] rijden.*
'that one can *wel* drive'
EVE: *ja, die wel.*
'yes, that one wel'

Wel in (4) and (5) is used to mark a relation of contrast. This can be seen by the fact that it follows an explicit negation (*niet* 'not' in the same line in (4) and in the preceding line in (5)). From the reaction that follows in both examples we can infer that *wel* was not used to correct the previous speaker. In both examples there is clearly no disagreement between the speakers involved.

Wel in (6) and (7) is classified as implicit contrast'.

(6) (tom20827.cha: line 107, CHI = Tomas (child), CAR = Caroline (investigator))
CHI: *Sam mag kijken.*
'Sam may watch'

[3] Some symbols giving additional information about the utterance (like pauses or unidentified strings of sounds) are removed.

CAR: *wat zeg je?*
'What do you say?'
CHI: *Sam mag **wel** kijken.*
'Sam may *wel* watch'
CAR: *ja, Sam gaat straks mee zwemmen.*
'yes, Sam will swim with you later on'

(7) (iri30309.cha": line 1453, CHI = Iris (child), FRA = Frank (investigator))
CHI: *ik wil hier # in knippen.*
'I want to cut this'
FRA: *wil je even knippen?*
'do you want to cut'
CHI: *ja.*
'yes'
FRA: *heb je (ee)n schaartje dan?*
'do you have scissors, then?'
CHI: *ja.*
'yes'
CHI: *ik heb **wel** schaar.*
'I have *wel* scissors'

In (6) and (7) *wel* is not used as a reaction to an implicit negation, nor is it part of a fixed combination. In (6), *wel* seems to be used as a reassurance. Caroline may think that Tomas will not allow Sam (his baby brother) to watch. *Wel* is used to negate this and has a comforting, or reassuring, effect. In (7) *wel* is part of an answer to a question. Such uses occur when the truth of a proposition was not yet established and can be analyzed as 'implicit contrast'.

4.3.2 Results

The results are listed in Table 1 and 2. The 7 categories whose mutual proportions are not relevant for the current analysis are grouped by the name *construction specific*. Furthermore, I left out the category unclassifiable. It should be noted, however, that the percentage of unclassifiable occurrences of *wel* of children was higher than the percentage of adults (26,9% versus 4,9%) for the reasons mentioned above. In Table 1, the children and their parents are represented underneath each other.

Name	Correction	Contrast	Implicit contrast	Construction specific
Abel	4	13	6	1
Parents Abel	1	3	18	13
Daan	2	16	8	0
Parents Daan	2	5	24	3
Iris	9	8	6	0
Parents Iris	0	8	14	11
Jos	13	6	6	0
Parents Jos	2	1	22	8
Matthias	6	14	4	0
Parents Matthias	1	4	22	9
Peter	8	16	2	0
Parents Peter	1	8	19	4
Tomas	20	2	4	0
Parents Tomas	0	8	21	3

Table 1: the usage of *wel* by 7 children and their parents

	Absolute number	Aggregated Percentage	Minimum	Maximum	Mean percentage
Correction children	62	26,1	7,7	76,9	35,4
Contrast children	75	31,5	7,7	61,5	43,4
Implicit contrast children	36	15,1	7,7	30,8	20,7
Construction specific children	1	0,4	0,00	4,2	0,6
Correction adults	7	2,8	0,00	6,1	3
Contrast adults	37	15	3	25	16
Implicit contrast adults	140	56,7	42,4	70,6	59,6
Construction specific adults	51	4,9	8,8	37,1	21,5

Table 2: frequency of different uses of *wel*

The percentages of the different uses are presented in Table 2. The column *absolute number* gives the number of occurrences of each type of *wel* for

children and adults. The column *aggregated percentage* gives the absolute number divided by the total number; 238 for the children, and 246 for the adults. The column *minimum* gives the lowest and *maximum* the highest percentage that was attested for that type of *wel* among the children or among the adults. Finally, the column *mean percentage* gives the average of the percentages that were attested for that type of *wel*. Tables 1 and 2 demonstrate that children show a pattern that is strikingly different from that of adults. While the mean percentage of *correction* is 35,4 for children, for adults this is only 3. The difference between the mean percentages for the category *implicit contrast* is striking as well. For adults this number is 59,6 while for children it is only 20,7. Interestingly, the most frequently used types of *wel* by children are the two strongest: correction and contrast, while the most frequently used type by adults is the weakest use: implicit contrast. A t-test for paired samples shows that for every category, the difference between children and adults is significant (df=6, correction: t= 3,50, p= .013, contrast: t= 2,98, p=.025, implicit contrast: t=-7,94, p=.000, construction specific: t= -5,20, p=.002).

The Tables 3 to 9 show the individual patterns of the 7 children. The tables show how many instances of every type of *wel* were uttered at a particular age (the age is notated as y;mm;dd). Furthermore, I have indicated at which age the third instance of a particular type occurred. I take this to be an indication that the relevant use is acquired. Bloom, Lahey, Hood, Lifter and Fiess (1980) use a quantitative criterion of five occurrences in their study on the acquisition of connectives. They want to exclude the possibility that a particular occurrence of a connective does not reflect the relevant knowledge of the child concerning the meaning of the connective. Evers-Vermeul and Sanders (2008) on the other hand use a qualitative criterion in their study on the acquisition of connectives. They take one occurrence of a connective as an indication that this particular connective is acquired. However, Evers-Vermeul and Sanders only take into account connectives that are used in a correct way, as a word combining two clauses and in a creative way (which means that the connective is not used in a fixed expression, in a line from a song or as a repetition of a parent). I have taken an intermediate position by combining qualitative and quantitative criteria. As outlined in this section, we only counted the occurrences of *wel* that were not a repetition of a parent or of the child herself. However, since the recordings do not capture all the speech a child is exposed to and since it may be unclear what counts as a fixed expression I use the criterion of three occurrences. This way I can be sure that the assumed moment of acquisition reflects the child's knowledge of the meaning and use of the word *wel*.

The third use of a particular type of *wel* is marked with a *. Furthermore I have indicated, next to the label *correction, contrast* or *implicit contrast*, whether this type was learned first, second or third.

Age Abel	Correction (2)	Contrast (1)	Implicit contrast (3)	Construction specific
2;01;02	1			
2;02;19		2		
2;03;02		1*		
2;03;23		6		
2;04;09	2*	2	1	
2;04;23	1	1	5*	1
2;05;06		1		

Table 3: use of *wel* by Abel

Age Daan	Correction (3)	Contrast (1)	Implicit contrast (2)	Construction specific
2;00;04		1		
2;02;02		1		
2;02;16		1*		
2;04;00		1		
2;04;14	1		1	
2;04;28			1	
2;05;11		4		
2;05;25	1	6	6*	
2;06;11		2		

Table 4: use of *wel* by Daan

Age Iris	Correction (2/3)	Contrast (1)	Implicit contrast (2/3)	Construction specific
2;08;13			1	
2;09;26		2		
2;11;12		1*		
3;00;17	1			
3;01;00	1			
3;01;14	1*	1	2*	
3;01;28		2		
3;02;11	3	2	2	
3;03;09	3			

Table 5: use of *wel* by Iris

Age Jos	Correction (1)	Contrast (3)	Implicit contrast (2)	Construction specific
2;02;22	1			
2;03;28			1	
2;04;11	1			
2;05;11	1*			
2;06;01	3	1	2*	
2;06;22	3	3*	2	
2;07;06	1	1		
2;07;20	2	1	1	
2;08;04	1			

Table 6: use of *wel* by Jos

Age Mat	Correction (1/2)	Contrast (1/2)	Implicit contrast (3)	Construction specific
2;03;19		1		
2;05;26	2	1		
2;06;03	1*	1*	1	
2;06;11	1	3		
2;06;19			1	
2;07;02	2	3		
2;07;09		2	1*	
2;07;23		3		

Table 7: use of *wel* by Mat

Age Peter	Correction (2)	Contrast (1)	Implicit contrast (3)	Construction specific
1;10;03			1	
2;00;07	1			
2;00;28		1	1	
2;01;13	1	2*		
2;03;07	4*	5		
2;03;21	2	5		
2;04;12		3		

Table 8: use of *wel* by Peter

Age Tomas	Correction (1)	Contrast (3)	Implicit contrast (2)	Construction specific
2;02;15	1			
2;03;06			1	
2;04;17	1			
2;05;07	1*	1		
2;06;00	10			
2;06;14	4			
2;07;10	1			
2;08;01	1	1		
2;08;27			3*	
2;09;12	1			

Table 9: use of *wel* by Tomas

The Tables 3 to 9 show that *wel* indicating contrast is acquired first by 4 out of 7 children and for one child it shares the first position with correction. Especially the difference between correction and implicit contrast is interesting. 5 children have acquired correction before implicit contrast and once they are acquired simultaneously. Only one child (Daan) has acquired implicit contrast before correction. So, despite their distribution in the input, we can say that in general implicit contrast is acquired later than correction.

4.3.3 Conclusions

There are two interesting observations to be made with respect to the data presented in this section. The first observation is that the strongest meaning of *wel* is strikingly rare in the adult usage of *wel*. We can see that, for the three uses of *wel* that are relevant in this chapter, the frequency increases as the meaning weakens. The second observation is that, in spite of the first observation, children seem to acquire the strongest uses with more ease than the weaker use. The mean percentage of *correction* is 35,4 for children, while for adults this is only 3. The difference between the mean percentages for the category *implicit contrast* is striking as well. For adults this number is 59,6 while for children it is only 20,7. Furthermore, only one child acquired implicit contrast before correction.

In the next section I will start with a discussion of the first observation. I will argue that it is not co-incidental that the weaker meanings are more frequent in the spontaneous speech of adults. Furthermore, I will show that there is a relation between the observation that the stronger uses are less frequent and the observation that the stronger meanings are acquired more

easily. I will use the remainder of Section 5 to formalize the idea of why stronger meanings are acquired before weaker meanings in Optimality Theory and Harmonic Grammar.

4.4 The acquisition of *wel*

In this part of Chapter 4, I will explore the influence of the semantics of the different uses of *wel* on the pattern of acquisition. I will start this section by a consideration of the relation between semantics and frequency. I will show that the negative correlation between strength and frequency is not accidental and that the order of acquisition is related to this as well.

4.4.1 The relation between semantic strength and frequency

In the previous section we saw that adults use the weaker uses of wel more often than the stronger uses, when speaking to children. We find a similar pattern when we look at the use of *wel* in the Spoken Dutch Corpus[4].

Use	**Frequency**
Correction	2
Contrast	180
Implicit contrast	215
Construction specific	280
Total	677

Table 10: *wel* in the Spoken Dutch Corpus

It has been noted before that strong meanings are less frequent than weak meanings. In chapter 3, I discussed Zwarts (2004), who shows that the word *(a)round* has several different meanings ranging from perfectly circular to slightly curved. The different uses are defined by Zwarts in model-theoretic terms using a vector based model and they are shown to be entailments, i.e. weaker versions of the prototypical circle meaning of *(a)round*. The interpretation chosen for a particular occurrence of *(a)round* is the strongest interpretation that is possible with respect to the context. In contrast to what might be expected based on the interpretational preference, Blutner (to appear) posits that not the strongest meanings are the most frequent but the

[4] The count in the Spoken Dutch Corpus was performed by Richard van Gerrevink. It should be noted that this count was not checked for interrater agreement.

weakest meanings are. Furthermore, Blutner argues that this observation has consequences for Bidirectional Optimality Theory. Bidirectional Optimality Theory (BiOT), which was shortly discussed in Chapter 3, is an inferential mechanism of utterance interpretation within OT that conforms to the Gricean suggestion of conversational implicatures (Blutner, de Hoop and Hendriks 2006). The basic idea that underlies BiOT is that a hearer can only arrive at the optimal interpretation of an utterance if she takes into account the alternative forms the speaker could have used to express this meaning. Where OT syntax takes the speaker's perspective and OT semantics the hearer's perspective, BiOT takes both the hearer's and the speaker's perspective at the same time. BiOT optimizes over form and meaning simultaneously and gives as an output one or multiple super-optimal pairs. The formal definition of super-optimality is as follows: a form-meaning pair <*F, M*> is called super-optimal if and only if:

a) there is no distinct super-optimal pair <*F', M*> such that <*F', M*> > <F, M>.
b) there is no distinct super-optimal pair <F, M'> such that <F, M'> > <F, M> (Jäger 2002).

> is an ordering relation that depends on the markedness of the form and meaning. A form-meaning pair is thus super-optimal if there is a) no other pair with a less marked form that expresses the same meaning and b) no other pair with a less marked meaning that is expressed by the same form. Markedness depends on several factors among which length of a form, complexity, order of acquisition and frequency (Blutner 1998, 2000).

Now consider Dutch, which has two possible forms to express the meaning 'around': *rond* and *om*. Blutner notes that the shortest, unmarked, form *om* combines with the weaker, most frequent meaning, whereas the longer, marked form *rond* combines with the stronger, less frequent meaning. The expected pattern, according to the principles of Bidirectional OT, would be that the marked form combines with the marked meaning and the unmarked form with the unmarked meaning. *Om* is the less marked form and 'circle' is the less marked meaning, hence the pair <*om*, 'cirlce'> is the first super-optimal pair. The pair <*rond*, 'detour'> is also super-optimal because there is no other super-optimal pair that contains the form *rond* or the meaning 'detour'.

However, in reality *om* pairs up with 'detour' and *rond* with 'circle'. So, there is a discrepancy between the markedness of form and the markedness of meaning in terms of strength or prototypicality. Blutner (to appear)

argues that the reason for this discrepancy is that the prototypical, or idealized situation in which the strongest meaning would be appropriate, is rare. He deviates from the original formulation of BiOT by arguing that bidirectional optimization is not an online process that takes place in the individual language user but an offline process that forms language in an evolutionary sense. In this process, two strategies are evolutionary stable. The first is the strategy that is predicted by BiOT, which Blutner calls the Horn-strategy. However, the reversed strategy, the Anti-Horn-strategy is also evolutionary stable. With the Anti-Horn-Strategy, the unmarked form pairs up with the marked meaning and vice versa. This therefore is an un-iconic strategy. Only when the unmarked meaning is the most frequent meaning, the Horn-strategy applies. The meaning division of *om* and *rond* is a good example of anti-iconicity because the prototypical or ideal meaning of the full circle is much rarer than the weakened meanings that are derived from this. The same is true for *wel*. The strongest meaning is the most specific meaning, since it combines the most semantic features. Consequently, this meaning is compatible with fewer situations.

The relation between semantic strength and frequency is also addressed in Zeevat (2007). In this work the recruitment of functional items in an evolutionary system is simulated. *Recruitment* means that a language adopts a lexical word to fill in a gap in the functional domain or when a functional word acquires a new functional use. The evolutionary model Zeevat (2007) develops is based on the notion of successful communication. Zeevat argues that the probability of the success of an utterance *U* for intention *I* can be described as the probability that the hearer recognizes *I* from *U*, that is, that what the hearer interprets is similar to what the speaker intended. However, Zeevat argues that even in successful communication the full intention of the speaker is never fully interpreted by the hearer. Instead, interpretation and intention can be closer together or further apart from each other. Zeevat, introduces a distance function that enables us to indicate degrees of success. This distance function *d (I, J)* measures the distance between the speaker's intention I and the hearer's interpretation *J*. The best strategy for the speaker is to choose an utterance that maximizes the probabilities that the distance between her intention and the hearer's interpretation is minimal.

In the experiment a form with an already existing meaning is recruited for a new meaning. The old meaning weakly entails the new meaning. Weak entailment between meaning A and B means that if A is true in a certain context, B is more likely to be true in the same context than it is to be false. In the default, most frequent situation, neither A nor B is true. The new meaning, for which a form has to be recruited, consists of feature B, but not

of feature A (*B&notA*). The old meaning consists of A. This meaning can be separated into two meanings: *A&B* and *A&notB.* In the initial state there is a marker for A that can be used for both meanings. The following assumptions were made in carrying out the experiment:

- The (default) meaning *notA&notB* is more frequent than the new meaning *notA&B.*
- The meaning *notA&notB* is more frequent than the old meaning *A&B.*
- The meaning *A&B* weakly entails the meaning *A&notB.*
- The meaning *A* is expressed by the form *F.*
- In the system there is tolerance for overmarking. This means that if the hearer interprets less (fewer features) than the speaker intended, this constitutes one failure. In contrast, if the hearer interprets more than the speaker intended, this constitutes only half a failure. The distance between the speaker's intention to express the meanings that consist of feature A nor B and the hearer's interpretation of a meaning that consist of feature A but not B, that is, the distance between the meaning *notA&notB* and *A&notB* (*d(notA&notB, A&notB))* is similar to *d(A&notB, A&B)* which is similar to *d(notA&B, A&B)* which is similar to *d(A&notB, A&B).* They all instigate only half a failure because of the tolerance for overmarking.

The experiment shows that due to the tolerance for overmarking, the expression of *notA&B* with *F* is more successful than the expression of *notA&B* with zero marking because interpreting *notA&B* as *notA&notB* constitutes a violation of 1.0 while interpreting *notA&B* as *A&B* only constitutes a violation of 0.5. The advantage rises until a situation comes into being in which *notA&B* is always expressed by *F* and the distinction between *notA&B* and *A&B* is no longer expressible. Crucially, Zeevat found that in the process of recruitment it is essential that the new meaning is both semantically weaker than the old function, that is, that the old function entails the new function and that the new function is not less frequent than the old function. If it is less frequent, the old use will suppress the new use and the new use will not make headway.

Both Blutner (to appear) and Zeevat (2007) argue that there is a correlation between semantic strength and frequency, namely that stronger meanings are less frequent than weaker meanings. Stronger meanings are less frequent because they are constituted by more semantic features. Because of the higher number of features, a strong meaning is more specific,

which makes it compatible with fewer situations. In this respect it is useful to look at the distinction between concrete and abstract meanings. Abstract words are generally more frequent than concrete words. In Plaut and Shallice (1993), the distinction between concrete and abstract words is realized by differentiating the amounts of semantic features that are used to realize the meaning in a connectionist model. Concrete words are realized by more features than abstract words. To justify this, in their own words, "first approximation to realize the contrast between abstract and concrete words", they refer to Schwartz, Marin, and Saffran (1979). Those authors argue that concrete words have a core meaning that can only slightly be altered by the context, while the meanings of abstract words are more dependent on the context in which they occur. Semantic strength is thus a form of concreteness. However, semantic strength is more specific than concreteness since a stronger meaning contains the same features as its weaker counterpart but more of them. The concept 'love' can be said to be less concrete than the concept 'hammer' but it is not the case that 'hammer' is stronger than 'love'.

Now, if weak or abstract meanings are more frequent than strong or concrete meanings, why are the latter generally acquired before the first? I argue that it is precisely the fact that weak uses are compatible with more situations than strong uses that makes those meanings hard to infer from the context. On the one hand, the fact that the implicit contrastive use of *wel* has 'less meaning' than the corrective and contrastive use makes it compatible with more situations and therefore more frequent. On the other hand, the fact that the implicit contrastive use of *wel* is suitable for many situations makes it difficult to infer the meaning from the context for language learners. In Chapter 3, we saw that the uses of *wel* that mark an implicit contrastive relation have in common that they react to an implicit negative assumption in the context. The effect that this use of *wel* creates might differ. Sometimes it functions as a reassurance, if the hearer made clear somehow that he fears that a certain desired situation will not take place. Sometimes it has an effect of politeness and sometimes the opposite. This makes it difficult for a learner to see the commonality in all the uses. In the context of the corrective use, on the other hand, there is always a negative statement present. It is easier to infer the function of this type of *wel* from the context. This explains the negative correlation between frequency and order of acquisition for *wel*. The weaker meanings are on the one hand applicable to more situations but on the other hand more difficult to infer from the context.

In the next sections, I will elaborate on the explanation I briefly outlined above and I will make the interaction between frequency and semantics more explicit.

4.4.2 Constraints on the acquisition of meaning

In this section, I will formalize the idea I described in the previous section, namely that words with weaker meanings are more difficult to acquire because their meanings are difficult to infer from the context. I will build on the model I introduced in the previous chapter to analyze the interpretation of *wel* by adults. Naturally, children will eventually behave like adults. I will show that children start with a different interaction of the constraints STRENGTH and FIT. Furthermore, FIT behaves differently in acquisition.

4.4.2.1 FIT or the role of the context in the acquisition of meaning

In section 4.2.1.3, I addressed the issue whether it is the case that first a concept is created after which the appropriate word for it is learned or that hearing a word leads to the creation of a concept. I concluded by arguing that acquisition works in both directions. Nonetheless, in the model I propose, acquisition is a hearer's job. Even if the child had formed a concept long before hearing the corresponding form for the first time, she would still first have to figure out that it is this concept that the word refers to. Upon hearing a novel form, children have to determine the referent of a word. They thereby have to 'choose' between the candidates that are generated by GEN. An important property of the generator in OT is that it generates an infinite set of candidates. Note that the candidates should be seen as hypothetically possible interpretations, not as actually realized conceptualizations at the symbolic level.

How do children determine the optimal candidate? I agree with Smith (2005) who argues that the acquisition of the lexicon entails recognizing the relevant contextual elements and learning a mapping between meanings and signals through the inference of meaning in context. We saw in the discussion of several experiments in section 4.2 that children are able to make such inferences. This means that when children hear a novel form, they use contextual information to determine its referent. In line with the associative view on language acquisition I take saliency to be the crucial factor in this choice. Upon hearing a novel word, children will pick the most salient concept as the referent for this word. I propose that saliency of a concept can be realized as the number of features it combines. I will only discuss inherent features of concepts. However, it has been shown that

processes like joint attention may influence acquisition too (see the discussion in section 4.2.2). I believe contextual aspects can be implemented in a model of semantic features as well. The interactional experience with a word may become part of the meaning it denotes. However, this would require a more elaborated, less abstract notion of meaning which is more difficult to model. I will not address this problem in this work.

4.4.2.1.1 FIT in language acquisition

In this section, I will argue that the constraint FIT, which was introduced in Chapter 3, causes the preference for salient meanings over non-salient meanings. In interpretation FIT penalizes those interpretations that are not in line with the context. Since I present concepts as combinations of features I would like to argue that candidate interpretations can violate FIT not just in an all-or-nothing manner, but in degrees. Namely, the more features of a concept are in contradiction with the context, the more severely FIT is violated. Furthermore, the constraint can not only penalize candidates that violate it, it can also favor candidates that fulfill it. If a feature is present both in the contextual representation as well as in the candidate interpretation, this candidate concept relates positively to the constraint FIT, which is indicated by a plus. This process is illustrated with an imaginary example with several toys. There are four toys which are similar in many respects. The crucial difference is that one produces music while the others do not. The input in this tableau is a form together with a context.

Input: a novel form *blurb* in a context of four round, colored objects one of which produces sound	FIT
{round, yellow}	+ +
{round, red}	+ +
{round, blue}	+ +
☞ {round, purple, plays music}	+ + +

Tableau 1: the constraint FIT

If a certain feature is present both in a candidate concept and in the contextual representation of a hearer, the candidate will get a +. If a candidate contains a feature that is not present in the context, this is a violation of Fit, which is indicated by a minus. The candidate with most plusses (or smallest amount of minuses) is optimal.

Input: a novel form in a context of four round, colored objects, one of which produces sound	Fit
{round, yellow}	+ +
{round, red}	+ +
{round, blue}	+ +
☞ {round, purple, plays music}	+ + +
{round, purple, plays music, lights up}	+ + + -

Tableau 2: the constraint FIT

For each feature of the candidate interpretation that is present in the context, the candidate receives a plus. For each feature that is not present in the context the candidate receives a minus. The plusses and minuses outweigh each other and therefore the fourth candidate is optimal.

We now have one constraint: FIT. The amount of violations or satisfactions of this constraint determines the optimal outcome. The effect of this constraint is that children choose the most informative interpretation for a new form. Note that what STRENGTH does for adults, FIT does for children. This suggests that seeking for the most informative option is not the result of one particular constraint, but instead is a general force that underlies several processes.

4.4.2.1.2 FIT and the acquisition of *wel*

Let us now look at *wel* again. Remember the definitions of the three strongest uses of *wel* from the previous chapter.

- *Wel* marks *correction* in an utterance U_1 which expresses the proposition Px if there is a previous utterance U_2 that expresses the proposition Qy such that P= ¬Q and x = y (and the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue).

- *Wel* marks *explicit contrast* in U_1 which expresses Px if there is a U_2 which expresses Qy, such that P = ¬Q or x = y and the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue.

- *Wel* marks *implicit contrast* in U_1 if there is a U_2 such that the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue.

The strongest meaning of *wel* comprises a set of features: P= ¬Q, x = y and the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue. Say we have an utterance containing *wel* with an entity x and a predicate P in the context where there is a proposition with a different entity y and a different predicate Q that suggests the negation of the sentence containing *wel* (this relation is denoted by the symbol →). However, in this particular context a concept is present that combines three abstract features, say A, B and C. This concept is denoted as {A, B, C}. The concept {A, B, C} is constituted by more features than the concept 'implicit contrast'. All three features (A, B and C) are present in the context. Therefore, the candidate {A, B, C} satisfies FIT three times while 'implicit contrast' only satisfies FIT once. The concept {A, B, C} is therefore optimal. Note that there will also be candidates with more features that are not present in the context. In this tableau one example of such a candidate is given, the concept that is constituted by the features D, F and E. Since none of these features is present in the context, the candidate {D, E, F} violates FIT three times.

Form: wel P(x) Context: Q(y)→¬P(x), {A, B, C}	FIT
Correction	+ - -
Contrast	+ -
Implicit contrast	+
☞ {A, B, C}	+ + +
{D, E, F}	- - -

Tableau 3: *wel* and FIT

As was discussed in section 4.2, children have a large number of possible referents to choose from upon hearing a novel word. The candidate interpretations are in competition. Tableau 3 illustrates that, due to the constraint FIT, children have a preference for more salient concepts. When a

concept consist of few features, i.e. when it is not very salient, it has an inferior position in the competition with other concepts. We can therefore explain why it is 'easier' to interpret the stronger uses of *wel* than the weaker use. The weaker use has more competition from other concepts that are present in the context. This explains why the stronger *wel* is acquired with more ease than the weaker *wel*, despite the fact that the weaker one occurs far more frequently in the input of language learners. Note that this analysis can also explain why concrete words are generally learned before abstract words. The meanings of abstract words are harder to infer from the context because their referents are less apparent in the world, i.e. they are conducted by less features, and therefore have an inherent disadvantage with respect to the constraint FIT.

We now have one constraint, FIT, that favors interpretations with many features over interpretations with few features. Because there is competition between candidates in becoming the optimal interpretation, non-salient concepts are inherently disadvantaged. However, eventually even the weakest meanings are acquired. This is because another aspect is important in acquisition, namely experience.

4.4.2.2 The influence of experience

In section 4.2.4, I discussed some recent studies that show that cross-situational experience is important in word-learning. In connectionist terms we can say that a link is created and strengthened between a meaning and a form every time those two co-occur. The knowledge of the relation between forms and meanings is instantiated by the constraint STRENGTH. Recall from Chapter 3 that I redefined the constraint STRENGTH as: interpret features that are associated with a form. This means that this constraint reflects the knowledge of a language user about the connections between a form and semantic features. The constraint STRENGTH is gradually built by language learners. Every time a concept is interpreted in relation with a specific form, the connection between the semantic features and the form is strengthened.

With respect to language acquisition, I have only discussed one relevant constraint so far. The relative importance with respect to other constraints did not play a role yet. As I will argue, the constraint STRENGTH gains importance as a language learner obtains more experience with a certain form. I will not make claims about the precise learning algorithm since the data do not lend themselves to that. I will merely apply an abstract notion of constraint promotion. When the constraint STRENGTH starts to play a role, the language user has two sources of information when she encounters a

form: the context and her previous experience. Those two influences may point in the same direction, but they may also be in conflict. How is this possible conflict resolved? In Optimality Theory constraints are ordered according to a strict priority ranking. We saw that this kind of interaction between constraints is capable of explaining the optimization process for the (adult) interpretation of *wel*. Eventually children will become adults and will behave accordingly. But what does the path that leads to this end-stage look like?

I have discussed how the stronger meaning is favored over the weaker meaning. How is the weaker meaning learned eventually? I will argue that two mechanisms play a role, one of which I discussed earlier in this chapter: cross-situational learning. The second one is what I will call meaning-deduction as is also argued to play a role in language evolution by Zeevat (2007). The two mechanisms are all a result of the interaction between STRENGTH and FIT. I will begin by discussing the role of cross-situational learning.

4.4.2.2.1 Cross-situational learning

I explained that the weaker meaning of *wel* can easily be overlooked in a context because there may be more salient concepts present. However, those more salient concepts differ per occasion and there are also situations in which no other concept is more salient than the concept of 'implicit contrast'. In that case *wel* will be interpreted as marking this relation. When this occurs, the connection between this meaning and the form *wel* is strengthened. As a language learner develops more experience in different situations, the co-occurrence of *wel* with the interpretation 'implicit contrast' will outnumber co-occurrences of *wel* with more salient concepts that may have been coincidentally present in a context in which *wel* was uttered. Thus, by hearing the form *wel* in different contexts, the connection between this form and the appropriate meaning is strengthened. Consider Tableau 4. In this tableau, the input is an utterance containing *wel* with a predicate Y and an entity x. The (relevant) context is an utterance (with a different predicate and entity) that implicates the negation of the utterance containing *wel*. The candidate interpretations 'correction', 'contrast', and 'implicit contrast' satisfy STRENGTH to the degree to which the semantic features they represent have a connection to the form *wel*. The form *wel* is connected to three semantic features. The interpretation 'correction' contains all three of them and therefore satisfies STRENGTH three times. The interpretation 'contrast' consists of two features and therefore receives two plusses for the constraint STRENGTH. 'Contrast' only consists of one feature. The concept that consists

of two unspecified features A and B, violates STRENGTH, since it contains two semantic features that are not connected to the form *wel*.

Form: *wel Y(x)* Context: W(z)→ ¬Y(x), {A, B}	FIT	STRENGTH
☞ Correction	+ - -	+ + +
Contrast	+ -	+ +
Implicit contrast	+	+
{A, B}	+ +	- -

Tableau 4: FIT and STRENGTH

Seeing the violation pattern in tableau 4, how do we know what the optimal candidate is? We know that for adults STRENGTH determines which candidates are possible interpretations for a given from. The constraint FIT determines which one of those possible interpretations is optimal given a certain context. FIT thereby outranks STRENGTH, which means that one violation of FIT is 'worse' than any number of violations of STRENGTH. Since children start out with no knowledge about what the possible candidates are, FIT must play a different role, a role which I described above. If we were now to rank FIT above STRENGTH, the concept {A, B} would be the optimal candidate. The experience with word forms could not influence the optimization process. However, if we were to rank STRENGTH above FIT, 'correction' would always be the optimal candidate. What we seem to need here is that not only the plusses and minuses outweigh each other within one constraint violation pattern but also between the two constraints. Interestingly, this is precisely how constraints interact in a close relative of Optimality Theory: Harmonic Grammar.

4.4.2.2.2 Harmonic Grammar

In the previous chapters I discussed Optimality Theory (OT). Harmonic Grammar (HG) is the predecessor of this theory and more closely related to connectionism. The most important difference between OT and HG is that OT hypothesizes that constraints are ordered according to a strict priority

ranking while in HG they are ranked according to numerical strength (Smolensky and Legendre 2006). In HG a structure is well-formed if it is maximally harmonic, that is, if it satisfies a set of soft constraints maximally. Similar to OT, constraints in HG are potentially conflicting. If two constraints are in conflict there is no output possible that satisfies them both. In that case the weight of the constraints determines which of the two is satisfied in the harmonic activation pattern.

HG is a connectionist grammar. That means that connectionism supplies the basic principles from which a more precise grammar formalism is derived (Smolensky 1994). In Chapter 2, I introduced the Integrated Connectionist/Symbolic Cognitive Architecture (ICS) (Smolensky and Legendre 2006). The central concept in the ICS theory of language is that of relative well-formedness or Harmony. The Harmony of an activation vector in a connectionist network is a numerical measure of the degree to which that vector respects the constraints encoded in the connectionist matrix: the degree to which the vector is well-formed, according to the connections. As an example, consider the simple network in Figure 4. In this network there is a negative connection between α and β, and a positive connection between γ and β.

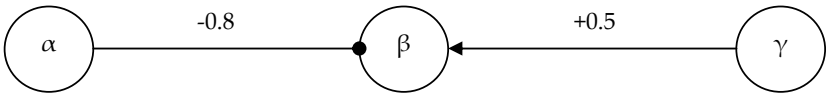


Figure 4: a simple connectionist network (Smolensky and Legendre 2006, p. 213)

With respect to this network a constraint like the following can be formulated: "if unit β is active, unit α should not be active". With respect to the single connection from β to α, the Harmony of a pattern **a** in which β and α are activated simultaneously, gets lowered. For example, a pattern in which α has an activation of +0.7 and β an activation of +0.4, Harmony is diminished by (+0.4) (-0.8) (+0.7) = -0.224. In general, the Harmony of an activation pattern is computed as: $H_{\beta\alpha} = a_\beta W_{\beta\alpha} a_\alpha$. The weight of the connection is multiplied with the weights of both units. If unit γ in activation pattern **a** is activated by +0.7 the Harmony with respect to the connection from γ to β is increased with (+0.4) (+05) (+0.7) = +0.140. The Harmony of pattern **a** with respect to both connections is the sum of the Harmony with

respect to the individual connections (-0.224 + 0.140 = -0.084). Applied to a whole network of units and the connections between them, the total Harmony of a pattern **a** in a network with connection weight matrix W is the sum of Harmony values of **a** with respect to all the individual connections. This is described by the following definition (Smolensky and Legendre 2006, p. 214):

$$H(\mathbf{a}) = \Sigma_{\beta\alpha}\, a_\beta\, W_{\beta\alpha}\, a_\alpha$$

HG assumes that activation flows through the network until a pattern is reached that has maximum Harmony. Maximum Harmony is reached by best satisfying all the connections in the network, or in other words, by best satisfying a set of soft constraints. This process runs as follows. First an input is imposed on a set of input units. The input units stay unchanged throughout the computation. Then, activation flows from the input units to other units and each unit repeatedly updates its activation value in response to the input from other units. Eventually the activation pattern settles and the pattern of activation is stable. Similar to OT, the result of harmony maximization can be visualized in a tableau.

Input: word	Weight 2	Weight 1	Harmony value
	Constraint 1	Constraint 2	
Interpretation 1	-1		-2
Interpretation 2		-3	-3
Interpretation 3	-1	-1	-3

Tableau 5: Harmonic Grammar

In the upper left box of Tableau 5 the input is given. The candidate interpretations are listed below this. In the middle columns the constraints are represented with the information about their weight. In this example the first constraint has a weight of 2 and the second constraint has a weight of 1. The weight of the constraint multiplied with the number of violations of that constraint gives the Harmony value, which is given in the final column. The first candidate violates the first constraint once, which leads to a Harmony of -2. Candidate interpretation 2 violates the second constraint three times, which leads to a Harmony value of -3. The third candidate violates both constraints once, which leads to a Harmony value of -3. The candidate with

the highest value is most harmonic, hence will emerge as the output for the given input. Note that the first candidate is optimal, despite the fact that it violates the higher ranked constraint.

Now that I have explained the basic architecture of Harmonic Grammar let me return to Tableau 3 with the two constraints FIT and STRENGTH. The tableau is represented below as a Harmonic Grammar tableau.

Form: wel Y(x) Context: ¬W(z)→Y(x), {A, B}	FIT	STRENGTH	Harmony
☞ Correction	+ - -	+ + +	+ +
☞ Contrast	+ -	+ +	+ +
☞ Implicit contrast	+	+	+ +
{A, B}	+ +	- -	0

Tableau 6: FIT and STRENGTH in Harmonic Grammar

In Tableau 6 the constraints have the same weight. With this interaction of the constraints, the weaker meanings of *wel* can only be at most as harmonic as their stronger co-candidates, since every violation of FIT by the stronger uses goes hand in hand with an extra satisfaction of STRENGTH. This undesired situation can be helped if we give the constraints varying weights. Any optimal interpretation will not be in conflict with the context. Therefore, FIT ultimately determines which interpretation becomes optimal and has a higher weight than STRENGTH. I have given them arbitrary weights of 3 and 2 respectively. In Tableau 7, the input is again a sentence containing *wel*, a predicate Y and an entity x. In the context a proposition W(z) is present that implicates the negation of the sentence containing *wel*. Furthermore a concept is present in the context that consists of the features A, B and C.

Form: wel Y(x) Context: W(z)→ ¬Y(x), {A, B, C}	FIT 3	STRENGTH 2	Harmony value
Correction	+ - -	+ + +	3
Contrast	+ -	+ +	4
☞ Implicit contrast	+	+	5
{A, B, C}	+ + +	- - -	3

Tableau 7: FIT and STRENGTH in Harmonic Grammar

The interpretation 'correction' has one positive connection to the context but two features of this interpretation are not present in the context. This results in a value -3 with respect to FIT. The result of the application of the second constraint is added to this. The candidate 'correction' satisfies STRENGTH three times, which results in a value of 6. The total Harmony value of 'correction' is (-3 + 6 =) 3. The Harmony value of 'contrast' is the sum of 0 for FIT and 4 for STRENGTH. The concept {A, B, C} fits the context but is not related to the form in question, which leads to three violations (one for each feature) for STRENGTH. The concept 'implicit contrast' consists of one feature which is both present in the context as well as related to the form *wel*. This leads to a Harmony value of 5, which makes this candidate optimal. Note that if STRENGTH would not play a role, the interpretation {A, B, C} would be optimal. The situation in Tableau 5 has the same result as the Optimality Theory analysis of the interpretation of *wel* in the previous chapter. However, the weight of STRENGTH develops gradually. A Dutch child gradually gains more experience with the form *wel* in different contexts. Let's assume a tableau that represents the optimization process of a language learner with less experience. Say the weight of STRENGTH is 1 for this instantiation of optimization, as is illustrated in Tableau 8. In this tableau we see that the interpretation 'implicit contrast' is not strong enough to overrule the interpretation {A, B, C}. Due to STRENGTH, however, it is as harmonic as the interpretation {A, B}. Only with a Harmonic Grammar-like interaction, the context may gradually lose its role as the only determinant in the interpretation of novel words. The influence of the context becomes less

important as the experience with word forms grows. By hearing the word in several contexts, eventually the right set of features will be associated with a form.

Form: wel Y(x) Context: ¬W(z)→Y(x), {A, B, C}	FIT 3	STRENGTH 1	Harmony value
Correction	+ - -	+ + +	0
Contrast	+ -	+ +	2
Implicit contrast	+	+	4
☞ {A, B, C}	+ + +	- - -	6
{A, B}	+ +	- -	4

Tableau 8: FIT and STRENGTH in Harmonic Grammar

4.4.2.2.3 Interdependence of the different uses in acquisition

In section 4.4.1, I referred to Zeevat (2007) who simulated the recruitment of already existing lexical items for new uses. The experiment showed that it is crucial to allow some overmarking in the model. This means that it is less harmful to communication if a hearer interprets more than the speaker intended, than when the hearer interprets less than the speaker intended. Zeevat argues that it is not problematic if the hearer assumes that a certain semantic aspect A is intended if it is not, it would be just a complication. On the other hand, it would be problematic if a semantic aspect B would not be recognized. Zeevat compares it to interpreting (8):

(8) (How about that baby?) It is cold

It does not have a contextual referent; it does not refer to the baby. A hearer should realize this before she can conclude that the sentence is about the weather. However, this vainly search for a referent is not a communication error, Zeevat argues, it is wasted energy. Similarly, a speaker can use the

form *F*, which usually expresses A and B, when it is common ground that feature A does not hold in a particular context, while intending the hearer to infer that B. Both speaker and hearer know that *F* cannot mean A when it is common ground that A is in conflict with the context.

A similar mechanism can be identified in the acquisition of *wel*; language learners can infer 'implicit contrast' from 'correction'. If we look at Tableau 9 we can see that, even if a language learner has never encountered the form *wel* with the meaning 'implicit contrast' this interpretation will be favored (it receives a plus) by the constraint STRENGTH.

Form: wel Y(x) Context: ¬W(z)→Y(x)	FIT 2	STRENGTH 1	Harmony value
Correction	+ - -	+ + +	0
Contrast	+ -	+ +	2
☞ Implicit contrast	+	+	4

Tableau 9: meaning deduction

Tableau 9 could be the representation of a person who has never interpreted *wel* as implicit contrast. However, the feature that constitutes 'implicit contrast' is also part of the representation of correction. The feature 'the proposition expressed by U_1 denies a negative proposition that was inferred on basis of U_2 and a certain issue' is therefore associated with the form *wel*. Since the other two features are not consistent with the context, the hearer can infer that this occurrence of *wel* marks an implicit contrastive relation. The acquisition of the stronger meanings of *wel* helps to acquire the weaker meaning of *wel*. This is what makes the acquisition of *wel* different from the acquisition of other polysemous words. In section 4.2.5 I discussed several studies on the acquisition of polysemous prepositions. One conclusion that was drawn in several studies was that children form a specific initial representation of the meaning of a word which changes as the experience with the form grows. For *wel* this is partially true. Children acquiring Dutch will initially have a restricted representation of *wel* which includes the two

strongest uses. However, because the weaker meaning is entailed by the stronger meanings, it can be inferred from the stronger meanings.

In this section I argued for a Harmonic Grammar interaction of constraints in the acquisition of *wel*. However, in chapter 3 we saw that the interpretation of *wel* (by adults) could be explained in an Optimality Theoretic framework. In the next section I will discuss this apparent discrepancy.

4.4.2.3 From Harmonic Grammar to Optimality Theory

In section 4.4.2.2.2, I showed that for a particular instantiation of optimizing the interpretation of *wel* a weight of 3 for FIT and 2 for STRENGTH gave the same result as the Optimality Theory analysis for the interpretation of *wel* that was discussed in Chapter 3. However, this situation cannot be the end-stage of acquisition since it leads to a problem similar to the one that was attested for the old definition of STRENGTH. An interpretation with an extra feature that is not associated with the form, but that is present in the context, will be most harmonic. In Tableau 10 we see that the first candidate is optimal, even though the feature B is not associated with the form. This will always be the case since an extra feature adds three points while it only costs two.

Form: wel Y(x) Context: ¬ Y(x), {A, B}	FIT 3	STRENGTH 2	Harmony value
☞ Correction+B	+ + + +	+ + + -	16
Correction	+ + +	+ + +	15
Contrast	+ +	+ +	10
Implicit contrast	+	+	5
{A, B, C}	+ + -	- - -	-3

Tableau 10: interpretation in Harmonic Grammar

For adults who have fully acquired a language we need the Optimality Theoretic interaction of constraints. We need a situation in which the context cannot add features to an interpretation, but only 'delete' features. In other words, we want a situation in which FIT is either violated or not and one violation is enough to reject a candidate. In Tableau 11 we see how this way of interacting leads to the desired outcome. Note that the constraint STRENGTH is also transformed into a conventional OT constraint again, which can only be violated (i.e. it can only get minuses and no plusses).

Form: wel Y(x) Context: ¬ Y(x), {A, B}	FIT	STRENGTH
Correction+B		*
☞ Correction		
Contrast		*
Implicit contrast		**
{A, B, C}	*!	***

Tableau 11: Optimality Theory again

Only the interpretation {A, B, C} violates FIT. Of the remaining candidates, the interpretation that has the most positive connections and the least negative connections to the form *wel* is optimal. So, we now have a situation in which the right result is obtained if two constraints interact differently in language acquisition and in interpretation by adults. In language acquisition, the constraints interact according to numerical weight while in adult interpretation they interact in an Optimality Theoretic manner. The change from Harmonic Grammar to Optimality Theory captures the idea that the context plays an important role in the acquisition of word meanings.

Legendre, Sorace and Smolensky (2006) entertain the possibility that knowledge relevant to language processing combines numerically weight constraint interaction (Harmonic Grammar) and strict domination of constraints (Optimality Theory). The part of the language system where rigid grammaticality applies, would be guided by constraints ordered according to strict domination while more pragmatic behavior might be

guided by constraints that reflect the statistical characteristics of experience more directly and that interact in a less restricted manner via arbitrarily weighed constraints. Legendre et al. hypothesize that in grammaticalization, constraints undergo a change from being of the latter type into being of the first type. I would like to propose that in the acquisition of meaning a similar transformation occurs. Children start the acquisition process with no information about the relations between words and meanings. (Experimental) research has shown that children use contextual information to infer the meaning of new forms. When they are presented with a word for the first time, the context is the only information children can rely on. However, once the words are properly acquired, the role of the context diminishes to a situation in which it can only 'choose' among the candidates that are possible interpretations with respect to STRENGTH. In both the initial stage as well as the end-stage, FIT is ranked higher than STRENGTH. Therefore, in this case, acquisition is not about obtaining the right ranking of the constraints, but about adjusting the type of interaction. Initially, the constraint FIT can favor or disfavor candidates to a certain degree. The most salient concept that is present in the context is optimal. When experience grows, the factor saliency gets competition from the factor experience. When a candidate interpretation has been associated with the given form before, it will have an advantage with respect to candidates that haven't. However, research on cross-situational learning showed us that multiple encounters are needed to eventually form the right link between form and meaning. This means that STRENGTH must develop gradually. The only path that leads to gradual development from an initial stage in which the context is the only source of information to the stage at which the context can only determine between the candidates that are allowed by the associations that are formed, is a path that allows for interaction of constraints in a Harmonic Grammarian way.

Although the constraint FIT maintains its higher ranking, it loses some of its power during the process. However, it still has a prominent role since an optimal interpretation must always be compatible with the context. From a constraint that can favor or disfavor constraints to a certain degree, it becomes a constraint that penalizes certain candidates in an all or nothing-manner. This change in the way constraints interact was not previously described in the literature. It could be the case that it is typical for semantic constraints in acquisition and perhaps even only for the constraints that capture the role of the context.

4.5 Conclusions

In this chapter I examined the acquisition of the different meanings of *wel* I discerned in Chapter 3. I have shown that the pattern of usage by children differs significantly from the pattern of adults. The strongest meaning of *wel* is strikingly rare in the adult usage of *wel*. However, despite the rarity in the input, children use *wel* to express the strongest meaning in over 26% of the cases. Moreover, while adults use *wel* to express 'implicit contrast' in the absolute majority of the cases (over 56%), this category constitutes only 15,1 percent of the child data. Furthermore, correction generally seems to be acquired earlier than implicit contrast.

I argued that the fact that the implicit contrastive use of *wel* has 'less meaning' than the corrective and contrastive use makes it compatible with more situations and therefore more frequent. We can therefore explain the negative correlation between semantic strength and frequency for *wel*. Furthermore, this pattern of frequency and semantics is related to the acquisition of the word. The fact that the implicit contrastive use of *wel* is suitable for many situations makes it difficult for language learners to infer the meaning from the context. The weaker meanings are on the one hand applicable to more situations but on the other hand more difficult to infer from the context.

I argued that in the initial stage of acquisition the context is the only source of information in interpretation. The constraint FIT is the only determinant in the optimization process. The factor context gets competition when the experience with the words of the target language grows. Gradually STRENGTH becomes more important. The same two constraints that explain interpretation also determine the acquisition of words. However, the way the constraints interact differs. Whereas in interpretation the constraints are ordered according to a strict priority ranking, in acquisition they are ranked according to numerical strength.

Chapter 5
Faithful forms through matching features

5.1 Introduction

In Chapter 1, I argued that there is no one-to-one correspondence between forms and meanings. In Chapter 3, we saw how the hearer comes to an optimal interpretation upon hearing a form. In Chapter 4 we saw how a child determines the meaning of a new word. In this chapter I will elucidate on the perspective of the speaker. When a speaker wants to express something, there could very well be no form available that perfectly corresponds with the intended meaning. If every slightest difference in meaning resulted in a different form, every language would consist of an innumerable amount of lexical items. In this chapter, I will show that, similar to the interpretation of words, the production of words is determined by a process of optimization. Words do not have to match the intended meaning perfectly, as long as they are optimal, that is, as long as they are a better fit than their competitors.

In section 5.2, I discuss Zwarts' (2008) analysis of the use of prepositions. Zwarts shows how a speaker chooses between the available propositions when she intends to express a particular spatial relation. He shows that a speaker chooses the preposition that best expresses the intended meaning, based on a set of ranked constraints. In other words, the speaker chooses the *optimal* form. I will argue that the constraint ranking Zwarts proposes can be allocated to a mechanism similar to the constraint STRENGTH in interpretation; the speaker chooses the form that has most overlapping semantic features with respect to the input.

Another indication that word choice involves optimization lies in the process of semantic change. The relation between words and meanings may change over time or in the origin of new varieties of a language. Due to a different constraint ranking, a different word may become optimal for the same intention. In the beginning of this process, a speaker uses a form to express a meaning that is different from its conventional meaning at that time. This creates a risk of being misunderstood, but uttering this word was the best way of communicating the intended meaning. In section 5.3 I will

discuss two analyses of semantic change that show that the expression of a particular intention may change due to a different constraint ranking.

Optimization is not limited to functional items, which are notoriously vague and polysemous. Even content words do not always match the intended meaning perfectly. This becomes apparent in the code switching behavior of bilingual speakers. In principle, bilingual speakers have two words corresponding to a particular meaning. Usually, speakers choose the word of the same language as the rest of the sentence. However, sometimes they insert words from their other language. In section 5.4 I will show that insertions are the result of the competition between (at least) two candidates, namely the lexical equivalents from both languages.

5.2 Optimization in the use of prepositions

Zwarts (2008) models the mapping from spatial meaning to prepositions in an Optimality Theoretic framework. In his model, the input is a bundle of features and the candidates are formed by a set of words from a particular language that express one or more of the input features. Every semantic feature corresponds to a faithfulness constraint FAITH(F_i). This constraint is violated if the relevant feature is part of the input but is not reflected in the output. Say, the input is the set of features F and G: {F, G}. There may be three relevant candidate words for this input, namely a word that expresses F (WORD$_F$), a word that expresses G (WORD$_G$) and a word that expresses F and G (WORD$_{F,G}$). However, Zwarts assumes that prepositions maximally express one feature. The choice is therefore between WORD$_F$ and WORD$_G$. There are two constraints relevant to this situation, FAITH(F) and FAITH(G). The question is which faithfulness constraint is ranked higher, that is, which feature is more important to express. Tableau 1 illustrates the optimization process in a situation in which FAITH(F) is ranked higher than FAITH(G).

{F, G}	FAITH(F)	FAITH(G)
☛ (WORD$_F$)		*
(WORD$_G$)	*	

Tableau 1: lexical optimization

In Tableau 1, the input consists of the features F and G and there are two relevant candidates (WORD$_F$) and (WORD$_G$). Since FAITH(F) is ranked above FAITH(G), (WORD$_F$) is the optimal expression for the input.

Zwarts (2008) applies this model to the production of prepositions. Prepositions typically express a relation between a Figure and a Ground. The Figure is an entity which is moved or which is conceptually potentially moveable with respect to a specific Ground (Asbury et al. 2008). In for example the sentence *a spider crawled over the floor*, the spider functions as the Figure and the floor is the Ground.

Zwarts argues that the English preposition *in* is associated with the semantic feature CONTAINMENT (CONT), which means that the Figure is contained by the Ground. The preposition *on* is associated with the feature SUPPORT (SUP), which means that the Figure is supported by the Ground. There are relations between a Figure and a Ground that can be characterized as pure CONTAINMENT, such as a fish swimming in the water, or as pure SUPPORT, such as a cup being on the table. However, Zwarts focuses on the situations in which both CONTAINMENT and SUPPORT apply. In a situation of a pen being in a box, for example, the pen is both contained and supported by the box. The example already shows that such a relation between Figure and Ground is expressed by the preposition *in*. Zwarts argues that this is due to the fact that the relation CONTAINMENT takes priority over the relation SUPPORT. He therefore concludes that FAITH(CONT) is ranked higher than FAITH(SUPP). This yields the following tableau.

{CONT, SUPP}	FAITH(CONT)	FAITH(SUPP)
☞ in_{cont}		*
on_{supp}	*	

Tableau 2: *in* versus *on*

The input to Tableau 2 consists of the features CONTAINMENT and SUPPORT. The two relevant candidates are *in*, which only expresses the feature CONTAINMENT, and *on* which only expresses the feature SUPPORT. Both candidates leave one feature unexpressed but since it is more important to be faithful to the feature CONTAINMENT than it is to be faithful to SUPPORT, *in* is optimal.

A similar analysis is provided for the preposition *on* versus *over/above*. When a Figure is supported by a Ground, the Figure is typically also higher than the ground. This relation is captured by the feature SUPERIOR (SUP). This results in the feature set {SUPPORT, SUPERIOR}. However, it is not necessarily the case that the Figure is higher than the Ground when the preposition *on* is used. In a situation where a painting is *on* a wall, the wall is usually not below the painting. Therefore, Zwarts argues, SUPPORT is the defining feature

of *on*. When the feature SUPPORT is absent and only the feature SUPERIOR applies, for example in a situation where a bird flies over a house, the preposition *above* or *over* can be used. So, when only the feature SUPPORT applies (as in the example of a picture on the wall), or when both features apply (when for example a vase is on a table) *on* is used while in situations where only SUPERIOR applies (as in the example of a bird flying over a house), *above* or *over* is used. This indicates that FAITH(SUPP) is ranked higher than FAITH(SUPER), as is indicated in Tableau 3.

{SUPP, SUPER}	FAITH(SUPP)	FAITH(SUPER)
☞ on$_{supp}$		*
above$_{super}$	*	
over$_{super}$	*	

Tableau 3: *on* versus *above*/*over*

In Tableau 3, the input is the set of features {SUPPORT, SUPERIOR}. The relevant candidates are *on*, which expresses SUPPORT, and *above* and *over*, which express the feature SUPERIOR. Again, the choice for any word leaves one feature unexpressed, but faithfulness to the feature SUPPORT is more important than faithfulness to the feature SUPERIOR.

A similar relation holds between the prepositions *around* and *over*. The preposition *over*, in for example *the bird flew over the yard*, describes that an object moves along a path that is located above the Ground. This use of *over* expresses the features {PATH, SUPERIOR}. Whether the path follows a straight line or is curved or whether the path contacts the ground is not specified. The preposition *around* is specified for expressing the feature CONVEX. Often, *around* is used for horizontal paths, as in *the car drove around the barrier*, but Zwarts argues that the feature HORIZONTAL cannot be an inherent lexical feature because *around* can also be used with paths with a vertical orientation. In a situation in which a vertical path completely encloses the Ground, for example in a situation in which an airplane makes a loop around a bridge, *around* can be used. Now, when both the features SUPERIOR and CONVEX are part of the input, in addition to the feature PATH, for example in a situation where someone climbs over a wall, the proposition *over* will be chosen, which shows that FAITH(SUPERIOR) is ranked higher than FAITH(CONVEX). This is illustrated in Tableau 4.

{SUPER, CON, PATH}	FAITH(SUPER)	FAITH(CONV)
around$_{conv}$	*	
☞ over$_{super}$		*

Tableau 4: *around* versus *over*

The priorities that were distinguished by Zwarts (2008) lead to the following ranking of constraints:

(1) FAITH(CONTAINMENT) >> FAITH(SUPPORT) >> FAITH(SUPERIOR) >> FAITH(CONVEX)

Zwarts (2008) offers the following explanation for the hierarchy. Usually, when an object is held by a container, this object is also supported by it. Therefore, situations that involve CONTAINMENT typically involve SUPPORT as well. Similarly, situations that involve SUPPORT typically involve the feature SUPERIOR, since an object that is supported by another object, say a vase by a table, is usually also superior to it. Furthermore, paths with the feature SUPERIOR typically also have the feature CONVEX. When a cat jumps over a hedge, for example, it also follows a path that is curved around the hedge.

So, *in* expresses CONTAINMENT and although CONTAINMENT typically brings along the feature SUPPORT, Zwarts argues that this feature cannot be an inherent lexical feature of the form *in*, because it is not applicable to every situation in which *in* is used. However, in Chapter 3 we saw that features that are associated with a form can be dismissed by the context. So, the fact that SUPPORT is not part of every interpretation of *in*, does not necessarily mean that it is not an inherent lexical feature of this preposition. Zwarts argues for an account in which meanings may be strengthened by the context due to pragmatic principles. In line with the analysis of *wel* in Chapter 3, I would like to propose that a form is associated with a meaning (a set of features) which can be weakened by the context. This way the entailment relation between the features is reflected in the candidates rather than in the constraints. The advantage of this approach is that the choice for one preposition over the other can be explained by a more general principle of faithfulness to the input. Say, *in* is associated with both the features CONTAINMENT and SUPPORT and *on* is associated with SUPPORT. When the input is the set of features {CONT, SUPP} the preposition *in* is optimal since it satisfies both FAITH(CONT) and FAITH(SUPP). The hierarchy in (1) can then be explained by the existence of an entailment relation between the features. If

the property CONTAINMENT is absent in the output, this entails a violation of more features than when the property SUPPORT is absent. I propose a general faithfulness constraint that demands that input features are present in the output: FAITHFEAT.

FAITHFEAT: features in the input must be reflected in the output

The constraint FAITHFEAT is similar to a well-known constraint in phonology, MAX, which requires all input segments to have output correspondence (see for example Legendre and Smolensky, 2006, p. 44)

Naturally, violating the FAITHFEAT constraint twice is worse than violating it only once. This can be implemented in Optimality Theory by means of a *power hierarchy* of constraints. A power hierarchy is a mechanism that yields a universal sub hierarchy of constraints, used amongst others by Smolensky (1995) and Legendre Smolensky and Wilson (1998). Legendre, Sorace and Smolensky (2006) make use of a power hierarchy to analyze auxiliary selection in the Romance languages. I will shortly discuss their analysis in order to clarify the notion *power hierarchy*.

5.2.1 Power hierarchy

In many languages, there are two classes of intransitive verbs: unaccusatives and unergatives. The two verb classes have different syntactic properties. To account for these differences, Perlmutter (1978) formulated The Unaccusative Hypothesis: certain intransitive clauses have an initial second argument but no initial first argument. This means that the argument of unaccusatives is a deep underlying object. The argument of unergatives, on the other hand, is a subject at all levels of representation. The difference is represented in (2) (Legendre, Sorace and Smolensky 2006, p. 356).

(2)	a. Unergative:	NP [VP V]	deep subject	e.g., *he works hard*
	b. Unaccustaive:	__ [VP V NP]	deep object	e.g., *he died recently*

This difference results in a difference in the syntactic contexts in which unergatives and unaccusatives can appear. These contexts can therefore serve as tests for unaccusativity or unergativity. However, across languages, equivalent verbs may behave as unaccusative in one language and as unergative in others. Furthermore, within one language the same verb may behave as an unaccusative in one context and as an unergative in another. These two observations are called *unaccusative mismatches*. Semantically,

unergatives correlate with the feature agentivity and unaccusatives with patienthood but there is no one-to-one mapping.

As an answer to the problem of the unaccusative mismatches, Legendre, Sorace and Smolensky (2006) follow Sorace (2000) who claims that unaccusativity and unergativity are gradient notions. One of the best tests to identify unaccusativity is auxiliary selection. Sorace (2000) proposes an auxiliary selection hierarchy to account for the selection of two types of auxiliaries: (the equivalents of) *be* and *have*. Sorace argues that there are core unaccusatives, which always select *be* and core unergative verbs, which always select *have*. In addition, there are more peripheral unergative and unaccusative verbs, whose auxiliary selection may differ cross-linguistically and within a language. The set of core unaccusative verbs are formed by verbs that express a telic dynamic change (e.g. *arrive*). The set of core unergative verbs are formed by verbs that express agentive nonmotional activity (e.g. *work*).

Legendre, Sorace and Smolensky (2006) build on this analysis in their model of auxiliary selection. They distinguish a set of event properties on which the selection depends. The features in (3) are identified as comprising the smallest set of features to exhaustively characterize auxiliary selection in Romance (Legendre, Sorace and Smolensky 2006, p. 363). The underlining indicates the abbreviations used later on.

(3) Event features: INHERENT DISPLACEMENT, INHERENT HOMOGENEITY, TELICITY, DIRECTION, STATE, INHERENT VOLITION, INTERNAL MOTION

The event features in (3) determine auxiliary selection. This is realized by harmonic alignment, a mechanism that interrelates prominence scales. The basic idea of harmonic alignment is that some combinations or associations in language are favored over others. For the present analysis two scales are introduced: the grammatical relation scale (4) and the event feature scale (5) (Legendre, Sorace and Smolensky 2006, p. 366).

(4) Grammatical relation scale: 1 (subject) > 2 (object)

(5) Event feature scales:

a. Displacement:	-DIS > +DIS
b. Homogeneity:	+HOM > -HOM
c. Telicity:	-TE > +TE
d. Directed change:	-DIR > +DIR

e. State	-ST > +STATE
f. Inherent volition	+VO > -VO
g. Internal motion	-MO > +MO

The scales (4) and (5) can be aligned, so that they reflect the markedness of the mapping of certain features to a certain grammatical role. This is shown in (6) (Legendre, Sorace and Smolensky 2006, p. 366). The symbol > means 'more harmonic' or 'less marked'.

(6) Harmonic alignments

a. 2/telic	> 1/telic	The mapping of +TE onto an unaccusative configuration (underlying 2) is less marked than the mapping of +TE onto an unergative configuration (underlying 1).
b. 1/atelic	> 2/atelic	
c. 2/telic	> 2/atelic	
d. 1/telic	> 1/atelic	
e. etc.		

The alignment of the two scales in (6) corresponds to a hierarchy of constraints, which function as a ban on less harmonic combinations. The constraint hierarchy looks as follows (Legendre, Sorace and Smolensky 2006, p. 366). The symbol » indicates the relation "more dominant".

(7) Constraint alignments

a. *1/telic	» *2/telic	'Don't map +TE onto an unergative configuration' outranks 'Don't map +TE onto an unaccusative configuration'.
b. *2/telic	» *1/atelic	
c. *2/atelic	» *2/telic	
d. *1/telic	» *1/atelic	
e. etc.		

Crucially, there is an implicational relation among the features in (3), except for the feature MO. The implicational hierarchy is given in (8).

(8) +DIS –HOM +TE +DIR +ST –VO.

This hierarchy means that if an event exhibits the feature +DIS it will also have the features –HOM, +TE, +DIR, +ST and -VO. If an event comprises the feature –HOM it will include +TE, +DIR, +ST and –VO. Etc. The set of features in (8) constitutes the prototypical unaccusative verb, which always selects the auxiliary *be*. In view of the implicational relation between the features, Legendre, Sorace and Smolensky (2006) define a set S of features that prefer the 2-role and a corresponding constraint *1/S that puts a ban on the combination of a member of this set with the 1-role. The constraint *1/S is an encapsulated constraint and is violated each time a constraint in {*1/f | f ∈S} is violated.

Naturally, violating *1/S six times is more marked than violating it only once. This results in the fact that it is worse to use the auxiliary (equivalent to) *have* in combination with the verb *arriver* 'arrive' than to use it with the verb *suer* 'swet', because *arriver* violates the constraint *1/S six times (it has six features dispreferring the first role) while *suer* only violates it once (it has only one feature dispreferring the unergative configuration). This is implemented by an OT power hierarchy. Two equivalents of this hierarchy are presented in (9) (Legendre, Sorace and Smolensky 2006, p. 367).

(9) Universal Mapping Constraint Hierarchy
a. F^6 » … » F^2 » F^1 (GR/ event semantics mapping)
b. *1/ +DIS » *1/–HOM » *1/+TE » *1/+DIR » *1/+ST » *1/–VO

In (9a), a general power hierarchy is presented. The constraint F^k is violated when F is violated k or more times. Any candidate that violates F^6 will also violate F^5 (and F^4, F^3, F^2 and F^1). The hierarchy indicates that violating a constraint six times constitutes a bigger violation than violating the same constraint five times. In (9b) the specific hierarchy for auxiliary selection is given. Any candidate that violates *1/+DIS will also violate *1/–HOM (and *1/+TE, *1/+DIR, *1/+ST and *1/–VO).

As mentioned, there is also within-language variation with respect to the auxiliary selection of certain verbs. This is modeled by applying partial ranking with a floating *2 constraint. If constraints are partially ranked, there is indeterminacy with respect to their relative ranking. A partial ranking therefore yields a set of total rankings, which potentially results in different outputs for the same input. The partial ranking of the *2 constraint and the Universal Mapping Constraint Hierarchy is illustrated in (10) (Legendre, Sorace and Smolensky 2006, p. 372).

(10) Fixed: *1/ +DIS » *1/–HOM » *1/+TE » *1/+DIR » *1/+ST »

Floating: ⟵ *2 ⟶

The partial ranking in (10) corresponds to the total rankings in (11) (Legendre, Sorace and Smolensky 2006, p. 372).

(11) a. *2 » *1/ +DIS » *1/–HOM » *1/+TE » *1/+DIR » *1/+ST
b. *1/ +DIS » *2 » *1/–HOM » *1/+TE » *1/+DIR » *1/+ST
c. *1/ +DIS » *1/–HOM » *2 » *1/+TE » *1/+DIR » *1/+ST
d. *1/ +DIS » *1/–HOM » *1/+TE » *2 » *1/+DIR » *1/+ST

Let us now return to the analysis of the production of prepositions. Zwarts (2008) argues that a situation in which CONTAINMENT applies is typically a situation where SUPPORT applies as well. For example, a pen that is contained by a box is also supported by that box. Furthermore, if SUPPORT is applicable in a certain situation, the feature SUPERIOR is typically applicable as well. A vase that is supported by a table is also superior to it. Moreover, if a path has the feature SUPERIOR, it typically has the feature CONVEX as well. A cat that climbs over a wall follows a curved path around this wall. Based on these observations, we can identify two feature hierarchies, one for locations (12) and one for paths (13).

(12) Location feature hierarchy: CONTAINMENT > SUPPORT > SUPERIOR

(13) Path feature hierarchy: SUPERIOR > CONVEX

The feature hierarchies correspond to two constraint hierarchies, represented in (14) and (15). Note that, in contrast to the hierarchy in Legendre, Sorace and Smolensky (2006), (14) and (15) are hierarchies of faithfulness constraints, indicating a universal faithfulness hierarchy. As Zwarts argues, these preferences in lexical selection are probably not subject to cross-linguistic variation. This means that, across languages, it is more important to be faithful to the feature CONTAINMENT than it is to be faithful to the feature SUPPORT.

(14) Faithfulness Hierarchy locations: FAITH(CONT) >> FAITH(SUPP) >> FAITH(SUPERIOR)

(15) Faithfulness Hierarchy paths: FAITH(SUPERIOR) >> FAITH(CONVEX)

Let us see if the reformulation of the relation between the features and constraints still yields the right result. In a situation in which the input is the set of features {CONT, SUPP} the preposition *in* is optimal since it satisfies both FAITH(CONT) and FAITH(SUPP).

{CONT, SUPP}	FAITH(CONT)	FAITH(SUPP)
☛ $in_{cont,\ supp}$		
on_{supp}	*	

Tableau 5: *in* versus *on* 2

In Tableau 5, the input is the feature set {CONT, SUPP}. The relevant candidates are *on*, which expresses SUPPORT and *in*, which now expresses both CONTAINMENT and SUPPORT and thereby satisfies both constraints. This tableau yields the right result, similar to Zwarts' analysis. The difference is that the result now reflects the explanation given by Zwarts concerning the typical entailment relations between features. Furthermore, the result is explained by a more general principle of faithfulness to the input, since the choice for *in* results in faithfulness to two features while the choice for *on* results in faithfulness to only one feature.

If the input is the feature SUPPORT, both candidates are equally well since they both satisfy FAITH(SUPP) and FAITH(CONT) does not apply, as is illustrated by Tableau 6.

{SUPP}	FAITH(CONT)	FAITH(SUPP)
☛ $in_{cont,\ supp}$		
☞ on_{supp}		

Tableau 6: *in* versus *on* 3

This incorrect outcome can be helped if we introduce a constraint that is well-known in phonology, DEP (see for example Smolensky 2006, p. 44).

DEP: Do not express features not present in the input.

The constraint DEP is violated by candidates that express a feature that is not part of the input. If we apply this constraint to the situation in Tableau 6, this yields the correct result, namely that *on* is used when only SUPPORT is in the input, as is represented in Tableau 7.

{SUPP}	FAITH(CONT)	FAITH(SUPP)	DEP
$in_{cont, supp}$			*
☞ on_{supp}			

Tableau 7: *in* versus *on* 4

If only the feature CONTAINMENT is in the input, *in* is still optimal, which is illustrated in Tableau 8.

{CONT}	FAITH(CONT)	FAITH(SUPP)	DEP
☞ $in_{cont, supp}$			*
on_{supp}	*		*

Tableau 8: *in* versus *on* 5

In Tableau 8, the optimal candidate violates DEP, but because there is no candidate available that has only expresses the feature CONTAINMENT, *in* is still optimal.

5.2.2 Conclusions

The analysis by Zwarts (2008), in this slightly alternated version, very clearly illustrates my main point. *Words do not have to be perfect, as long as they are optimal*. The choice for a word is the outcome of a competition between several candidates. In a situation where only the feature SUPPORT applies, for example in a situation where a vase is on a table, *in* is not optimal because it violates DEP. In a situation where only CONTAINMENT applies, for example when a fish is swimming in the water, *in* also violates DEP but is nonetheless optimal because in this case there is no better candidate available. There is no form available that only expresses the feature CONTAINMENT. Therefore the optimal choice is the item that expresses CONTAINMENT and SUPPORT. Note that the question of why there is no such form available (presumably because situations in which CONTAINMENT applies but SUPPORT does not, are rare, as Zwarts indicates) is not in focus.

In the next section, I will discuss the role of optimization in semantic change. I will show that words may gain new expressive functions, due to a different ranking of the relevant constraints.

5.3 Optimization and semantic change

The relation between words and meanings may change over time or in the origin of new varieties of a language. Due to a different constraint ranking, a different word may become optimal for the same input. In the previous section we saw that a speaker can use a lexical item that is associated with a set of features to express a subset of those features. Fong (2005) shows that a similar mechanism is active in the use of the adverb *already* in Colloquial Singapore English (CSE). Fong argues that in CSE the use of *already* is the result of the interaction of markedness and faithfulness constraints. I will discuss her analysis in the next section. Furthermore, a same mechanism plays a role in semantic change during evolution. This will be addressed in section 5.3.2.

5.3.1 The use of already *in Standard English and Colloquial Singapore English*

Already has three different aspectual readings in CSE: 'near future', 'just started', and 'ended'. The readings are illustrated in (16) (Lim 2001, cited in Fong 2005).

(16) She beat the eggs already
  a. She is (already) going to start beating the eggs (near future)
  b. She has (already) started to beat the eggs (just started)
  c. She has already beaten the eggs (ended)

Next to its use as a marker of aspect, it has the same properties as *already* in Standard English, namely that it comes with an anteriority presupposition. Fong follows Michaelis (1992, 1996) who states that 'already not only encodes the existence of a given state of affairs at reference time, but also presupposes the anteriority of that state of affairs to an interval of a specific type (Michaelis 1992, cited in Fong 2005). Example (17) (Michaelis 1992, cited in Fong 2005) illustrates that *already* expresses that the state of having curly hair exists prior to the possible occurrence of getting a permanent.

(17) Why would you need a permanent? You already have curly hair.

This anteriority presupposition is the cause of the infelicity in Standard English of *already* in (18) in a context in which the speaker of the sentence has been waiting for the baby to wake up for a long time (Fong 2005).

(18) #Finally, the baby has woken up already! Now we can leave.

However, in CSE, *already* can occur in such a context if it is used as an aspectual operator, as in (19).

(19) Finally, the baby wake up already! Now we can leave
'…the baby has woken up!…'

In (19), *already* is used as an aspectual marker and there is no anteriority presupposition. This example shows that the anteriority presupposition may be suspended in SCE. We can conclude that in CSE *already* has multiple functions; it can mark several aspectual meanings (as was illustrated in (16)) and it can be used with the anteriority presupposition as in (17), similar to *already* in Standard English. This brings up the question about the commonality in the several uses of *already*.

Michaelis (1992, 1996, cited in Fong 2005) claims that *already p*, presupposes that the beginning of *p* takes place before a Reference Interval (RI). The RI includes the start of a situation *p'* which is of the same type as the situation denoted by *already p*. Consider example (17) again. In (17), the RI is the interval during which the hearer gets a perm in order to get curly hair (*p'*). The situation *p* in which the hearer has curly hair, is prior to getting the perm. Some have claimed that part of the semantics of *already p* is that there is a prior state ¬*p*. However, Fong argues that the interpretation of a prior state ¬*p* is due to pragmatics and not encoded by the use of *already*. She thereby follows Mittwoch (1993) who claims that the preceding phase ¬*p* 'derives solely from the pragmatic meaning of *schon* [the German equivalent of *already*, L.H.]/*already* … which involves temporal comparison of some kind' (Mittwoch 1993, cited in Fong 2005).

Based on these observations, Fong argues that *already*, as used in Standard English, introduces a meaning of contrasting phases, that is, two distinct phases separated by a transition point. For example, in the sentence *the mice have already eaten the cheese*, the first phase is one where the mice have not yet eaten the cheese and the second phase is one where they have. In a sentence like (20) (Fong 2005), the sentence asserts states that do not involve a change, but the RI still includes contrasting phases.

(20) The baby is already rich. [*Of a baby who gets an inheritance at birth*]

The sentence in (20) involves a comparison between two points on a temporal scale. The baby is rich at a point in time earlier than the point in the RI at which people normally become rich.

When *already* is used with one of the aspectual meanings ('near future', 'just started' or 'ended') in CSE, it also indicates the presence of contrasting phases. When *already* is used to indicate that an eventuality has 'ended', it marks the presence of an eventuality E that has ended and is followed by a situation not-E (E<not-E). When *already* indicates that an eventuality has 'just started', it marks the change form not-E to E (not-E<E). Finally, when *already* is used to indicate that an eventuality is expected to start in the near future, the reference point is in a state not-E, before the expected start of E (not-E<E).

Fong concludes that all uses of already involve contrasting phases. Therefore, she argues for the following generalization:

(21) In both Standard English and CSE, *already* encodes the meaning of contrasting phases, but entails nothing about the ordering of phases.

The core meaning of *already* in both Standard English and CSE therefore consists of two features: diphasic and the aforementioned anteriority presupposition.

The situation in which *already* is used to indicate that an eventuality has ended, can be described as *perfective*. In addition to the use of the adverb *already* together with the verb in its base form (as illustrated in (16c)), the perfect meaning can be expressed in two other ways in CSE. It can be expressed by the same means as in Standard English, using the *have V-en* form and it can be expressed by a main verb in participle form. Fong analyses the expression of the present perfect meaning in Standard English and CSE in Optimality Theory. The semantics of the present perfect is defined as a state S that results from the occurrence of a certain event E (i.e. an event structure comprising contrasting phases) and an ordering of the two E<S. The present tense is treated as having a finite nature. So, the semantics of the present perfect consist of three features: diphasic, E<S and finite. In finding the optimal expression for this input, the following constraints are at work:

Markedness constraints:
*VSTR: Avoid verb structure (verbal morphology, structural complexity in the verb phrase, e.g. recursive VP structure)

Faithfulness constraints:
MAX: Express input features
DEP: Do not express features not present in the output

The markedness constraint is a variant of a well-know family of constraints in Optimality Theory against complex structures, *STRUCTURE (Prince and Smolensky 1993/2004). The faithfulness constraints were introduced before in this chapter. Both constraints are actually families of constraints. For her purpose, Fong formulates three more specific constraints:

M(ASP): Express input aspectual contrasts
M(TNS): Express input finiteness contrasts
M(AGR): Express input agreement features

In Tableau 9 the ranking that gives the right output for Standard English is given.

[fin[diphasic; E<S[she beat 3SG the eggs]]]	DEP	M(ASP)	M(T)	M(AGR)	*VSTR
☛ She has beaten…					***
She beat…		**!	*	*	
She beat…already	*!	*	*	*	
She beats…		**!			*
She beats…already	*!	*			*
She beaten…			*!	*	*

Tableau 9: Standard English *has*-en (Fong 2005, p. 11)

The input to Tableau 9 is the set of three features that define the perfect meaning: diphasic, E<S and finite. **N**ote that what counts as a violation of *VSTR is any type of verbal affixation or any recursive VP structure (auxiliary+V, e.g. *have*+V). Introducing any feature not given in the input counts as a violation of DEP and not having a feature in the output that is part of the input, yields a violation of the relevant MAX constraint. In

Standard English, the *have V-en* form is optimal since it is faithful to every feature in the input. The *have V-en* form violates the constraint *STR three times but since this constraint is ranked below the faithfulness constraints, this form is the optimal expression for the input.

In CSE, verbal morphology can be absent. Therefore, *VSTR is ranked above the other constraints in CSE, as is illustrated in Tableau 10. To express the aspectual meaning, *already* is used, which has the relevant feature diphasic as part of its semantics. However, since *already* also expresses an additional feature, the anteriority presupposition, it violates DEP. Furthermore, *already* does not express the ordering of the phases (E<S) which results in a violation of a MAX constraint.

[fin[diphasic; E<S[she beat 3SG the eggs]]]	*VSTR	M(ASP)	M(T)	M(AGR)	DEP
☛ She beat …already		*	*	*	*
She has beaten…	***!				
She beats	*!	**			
She beats…already	*!	*			*
She beaten…	*!		*	*	
She beat…		**!	*	*	

Tableau 10: CSE V+*already* (Fong 2005, p. 12)

Tableau 10 shows that the optimal expression for the given input is *she beat … already.* This form violates all three faithfulness constraints and DEP, but since *VSTR is ranked highest, it is still optimal. Due to this constraint ranking, CSE can use the unmarked (simple) form *already* to express perfective aspect. However, this cannot be the whole story. Since CSE can use other strategies to mark the present perfect too, a partial ordering of some constraints must be assumed. When constraints are partially ordered, their mutual ranking is unspecified which leads to variation in the output. In (20) three sample total rankings that generate the available forms are given.

(22) M(ASP) >> M(AGR) >> DEP >> *VSTR: *She has beaten the eggs.*
M(ASP) >> *VSTR >> M(AGR) >> DEP: *She beaten the eggs.*
*VSTR >> M(ASP) >> M(AGR) >> DEP: *She beat the eggs already.*

The OT-analysis by Fong (2005) shows how new varieties of English can use the availability of unmarked forms in English. Fong argues that the

expression of aspectual meanings in CSE can be seen as a competition of different forms to satisfy two requirements that are in conflict, namely the faithful expression of an input and the avoidance of marked verbal structures. The unmarked form *already* can be used because it has a relevant semantic feature as part of its semantics. A similar mechanism plays a role in semantic change during language evolution.

5.3.2 Semantic change during evolution

Zeevat (2006) shows that during a process of recruitment a word may be used to express a new function that consists of a subset of the features of the old function. In Zeevat (2006) an experiment is conducted to recreate recruitment in an evolutionary simulation system. One speaks of recruitment when a language adopts a lexical word to fill in a gap in the functional domain or when a functional word acquires a new functional use. The experiment is performed by creating an update function in a corpus of form meaning pairs. The corpus is represented as a function from form-meaning pairs to probabilities. The probability is the number of times the form was used to express a particular meaning divided by the total number of times anything was used to express any meaning.

In the initial stage of the experiment there is a form F which expresses the meaning M_1. In addition, there is a meaning M_2 which is weakly entailed by M_1. Weak entailment between meaning M_1 and M_2 means that if M_1 is true in a certain context, M_2 is more likely to be true in the same context than it is to be false. M_1 is therefore stronger than M_2, with the notion *strength* used with the same definition as in Chapters 3 and 4. The meaning M_2 is not expressible in the initial stage, which means that it shares the null-form with the meaning which contains no semantic features. I will refer to this meaning by $\neg M_1 \,\&\, \neg M_2$. The experiment shows that if the following requirements are met, the form F will start meaning M_2. First of all, the meanings M_1 and M_2 should be less frequent than respectively $\neg M_1$ and $\neg M_2$. Furthermore, the meaning M_2 should be important, which means that not recognizing it is worse than overinterpreting it as meaning M_1. This is realized in the model by counting only half a failure in communication when the hearer interprets M_1 when only M_2 was intended, while not recognizing M_2 at all is a complete failure.

The change of meaning is mainly caused by the fact that the meaning M_2 is dominated by the meaning $\neg M_1 \,\&\, \neg M_2$, as the interpretation for the null-form. This means that a hearer confronted with the null-form interprets $\neg M_1 \,\&\, \neg M_2$, while the speaker intended M_2. Because of the tolerance for

overmarking, communication will become more successful if the speaker chooses F to express the meaning M_2. Especially when the combination of the form F with the meaning M_2 becomes more frequent, the chance that the hearer will make the correct interpretation will grow. Furthermore, Zeevat argues that if the meaning M_2 is more frequent than the meaning M_1, M_2 will even take over the form, which means M_1 can no longer be expressed by F. Otherwise the form F remains ambiguous.

This process of recruitment can be modeled by the same constraints as the production of prepositions and the use of *already* in CSE, as described in the previous sections. In the experiment described by Zeevat (2006), a lexical item is recruited for a function that contains a subset of the features of the original function. In the initial stage, the semantic input M_1 which consists, say, of the features A and B is expressed by F. This is due to the faithfulness constraint FAITHFEAT or MAX. For this theoretical case we don't have to be more precise about the specific constraints. Furthermore, there is a meaning M_2, which consist of the feature A. Similar to the production of prepositions, a hierarchy of faithfulness constraints can be construed that captures the entailment relation between meaning M_1 and M_2.

(23) FAITH(M_1) >> FAITH(M_2)

In the initial stage, meaning M_1 is expressed by F, which is illustrated in Tableau 11. In the same stage, M_2 is not expressed by F because the constraint DEP is ranked above the constraint that forces the expression of the meaning M_2. This is illustrated by Tableau 12.

M_1 = {A, B}	FAITH(M_1)	DEP	FAITH(M_2)
☛ F {AB}			
Ø	*		

Tableau 11: the expression of M_1 in stage 1

M_2 = {A}	FAITH(M_1)	DEP	FAITH(M_2)
F {AB}		*	
☛ Ø			*

Tableau 12: the expression of M_2 in stage 1

In Tableaux 11 and 12, we see that meaning M_1 is expressed by F and the null-form is the optimal expression for meaning M_2, due to the constraint

DEP. In this stage, the meaning M_2 is not expressible. According to Zeevat (2007), this is a requirement for recruitment to happen. Fong's (2005) analysis shows that it can also be the case that a different form is available but that this form has disadvantages, for example because it is more complex. Another prerequisite for recruitment is that the new meaning is important. The importance causes a shift in the constraint ranking. The constraint DEP is now ranked below FAITH(M_2), due to which this meaning can be expressed by the form F.

Tableau 13 shows that in the second stage, meaning M_1 is still expressed by F. Tableau 14 shows that meaning M_2 is now also expressible by F.

M_1 = {A, B}	FAITH(M_1)	FAITH(M_2)	DEP
☛ F {AB}			
Ø	*		

Tableau 13: the expression of M_1 in stage 2

M_2 = {A}	FAITH(M_1)	FAITH(M_2)	DEP
☛ F {AB}			*
Ø		*	

Tableau 14: the expression of M_2 in stage 2

In the Tableaux 13 and 14, we see that the constraint FAITH(M_2) has moved up in the hierarchy. The effect is that not expressing M_2 is worse than expressing a superfluous feature.

Note that the OT-Tableaux 11-14 do not directly reflect the frequency effects found in the experiment by Zeevat (2006). Zeevat argues that when the combination of the form F with the meaning M_2 becomes more frequent, the chance that the hearer will make the correct interpretation will grow, which again results in extra use of the combination of F with the meaning M_2. The frequency effect may lie in a gradual raise of FAITH(M_2) over DEP. The more F is used to express M_2, the more DEP moves downwards in the hierarchy, due to which F is used even more often to express M_2. Zeevat also argues that the experiment shows that if the meaning M_2 is more frequent than the meaning M_1, M_2 will take over the form, which means M_1 can no longer be expressed by F. Otherwise the form F remains ambiguous. However, the three uses of *wel* under consideration in Chapter 4 show a negative correlation between semantic strength and frequency. This shows that, synchronically, a state can exist in which a stronger, less frequent

meaning co-exists next to a more frequent, weaker meaning of the same form. I think the outcome of the experiment is caused by the fact that it does not take into account the preference of the hearer for strong meanings, as was argued for in Chapter 3. In Chapter 3, I showed that people preferably interpret an utterance with the strongest meaning that is compatible with the context. Weaker meanings therefore only surface in contexts that are incompatible with the strongest meaning. In chapter 3, I argued that those contexts are typically more frequent than the contexts in which the strongest meaning does apply.

5.3.3 Conclusions

In this section, I have shown that, due to a different constraint ranking, a different form may become the optimal expression for the same input. In order for semantic change to take place, the relation between forms and meanings must display some flexibility. The ability of this relation to change shows that it cannot be the case that a form is associated with one atomic meaning. Instead, a form is associated with several aspects of meaning, to semantic features. Because of that, a speaker can use a lexical item that is associated with a set of features to express a subset of those features, as was shown for the semantic change of *already* in CSE as described by Fong (2005). Furthermore, the same principle may underlie semantic change during evolution, as was shown by the simulation of recruitment by Zeevat (2006).

In the next section, I will discuss one more situation in which there is an interesting competition between words, namely the code switching behavior of bilingual speakers.

5.4 Insertions as the outcome of lexical competition

5.4.1 Introduction

In the previous sections, we saw that optimization plays a role in the production of prepositions and in semantic change. In this section I will argue that the production of specific content words is the result of an optimization process just as well. This may not be apparent when we look at a single language. The meanings of most content words are relatively stable across contexts. Their meanings are usually too different to yield a serious competition between forms. Things change, however, when we look at bilingual speakers. Bilingual speakers speak two languages and can therefore be said to have two forms for every meaning. To express a

particular intention, speakers usually pick the word from the language they are speaking at the moment. However, sometimes a word of language L_2 is uttered in a sentence that for the remainder is constructed out of language L_1. This is called *insertion*. In (24) the Dutch word *arbeidsbureau* 'job office' is inserted in a sentence that for the remainder consists of Turkish words and is construed according to the Turkish grammar. In (25), the Dutch word *laborant* 'lab worker' is inserted in an otherwise Turkish sentence (Backus 1996, p. 164 and p. 165). Dutch words are italicized in the utterance and in the translation.

(24) Şöyle, şey ben *arbeidsbureau*'ya gittim
'Like that, I went to, you know, the *employment agency*'

(25) *Laborant* olacaktım işte
'I was going to be a *lab worker*'

Insertions are interesting because they show the outcome of the competition between (at least) two candidates, namely the lexical equivalents from two languages. In this section, I will go into the nature of insertions and the mechanisms that cause them.

Bilingual speech is influenced by many factors, such as the nature of the languages involved, the competence of the speaker and the context in which the speech occurs. The speech a bilingual speaker produces is the result of the interaction of all those influences. The different influences can point into the same direction but they can also be in conflict. It has been argued that, once a language has been chosen, the unmarked choice is to continue speaking this language (Auer 1984). When a word is inserted, the speaker has deviated from this unmarked pattern. In this section, I will show that the preference for speaking one language at a time may be in conflict with the desire to choose the form that best matches the intended meaning.

To get a good understanding of the nature of insertions, it is important to know something about bilingual speech in general. I will therefore start by explaining the basic mechanisms that are involved in *code switching*, the mixing of languages by bilinguals. How insertions relate to other types of bilingual speech is subject to debate. I will shortly go into this matter in section 5.4.2. In section 5.4.3, I discuss the reasons for insertions. I will argue that insertions can be explained by the interaction of faithfulness and markedness constraints.

5.4.2 Code switching

Bilingual people often switch between their languages when speaking to other bilinguals. This is called code switching. There are different types of code switches. When a switch takes place between sentences this is called *intersentential* code switching. When a switch is made within one sentence this is called *intrasentential* code switching. Many factors have been said to influence code switching. Some scholars focus on the restrictions on code switching. Their aim is to explain why certain switches are not attested. Usually, syntactic constraints on code switching are formulated to explain this. Examples of such restrictions are the government constraint (DiSciullo, Muysken and Singh 1986, later modified by Muysken 1990) which says that element Y must have the same language index as element X when Y is governed by X. Another example is the equivalence constraint, introduced by Poplack (1981) which states that a switch may occur between two sentence elements if they are normally ordered in the same way by both languages involved. Constraints like the government constraint and the equivalence constraint restrict the places at which code switching can occur. They do not intend to explain why code switching takes place in the first place.

Much research has focused on factors influencing language choice. In the literature, a distinction is often made between situational code switching and metaphorical code switching. Gumperz (1982) describes situational code switching as an automatic process. Participants do not switch between codes consciously. They are primarily concerned with the communicative effect of their message. Therefore, social rules that appear to play a role seem to function as grammatical rules, that is, they form part of the underlying knowledge that speakers use to convey meaning. On the other hand there is the metaphorical language switch. Metaphorical code switches are not predictable but are dependent on the decision of the individual speaker. Metaphorical switches are actively chosen to create meaning. With a metaphorical code switch one uses the knowledge of language that one has and consciously deviates from the pattern that this knowledge would predict. Gumperz (1982) therefore speaks of a violation of co-occurrence expectation (p. 98).

A similar argumentation is put forward by Myers-Scotton in her Markedness Model (1993, 1998). Myers-Scotton uses the notion of markedness to explain aspects of linguistic behaviour. Within a community, the different language varieties are associated with certain groups of people, typical situations in which they are used etc. Speakers act on the fact that the

hearer has this knowledge about these different varieties. The Markedness Model assumes that speakers are rational. This means that speakers make choices to reach their goal, which is to enhance rewards and to minimize costs. In other words, according to Myers-Scotton, the goal is to *optimize*. In the Markedness Model different options are compared with respect to the effect they bring about. A switch between languages can be the result of a change in the situational factors during a conversation. Due to the situational change, the unmarked language choice may change. In (26) we see an example of such a switch based on a change in the addressee (Myers-Scotton 1993, p.116). In this example John M., an executive in a soft-drink bottle company in Nairobi, speaks English to his white-collar subordinate but switches to Swahili when speaking to his receptionist. A relative of John, Edward M. is also present. Swahili is italicized.

(26) Subordinate (entering John M.'s office and speaking to Edward M. just after John M. has stepped out for a minute): Where has this guy gone to?
Edward: He's just gone out. He will soon be back.
John (to subordinate when he returns): Why did you change the plan for our stand at the showground? Who recommended the change?
Subordinate (looking guilty): Nobody told me.
John: Go and change it according to our previous plan. Also make sure that the painting is done properly.
John (to Edward when subordinate has left): I've told this man how to build our stand, but he went and did a different thing. *Ni mtu mjeuri sana* ('He's a stubborn person.') I'll make him pay for the paint he spoilt.
John (calling to receptionist): *letea mgeni soda anywe* ('bring the guest a soda so that he may drink')
Receptionist (to Edward): *Nikuletee soda gani?* ('What kind of soda can I bring you?')
Edward: *Nipe Pepsi*. ('Bring me a Pepsi')

Code switching itself may also be the unmarked choice. Unmarked code switching typically happens among bilingual peers who wish to symbolize their membership of two language communities. In such situations, speakers continuously switch between multiple languages, often within sentences. An example given by Myers-Scotton to illustrate unmarked code switching is given in (27). In the example, two schoolteachers are speaking Shona (a

Bantu-language) and English alternately. English is italicized (Myers-Scotton 1993a, cited in Myers-Scotton 1993, p. 123-124).

(27) Teacher: Manje zvakafanana nekuti kana uri kuita *grade one* manje saka vana vazhinji vechisikana ku-*primary* vanogona sitereki. Vanokasika ku-*absorb* zvinhu. *But as time goes on* vana kuenda ku-*grade five, six, seven, form one* vanonoka kuita *catch-up* mu-ma-*lessons*. *But once they catch up they go ahead.*
'Now, for example, it is the same when you are in grade one now so that many of the girls understand much better. They hurry to absorb things. But as time goes on, children go to grade five, six, seven and form one boys are late to catch up with lessons. But once they catch up they go ahead.

When speakers deviate from the unmarked choice this yields an effect, usually a change in the social distance between the discourse participants. According to Myers-Scotton, the speaker switches from Swahili to English to express an authoritative/angry stance in example (28). The conversation takes place in a bus in Nairobi. The conductor asks a passenger where he is going to determine the fare. Swahili is the unmarked language in this situation. English is italicized (Scotton and Ury 1977, cited in Myers-Scotton 1993, p. 133).

(28) Passenger: Nataka kwenda Posta. ('I want to go to the post office.')
Conductor: Kutoka hapa mpaka posta nauli ni senti hamsini. ('From here to the post office, the fare is 50 cents.')
(Passenger gives the conductor a shilling, from which he should get 50 cents in change.)
Conductor: Ngojea *change* yako. ('Wait for your change.')
(Passenger says nothing until some minutes have passed and the bus is nearing the post office where the passenger plans to get off.)
Passenger: Nataka *change* yangu ('I want my change.')
Conductor: *Change* utapata, Bwana ('You'll get your change.')
Passenger: *I am nearing my destination*.
Conductor: D*o you think I could run away with your change?*

Other reasons for making a marked switch are excluding others, aesthetic effects etc.

In this section, I have outlined the basic mechanisms underlying code switching behaviour. Whether the insertion of lexical items is a special case of code switching and whether insertions are explained by the same mechanisms is matter of debate. I will address this issue in the next section.

5.4.3 Insertions

The insertion of single words is sometimes regarded as a process that is fundamentally different from code switching. An important part of this discussion relates to the relation between insertions and loanwords or borrowings. Many languages include lexical items that originate from a different language. For example, in Dutch (and in many other languages) the word *computer* is used, which is borrowed from English. It is not the case that during the utterance of this word, speakers of Dutch switch to English. Rather, the word has become an established part of the Dutch lexicon. However, the distinction between insertions and loan words or borrowings is not always that clear. Poplack (1993) defines borrowing as 'the adaptation of lexical material to the morphological and syntactic (and usually, phonological) patterns of the recipient language' (p. 256). Some precise criteria for characterizing loanwords are given in Poplack and Sankoff (1984, p. 103-104)[1]:

1. Frequency of use: the more frequently a specific donor-language item is used and by more people, the more reasonable it is to consider it as having become a bona-fide term of the recipient language.
2. Native language synonym displacement: if a borrowed term can be shown to displace in usage an indigenous term for the same concept, it can be considered to have taken over the latter's role in the lexicon.
3. Morphophonemic and/or syntactic integration: if a borrowed term takes on a phonological shape typical to the recipient language, acquires the morphological affixes appropriate to that language, and functions in the sentences as a native word of some syntactic category, then it can be considered a well-established borrowing.
4. Acceptability: if native speakers judge a donor-language word to be an appropriate designation whether or not they are aware of its

[1] They partly base their criteria on previous literature among which: Hasselmo (1969), Mackey (1970), Murphy (1974), Haugen (1956), Weinreich (1953) and Bloomfield (1933).

> etymological origins, this shows that it may occupy a place in the recipient lexicon.

Based on similar criteria, Poplack (1993) and Sankoff, Poplack and Vanniarajan (1990) distinguish between established *loanwords* and *nonce borrowings.* Whereas loanwords have become part of the lexicon of the receiving language, nonce borrowings have no such status and are solely borrowed on the spur of the moment. Loanwords typically show full linguistic integration, native-language synonym displacement and wide spread-diffusion. Nonce borrowings are identical in linguistic manifestation but need not satisfy the diffusion requirement. Nonce borrowings are similar to code switches in that they require active access to the second language but in contrast to code switches they are morphologically and syntactically integrated in the host language. Both loanwords and nonce borrowings are seen as fundamentally different from code switching. Constraints that restrict code switching to take place, like the government constraint and the equivalence constraint therefore do not apply to borrowings.

The distinction between code switching and borrowing is also addressed by Muysken (1995). Muysken distinguishes two dimensions of what he calls lexical interference (which captures both code switching and borrowing). The first dimension relates to the question whether a particular case takes place at a sub-lexical level or at a supra-lexical level. Supra-lexical mixing involves inserting words with different language indices into a phrase structure at the clause level. Sub-lexical mixing involves the insertion of formatives into an alien word structure (*alien* because it behaves externally like an element of the host language). The second dimension is whether the element or structure is part of a memorized list, which has gained acceptance within the speech community. Items can be organized along a scale running from creative to reproductive. Muysken refers to this dimension as *listedness*, after Di Sciullo and Willams (1987). With the two dimensions, four types of lexical interference can be distinguished (Muysken 1995, p.190).

	not listed	listed
supra-lexical	code switching	conventionalized code switching
sub-lexical	nonce-loans	established loans

Muysken (1995) and Poplack (1993) (and Sankoff et al. 1990) make a distinction between inserting a single word in language A in an utterance that is otherwise constructed out of the syntax and lexicon of language B, and switching from language A to language B. Within this view, insertions (whether established loan words or inserted only once) are different from code switches.

Myers-Scotton (1993b) opposes the view that the insertion of single words is a process that is fundamentally different from code switching. Myers-Scotton acknowledges the existence of single word code switches. Single word switches refer to the elements that Poplack (1993) labels *nonce borrowings*. Single word switches and borrowed words are related phenomena; there are both similarities and differences between them. Single word switches and borrowings both show adaptation to the host language. However, Myers-Scotton hypothesizes that there may be a continuum, where borrowed forms conform more to the host language than code switches. With respect to this continuum Myers-Scotton distinguishes between two types of borrowed forms: cultural forms and core borrowed forms. Cultural borrowings express concepts new to the culture of the host language. Examples she gives are *baisikeli* for 'bicycle' in Swahili or *bhajeti* for 'budget' in Shona. Core borrowings, on the other hand, express concepts for which the host language does have a viable equivalent. Examples are the English borrowings *wan/wani* for 'one' and *taim* for 'time' in Shona. In the initial stages, core borrowings have a different status from cultural borrowings since they are in competition with the indigenous forms. Myers-Scotton argues that core borrowings are borrowed because certain types of situations promote desires to identify with the language and culture that supplies the loanword. Another difference between single word switches and borrowed words is their status in the lexicon of the host language. Borrowings have entered in this lexicon but code switches have not. Myers-Scotton hypothesizes that the status of an etymologically foreign word can be identified by measuring the frequency with which it occurs representing the concept it encodes in relation with the indigenous word for the same concept.

Backus (1996) does not make a fundamental distinction between loanwords and single word switches either. Backus uses the term *insertion* for all singly occurring words that have their origin in the embedded language. Backus argues for a continuum with on one side prototypical insertions and on the other side prototypical alternations. Prototypical insertions are single words from language A embedded into language B and prototypical alternations are utterances in language A following an utterance

in language B. In between the two prototypes there can be switches that are longer than single words, yet do not possess the same degree of autonomy as full sentences. Within the class of insertions different types can be distinguished, some of which may be closer than others to what can be called loanwords.

I follow Myers-Scotton and Backus and assume that loan words can be explained by the same mechanisms as insertions. In this work, I will only focus on the situational code switch. I will model insertions as the result of a process at the subsymbolic level, due to which speakers choose the best way of conveying the content of their message. Extra-linguistic factors such as prestige and social distance are an important factor in code switching too but I will not discuss these here. In the next section, I will elaborate on the reasons for insertions as described in the literature. I will argue that insertions can be viewed as the outcome of the influence between two possibly conflicting forces; the faithfulness to the features in the input and the markedness of switching between languages.

5.4.4 Explaining insertions

In this chapter, I have argued that speakers choose a particular word because it is the optimal candidate for expressing the intended meaning. The same holds for bilingual speakers when they choose a word from L_2 over the L_1 variant. This is endorsed by theories about code switching and insertions by Myers-Scotton and Jake (2000) and Backus (1996, 2001). Backus formulates two generalizations with respect to insertions. The first is the Specificity Hypothesis.

> **Specificity Hypothesis:** Embedded language elements in code switching have a high degree of semantic specificity.

The second generalization is the Semantic Domain Hypothesis.

> **Semantic Domain Hypothesis:** Every embedded language insertion is used by virtue of its belonging to a typically embedded language semantic domain

Backus bases the generalizations on an extensive study on insertions of Turkish people living in the Netherlands. He collected data from three generations of Turks living in the Netherlands. The first generation came to the Netherlands as an adult. For the first generation, Turkish is the dominant

language. This generation mostly inserts very specific Dutch words in Turkish utterances. Some insertions are proper gap-fillers; there is no Turkish equivalent, as for the name for the city area *Tilburg-Noord* 'northern Tilburg' in (29) (Backus 1996, p. 141).

(29) Benyedi sekiz ay sonra gine bir kursa başladım, oda *Tilburg-Noord*-dayıde
'I started another class after seven or eight months, that was in *Tilburg-Noord* as well'

The majority of the insertions of the first generation are related to the domain of the school where they are learning Dutch (e.g. *toets* 'test', *pauze* 'break', *vakantie* 'holiday', *nieuwkomers* 'newcomers') or other areas typically related to the Dutch culture (e.g. *Burger King*, *gulden* 'guilder', *terras* 'open-air café').

The intermediate generation, of which Ayhan was the main informant, came to the Netherlands as a young child. Ayhan roughly utters twice as many Turkish clauses as Dutch clauses. His insertions are often explicable in terms of specificity, like *arbeidsbureau* 'employment agency' in (30).

(30) Şöyle, şey ben *arbeidsbureau*´ya gittim
'Like that, I went to, you know, the *employment agency*'

The insertions are often related to aspects of life where Dutch is the dominant language, like education or job hunting (e.g. *arbeidsbureau* 'employment agency', *administratief medewerker* 'administrative employee'), hospital (e.g. *foto* 'X-ray', *laborant* 'lab worker') or Dutch social life (e.g. *kerst* 'Christmas', *samenwonen* 'to cohabit').

Members of the second generation were either born in the Netherlands or came there as a baby. During the recordings, Dutch is used four times as much as Turkish and the amount of insertions is small compared to the other generations. The insertions that do occur often originate from domains associated with Dutch, such as dating or fashion, as in (31) (Backus 1996, p. 195)

(31) Ama *shirt* üstune giyiyorum olmuyor
'But it won't do to wear something over a *shirt*'

Backus concludes that words can be placed on a continuum with respect to the specificity of their meaning, with on one side the more specific words

and on the other end words with a very general meaning. At the very end of the specific side of the continuum we find proper nouns. This category includes names for places and persons. They have no translational equivalent and therefore a speaker has no choice but to utter the proper noun irrespective of the language she is speaking at the moment. Insertions can also be *cultural borrowings*. They express culturally bound concepts and do not have an equivalent in the other language. They are lexical gap-fillers like the proper nouns but are nonetheless further away from the specific end of the continuum. Backus argues that many insertions can be classified as cultural borrowings. They are the only feasible candidates to express a given concept.

Sometimes words are inserted that seem to have a suitable equivalent in the other language. For example, Backus found that his Turkish informants used the Dutch *pilsje* 'pint' instead of the Turkish equivalent *bira.* However, closer examination of the two lexical items often shows that there are good reasons for the insertion. The Dutch word *pilsje* is very much associated with a situation in a Dutch bar, where one orders a Dutch beer in Dutch. Although both words seem to express the same concept, the social situation makes the Dutch word a better alternative. Backus therefore argues that speakers insert words because the chosen word better fits the concept a speaker has in mind. Every word has a core meaning which is shared by every speaker but it also has peripheral meanings which can be different for various speakers. For specific words like nouns people can have different peripheral meanings. Moving to the less specific side of the continuum, words not only become more general in meaning but they also become more and more equivalent to their counterpart in the other language.

Backus' analysis is in line with Myers-Scotton and Jake's (2000), who argue that speakers choose to express the word (or lexeme) that they expect conveys best the semantic, pragmatic and sociopragmatic features of their intentions. They propose a model of language consisting of three levels, schematized in Table 1. In this model, the speaker starts with a conceptual intention which consists of a set of semantic and pragmatic features. The semantic and pragmatic features of the intention are then conflated as a language-specific bundle of features. This bundle of features activates a lemma in the mental lexicon. This lemma is a carrier of information about the associated predicate-argument structure and morphological realization patterns.

Conceptual level:	Universally present lexical-conceptual structure in the conceptualizer. "Choices" made: If discourse includes CS, then select ML and semantic pragmatic feature bundles Language specific feature bundles activate entries in the mental lexicon (language specific lemmas) Language specific lemmas send directions to the formulator
	↓
Functional level:	The "activated" formulator projects Predicate argument structures (e.g. thematic roles) and Morphological realization patterns (e.g. word order, case marking, etc.)
	↓
Positional level:	Morphological realization (surface structure after move-alpha, agreement inflections, etc.)

Table 1: speakers' intentions (Myers-Scotton and Jake 2000, p. 287)

The features that form the intentions are universal but the compounding of those features in the feature bundles that constitute the lemma, is language specific. Myers-Scotton and Jake argue that the insertion of words can often be explained by a mismatch between the lexical equivalents of two languages. The mismatch may result in a lexical gap. A lexical gap occurs when the differences between two equivalents are too big or when there is no equivalent at all. In that case, the word may be borrowed from the source language. If the gap is only partial, the word will not be borrowed but speakers may insert the word in bilingual speech.

As indicated, a difference in the compounding of semantic and pragmatic features between languages may result in an insertion. In (32) and (33), different associations with the Dutch and Turkish form trigger the choice for one over the other. The speaker of sentences (32) and (33) (Backus 1994, cited in Myers-Scotton and Jake 2000, p. 291) are alternating between Turkish and Dutch. Related words in Turkish and Dutch are used to refer to 'dress' at different moments in the discourse. Example (32) occurs when the

speaker focuses on a traditional event while example (33) occurs in a more general discussion about fashion.

(32) *Als jij die trouwjurk ziet en die* kina gece-si elbise-si
'*If you see that wedding dress and the* "henna evening" dress'

(33) *En die gaat ze dragen onder haar* kina gece-si *rok*
'And she will wear that under her "henna evening" *dress*'

In Swahili/English bilingual speech, the English verb *decide* occurs frequently, as in (34) (Myers-Scotton 1993, cited in Myers-Scotton and Jake 2000, p. 292-293).

(34) Kwa vile ziko nyingi, siwezi *decide* ile inafaa zaidi
'Because there are many, I can't decide the most proper one'

Myers-Scotton and Jake (2000) argue that this is due to a lack of congruence of semantic features. The Swahili counterpart of *decide* (*-kata shauri*, literally 'cut/reduce problem') has the feature "inchoative entering into-a-state" while *decide* has the feature "agentive putting into a state" as part of its semantics.

The theory by Myers-Scotton and Jake is in line with the OT-analysis I have laid out in this thesis. Recall the general faithfulness constraint FAITHFEAT.

FAITHFEAT: features in the input must be reflected in the output

A power hierarchy of faithfulness constraints can be formulated that captures the fact that the absence of five features in the output is worse than the absence of four, which is worse than three, etc. In analogy to the hierarchy in (9), the constraint FAITHFEAT^{k} is violated when FAITHFEAT is violated k or more times. Say we have a semantic domain which consists of 6 features A, B, C, D, E and F. This results in a hierarchy of faithfulness constraints, represented in (35).

(35) a. $F^{6} \gg \ldots F^{3} \gg F^{2} \gg F^{1}$

Say, a speaker intends to express the concept that consists of the features A, B, C and D. She has two languages at her disposal: L_1 and L_2. With respect to the domain under scrutiny, L_1 has a form that conflates the features A, B, C

in {A, B, C}$_1$ and the features D, E, F in {D, E, F}$_1$. Language L$_2$ conflates the features A and B in {A, B}$_2$ and the features C, D, E and F in {C, D, E, F}$_2$. The process of lexical selection is presented in tableau 15. Note that I have not incorporated the constraint DEP in this analysis, for sake of simplicity. DEP could be implemented as a constraint hierarchy according to which one superfluous feature is worse than two which is worse than three etc.

{ABCD}	F^6	F^5	F^4	F^3	F^2	F^1
☞ {ABC}$_1$						*
{DEF}$_1$				*	*	*
{AB}$_2$				*	*	*
{CDEF}$_2$					*	*

Tableau 15: insertions as the result of faithfulness constraints

Tableau 15 shows that the first candidate is more faithful to the input than the other candidates and is therefore optimal.

The present constraint ranking predicts that speakers freely choose between the words of their languages for whichever is more faithful to the input. However, switching between languages is argued to be marked. Auer (1984) argues that the unmarked choice is to keep speaking the same language. Backus (1996) puts this down to the process of triggering. A word in a specific language triggers words from the same language. I formulate this as a constraint against switching, *SL.

*SL: Don't switch between languages

Now we have two possibly conflicting constraints that determine the choice for a word. According to FAITHFEAT the speaker chooses the word that best expresses the intended meaning. According to *SL the speaker chooses the word from the same language as the previous word. Note that the assumption that the previous word is the crucial indicator for *SL is probably too simple. The actual factor of influence may depend on the hierarchical relations between clauses and words and their order of appearance in the planning of the construction of the sentence. The constraint *SL interacts with the hierarchy of constraints in (33). Let us assume that a word is inserted if the difference in faithfulness between the intention and the word from the language being spoken is too big. This can be implemented in OT placing the constraint *SL somewhere in the hierarchy, which creates a cut-off point for code switching. If we place *SL in

between F^2 and F^3, a word will be inserted if the word of the language being spoken lacks three features with respect to the input, on the condition that the inserted word is more faithful to the input.

Say the features of our semantic domain A, B, C, D, E and F are conflated in L_1 as {A, B}, {B, C} and {C, D}, and L_2 they are conflated as {A, B, C} and {D, E, F} and say, a bilingual speaker of L_1 and L_2 intents to express the set of features {A, B, C, D} in a sentence that is constructed out of L_1.

L_1, {ABCDE}	F^6	F^5	F^4	F^3	*SL	F^2	F^1
{AB}$_1$				*		*	*
{CD}$_1$				*		*	*
{EF}$_1$				*	*		
☞ {ABC}$_2$					*	*	*
{DEF}$_2$				*	*	*	*

Tableau 16: the interaction of faithfulness constraints and *SL

In Tableau 16, the input is an intention that consists of the features {A, B, C, D, E}, which follows a word from L_1. The relevant candidates are the forms from L_1 {A, B}$_1$, {C, D}$_1$ and {E, F}$_1$ and the forms from L_2, {A, B, C}$_2$ and {D, E, F}$_2$. Under the current constraint ranking, {A, B, C}$_2$ is optimal, since F^3 is ranked higher than *SL. The forms from L_1 all minimally lack three features with respect to the input. Under the current ranking, lacking three features is a bigger violation than being of a different language.

If only two features are missing in the L_1 candidate, the word from L_2 will not be inserted, even if the form from L_2 is more faithful, as is illustrated in Tableau 17.

L_1, {ABCDE}	F^6	F^5	F^4	F^3	*SL	F^2	F^1
☞ {ABC}$_1$						*	*
{DEF}$_1$				*		*	*
{ABCD}$_2$					*		*
{EF}$_2$			*	*	*	*	*

Tableau 17: the interaction of faithfulness constraints and *SL 2

In Tableau 17, the input is again the set of features {A, B, C, D, E}. The candidates are the forms of L_1 that conflate respectively the features A, B and C and D, E and F and the forms of L_2 that conflate respectively A, B, C and D

and E and F. In this case, the candidate {A, B, C, D}$_2$ is more faithful to the input but the difference between the candidate form L$_1$, {A, B, C}$_1$ and the intention is not big enough for insertion to be allowed.

With the current ranking of the constraints, a word from L$_2$ will be inserted in a situation where the word from L$_1$ lacks two features, even if the L$_2$ candidate only has one more faithful feature. However, a situation in which words are inserted only if they are better to a certain degree, say if they are faithful to minimally two additional features in the input may be more plausible. This can be implemented by applying local conjunction of constraints (Prince and Smolensky 1993/2004). Local conjunction holds that two simpler constraints C1 and C2 are conjoined so that this complex constraint C1+C2 is violated when both C1 and C2 are violated within a common domain. Say, the constraint *SL is conjoined to F^2, and this new complex constraint is ranked above F^3. This means that missing two features plus having a different language index with respect to the previous word, is worse than missing three features. The result is that the L$_2$ word must have two extra features in comparison to the L$_1$ word, in order to be inserted. This situation is illustrated in Tableau 18.

L$_1$, {ABCDE}	F^4	F^2 + *SL	F^3	*SL	F^2	F^1
☞ {ABC}$_1$			*		*	*
{BCDE}$_2$		*		*	*	*

Tableau 18: Local conjunction

In Tableau 18, the input is an intention that consists of the features {A, B, C, D, E} which follows a word from L$_1$. The relevant candidate is a word from L$_1$ that is associated with the features A and B, and a word from L$_2$ that is associated with the features B, C, D and E. The second candidate violates the constraint F^2 + *SL and the first candidate violates F^3. Since F^2 + *SL is ranked higher than F^3, the first candidate is optimal, in contrast to the situation in Tableau 17. If the difference between the L$_1$ word and the L$_2$ word is two faithful features, the L$_2$ word will inserted, which is illustrated in Tableau 19.

L$_1$, {ABCDEF}	F^4	F^2 + *SL	F^3	*SL	F^2	F^1
☞ {AB}$_1$	*		*		*	*
{BCDE}$_2$		*		*	*	*

Tableau 19: Local conjunction 2

5.4.5 Variation

Although many of the insertions that were found by Backus (1996, 2000) were in line with the two generalizations discussed in section 5.4.4., some of the insertions, especially by the intermediate and the second generation, seemed to be more on the non-specific side of the continuum. Furthermore, they did not seem to be related to specifically Dutch semantic domains. For example, in (36) the verb *kijken* 'look at' is inserted (Backus 1996, p. 163).

(36) *Ja maar toch*, millet *kijken* yapıyor
'*Yeah, but still*, people will be *watching* you'

Furthermore, sometimes the Turkish and Dutch counterparts are used in roughly the same context, which is shown in (37) and (38) (Backus 1996, p. 181).

(37) Ilkine baktın mı, ilk *deel*-i-ne
'Did you see the first one, the first *part*?'

(38) Ondan sonra ne oldu? Ben ikinci *bölüm*ünü kaçırdım
'What happened then? I missed the second *episode*'

There is no apparent reason to use the Dutch word in (37) and its Turkish counterpart in (38). The words are used to refer to episodes of the same TV-show.

Recall the floating *2 constraint in (10) in section 5.2.1. If constraints are partially ranked, there is indeterminacy with respect to their relative ranking. A partial ranking therefore yields a set of total rankings, which potentially results in different outputs for the same input. I propose a similar partial ranking for the hierarchy of faithfulness constraints and the constraint *SL.

(39) Fixed: F^6 » F^5 >> F^4 >> F^3 » F^2 » F^1
Floating: ⟷ *SL

This partial constraint ranking results in the following set of total rankings:

(40) a. F^6 » F^5 » F^4 » *SL » F^3 » F^2 » F^1
b. F^6 » F^5 » F^4 » F^3 »*SL » F^2 » F^1
c. F^6 » F^5 » F^4 » F^3 » F^2 » *SL » F^1
d. F^6 » F^5 » F^4 » F^3 » F^2 » F^1 » *SL

Due to the partial ranking in (39), one of the total rankings in (40) can be active at a particular evaluation time. This results in a situation in which sometimes an L_2 word will be inserted when the L_1 counterpart lacks for example two features (this is the case if ranking a or b is active) while sometimes the L_2 counterpart will be used (this is the case under ranking c and d). This situation was attested in Backus' data.

The fact that some L_2 words are inserted that seem to be equal to their L_1 counterpart is not explained by the partial constraint ranking in (40). If the L_1 and L_2 equivalent are equally faithful to the input, the L_2 variant will always violate an extra constraint, *SL. A possible explanation is that the set of semantic features that are associated with a form varies. The relation between forms and semantic features can be seen as connections between units representing phonological forms and units representing semantic features. In Chapter 4, I have argued that associations between forms and semantic features are formed gradually. In a bilingual situation it may be the case that some associations remain unstable due to the existence of two lexicons and presumably less experience with individual form-meaning pairs. In the model outlined in this chapter, this would result in a varying candidate set. The connections between semantic features and forms, which are treated as a given in this model, can be seen as constraints. The construction of the candidate set can therefore be the result of an optimization process. However, the modeling of this construction falls outside the scope of the present work.

Another issue Backus points out is that the linguistic behavior of the second generation is characterized by a frequent switch between languages. In fact, most of the code switches are alternational (between sentences), as in (41).

(41) ya da şeyi var ya, *van die met die bontkragen*
'and then there are these things, *of those, with those fur collars'*

Backus (1996) argues that the high number of alternational switches is due to higher collocational entrenchment for Dutch. Using a Dutch word triggers the use of other Dutch words. This also explains why insertions are relatively rare in the data of the second generation. This observation

suggests that the constraint *SL can be separated into multiple constraints. In case of Turkish/Dutch bilinguals, this would result in the constraints *SD: Don't switch if you are speaking Dutch and *ST: Don't switch if you are speaking Turkish. For the second generation, *SD has a higher place in the hierarchy than *ST. This ranking results in the situation that speakers may switch to Dutch when a Dutch word is more faithful to the input, but they switch back to Turkish less easily, which results in an alternational switch instead of an insertion.

5.4.6 Conclusions

In this section, I have argued that insertions are the result of the competition between the lexical equivalents from multiple languages. Based on theories about insertions by Backus (1996, 2000) and Myers-Scotton and Jake (2000), I argued that the winner of the competition is determined by two conflicting forces, namely faithfulness to the input and the markedness of switching between languages. Faithfulness to the input is modelled by a power hierarchy according to which it is worse to lack six features with respect to the input than to lack five features, which is worse than lacking four features etc. By placing the constraint *SL somewhere along this hierarchy, a cut-off point for code switches is created.

Insertions show that the production of content words is the result of an optimization process too. For monolingual speakers this may not be apparent but the behaviour of bilingual speakers shows that during the production of content words, alternatives are being compared. This may lead to the insertion of elements from a different language.

5.5 Conclusions

In this thesis, I claim that there is no simple one-to-one correspondence between word forms and meanings. In this chapter I have argued for this claim from the perspective of the speaker. When the speaker wishes to express a certain intention, she has to choose between the forms that are available in her language. Likely, there is no form available that matches her intentions perfectly. In that case, she will choose for the best, that is, the optimal form. In section 5.2, we saw how this process of optimization works for the production of English prepositions. In English, there is a set of forms to express the possible spatial relations between a Figure and a Ground. The analysis by Zwarts (2008) shows that the number of possible relations is

bigger than the set of available forms. The same form is therefore used for the expression of multiple relations. Based on the analysis by Zwarts, I argued that a speaker chooses the preposition that displays the biggest overlap between the features associated with the form and the features in the input.

The hearer and the speaker have different roles in conversation. Whereas the hearer has no choice but to interpret the form that is offered to her to the best of her ability, the speaker has to balance costs and benefits in choosing a form. In section 5.2, I discussed Fong's (2005) analysis of the use of *already* in CSE. This analysis shows that the speaker's interest is not only to be faithful to the input, the speaker also wants to be economical. The expression of the present perfect meaning is determined by the interaction of faithfulness and markedness constraints. Furthermore, the analysis shows that the relation between words and meanings may change in the origin of a new variety of a language. The relation between forms and meanings may change over time as well. This was shown by the simulation of recruitment by Zeevat (2006), which was also discussed in section 5.2. The ability of words to gain additional functions is evidence against the idea that a form is associated with one atomic meaning. This supports the claim argued for in this thesis, namely that a form is associated with several aspects of meaning, semantic features.

In section 5.3, I argued that the insertion of words by bilinguals is the result of the interaction of faithfulness and markedness constraints as well. Bilingual speakers compare the lexical equivalents of their languages and choose the form that best matches their intentions. However, the costs of switching between languages is taken into account too.

In chapter 3, I showed that hearers choose the interpretation that comes closest to the set of features associated with the form that is offered to them. This was accomplished by the introduction of the constraint STRENGTH. For speakers it holds that they choose the form whose associated set of features most resembles their intention. This was implemented by (a power hierarchy of) faithfulness constraints, which demand that input features are reflected in the output. However, for speakers not only the amount of overlapping features determines the optimal candidate. Markedness constraints cause the avoidance of complexity, sometimes at the expense of faithfulness to the input.

Chapter 6
Conclusions

In Chapter 1, I argued that lexical knowledge does not consist of a list of form-meaning combinations. It is not the case that people have some sort of dictionary in their heads that links a word form to a meaning or to a set of meanings. In this thesis I tried to show that meaning is not a static property of a form but that it is the input to the process of the production or it is the result of the process of interpretation. Consequently, the meaning of a word only 'exists' when it is being used. Interpretation and production are processes of optimization. This means that there is no fixed relation between forms and meanings but that the candidate form or interpretation that best satisfies a set of constraints of a varying nature wins.

In interpretation, the input is a form and the output is an interpretation of that form. Upon hearing a word candidate interpretations compete for becoming the optimal outcome. In chapter 3, I have described the range of possible meanings of the Dutch discourse particle *wel*. They all have in common that they function as a denial of a negation. The uses differ in semantic strength according to the amount of information they presuppose. The weaker meanings all presuppose a subset of the information that the strongest use of *wel* presupposes. In line with the Strongest Meaning Hypothesis (Dalrymple, Kanazawa, Mchombo and Peters 1994) I argued for a strong basic meaning that may be weakened by the context. This means that the form *wel* is associated with the set of features that constitute the strongest use. An actual interpretation of an occurrence *wel* can consist of a subset of this set of semantic features.

People have a preference for strong over weak interpretations. This preference is instantiated by the constraint STRENGTH. STRENGTH is a faithfulness constraint that reflects the desire to interpret all aspects of meaning that are associated with a form. However, if some of the information that *wel* presupposes is not present in the context, this leads to inconsistency. The constraint FIT expresses that interpretations may not be in conflict with the (linguistic) context. Since FIT is ranked higher than STRENGTH, a weaker meaning that fits the context wins over a stronger meaning which is in contradiction with the context.

A speaker associates forms with semantic features. Clearly, children are not born with such associations. Children start the acquisition process with no knowledge about the relation between words and meanings. In Chapter 4, I looked at the acquisition of the different meanings of *wel* I discerned in Chapter 3. The strongest meaning of *wel* is strikingly rare in the adult usage of *wel*. Children, on the other hand, use it frequently and seem to acquire this use more easily than the weakest use, which is very frequent in adult speech.

In the initial stage of acquisition the context is the only source of information in interpretation. Because the strongest use of *wel* consists of more features (i.e. has more meaning) than the weaker uses, this use is more easily recognizable in the context. For the same reason the strongest use occurs infrequently in adult language. Due to its more specific meaning, it is compatible with fewer situations.

The relation between the interpretation of a word and the context was instantiated by the constraint FIT in Chapter 3. The constraint penalizes interpretations that are not in line with the context. In acquisition the context must play a different role. It cannot be the case that it restricts the interpretations that are possible with respect to the associations between forms and meanings, because the associations are not yet formed. Rather, the context is the source of meaning. The constraint FIT therefore does not only penalize contradictory interpretations, it also favors salient meanings. In the initial stage of acquisition, the constraint FIT is the only determinant in the optimization process. The factor context gets competition when the experience with the words of the target language grows. Gradually STRENGTH becomes more important. During this process, the interaction of FIT and STRENGTH is different than the interaction of the two constraints in adult interpretation. In adult interpretation the constraints are ordered according to a strict priority ranking, in acquisition they are ranked according to numerical strength.

In Chapter 5 I took the perspective of the speaker. The speaker starts with an intention to express something. This intention comprises a set of features. The candidate forms are compared with respect to how much of the meaning of the intention they convey. In other words, they are evaluated against the faithfulness constraint FAITHFEAT.

Prepositions form a closed class of forms that express spatial meaning. The amount of possible spatial relations is bigger than the amount of available prepositions. Therefore, there is no one-to-one correspondence between meaning and form. Instead, the speaker chooses the preposition that displays the biggest overlap between the features associated with the form and the features in the input (Zwarts 2008).

Fong's (2003) analysis of the use of *already* in Colloquial Singaporean English shows that the speaker and the hearer have different roles in conversation. The speaker's interest is not only to be faithful to the input features but that she also wants to be economical. The expression of the present perfect meaning in Colloquial Singaporean English is determined by the interaction of faithfulness and markedness constraints. The analysis by Fong also shows that the relation between words and meanings may change in the origin of a new variety of a language. Zeevat (2006) shows that the relation between forms and meanings may change over time as well. Due to a different constraint ranking, a different output becomes optimal for the same input.

The production of insertions by bilinguals shows that word choice is the outcome of a competition between several candidates. Bilingual speakers compare the lexical equivalents of their languages and choose the form that best matches their intentions. However, the costs of switching between languages are taken into account too. Therefore, insertions are the result of the interaction of faithfulness and markedness constraints.

This thesis dealt with the relation between words and meanings. I have argued against a static view on word meaning. Instead, I have argued that the relation between words and meanings should be seen as the outcome of an optimization process. I have shown that during this process candidates are evaluated against a set of ranked constraints. The constraints are of a varying nature. They do not only pertain to the relation between input and output but also to the relation with the context and to principles of economy. In short, this thesis described the way of a word in process, in interpretation, acquisition, and production.

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Samenvatting (Summary in Dutch)

Het begrijpen, leren en produceren van woorden

Onze kennis van de betekenis van woorden lijkt eenvoudig. We hebben gewoon een lijst met woorden in ons hoofd met de daarbij horende betekenis. Maar als je wat beter naar ons woordgebruik kijkt, blijkt het toch wat ingewikkelder te zijn.

Je zou kunnen denken dat mensen een soort inwendig woordenboek hebben, met lemma's en daarachter de betekenis. Echter, de betekenis van woorden is flexibel, zoals de betekenis van het woord *muis*.

(1) Mijn muis doet raar

De interpretatie van muis in (1) hangt af van de context waarin de zin uitgesproken wordt. Als de zin in een dierenwinkel uitgesproken wordt, zal de aangesprokene *muis* interpreteren als een verwijzing naar een grijzig knaagdier maar als het in een computerwinkel uitgesproken wordt, zal het geïnterpreteerd worden als een computeronderdeel. Nu kan je zeggen dat er dan twee betekenissen bij het lemma *muis* staan of dat er twee lemma's *muis* bestaan in ons inwendige woordenboek. Maar dat wordt lastiger als je bijvoorbeeld naar het volgende paar kijkt.

(2) Ik houd van snelle auto's
(3) Ik houd van snelle maaltijden

In (2) slaat *snel* op de manier waarop een auto beweegt of kan bewegen. In de (3) slaat *snel* op de tijd die nodig is om een maaltijd te bereiden of op te eten. De betekenis van snel is dus anders in (2) dan in (3). Maar kunnen we hier echt spreken van verschillende betekenissen die apart opgesomd moeten worden? Bovendien kunnen woorden creatief gebruikt worden zoals in (4).

(4) Ik heb gisteren lekker gekroket

In (4) wordt het zelfstandig naamwoord *kroket* gebruikt als werkwoord. Dit zou niet mogelijk zijn als alle gebruiksmogelijkheden opgesomd zijn voor een spreker.

De voorgaande voorbeelden maken het niet waarschijnlijk dat mensen alle gebruiksmogelijkheden van een woord simpelweg onthouden. Maar hoe kunnen we woorden dan zo probleemloos begrijpen, leren en produceren? In deze dissertatie stel ik voor dat de interpretatie, verwerving en productie van woorden het resultaat is van een optimalisatieproces. Optimalisatie vormt de kern van Optimaliteitstheorie (OT). OT gaat ervan uit dat de taal zoals wij die produceren en interpreteren het product is van tegenstrijdige krachten, geformuleerd als constraints. In hoofdstuk 2 introduceer ik OT en beargumenteer ik dat ook de relatie tussen woorden en betekenissen onderworpen is aan tegenstrijdige krachten.

In deze dissertatie stel ik voor dat een woord samengaat met stukjes betekenis, *semantische features* geheten. In hoofdstuk 3 bespreek ik hoe een woord een betekenis krijgt in een context, op basis van deze features. Ik laat dit zien aan de hand van een analyse van het woord *wel*. Het woord *wel* heeft veel verschillende mogelijke interpretaties. De betekenis van *wel* is erg afhankelijk van de context. Er is echter één sterkste of prototypische betekenis, namelijk waar *wel* een negatieve uiting van iemand anders corrigeert, als in voorbeeld (5)

(5) Elske: de Ikea is geen leuke winkel
Roos: de Ikea is wel een leuke winkel

De andere betekenissen zijn zwakkere vormen van deze functie. Bij de interpretatie van een voorkomen van *wel*, spelen twee krachten een rol. Aan de ene kant wil de hoorder van een woord zoveel mogelijk trouw zijn aan de sterkste of prototypische betekenis. Aan de andere kant wil de hoorder een interpretatie die past in de context. Ik laat zien dat de tweede kracht belangrijker is dan de eerste omdat een zwakkere betekenis die past in de context boven een sterke betekenis die in conflict is met de context gaat.

Hoe leren kinderen de gebruiksmogelijkheden van *wel*, als deze zo divers zijn? In hoofdstuk 4 onderzoek ik de verwerving van *wel*. Ik vergelijk het gebruik van *wel* van volwassenen met het gebruik van *wel* door kinderen door middel van corpusdata. Uit de data blijkt dat kinderen de sterkste betekenis veel vaker gebruiken dan volwassen, die juist de zwakkere betekenis veel vaker gebruiken. Ik laat in dit hoofdstuk zien dat dit patroon niet toevallig is. De zwakkere gebruiken van *wel* hebben 'minder' betekenis (ze bestaan uit minder semantische features) dan de sterkere gebruiken. Het

gevolg hiervan is enerzijds dat ze compatibel zijn met meer contexten, waardoor ze frequenter zijn. Anderzijds is het voor een taallerend kind moeilijker op te maken wat een zwakker gebruik van *wel* nu precies toevoegt aan betekenis. Ik laat zien dat bij het leren van *wel* dezelfde krachten, of constraints, een rol spelen als bij het interpreteren van *wel* door volwassen. Echter, de manier waarop de constraints op elkaar inwerken, verandert geleidelijk.

Hoofdstuk 5 gaat uit van de spreker. Hierin ga ik na welke krachten van invloed zijn bij de keuze voor een woord. Een spreker start met een intentie om iets uit te drukken. Deze intentie bestaat uit semantische features. De spreker kiest dan uit de beschikbare woorden uit haar taal het woord dat de meeste semantische features deelt met haar intentie. Echter, een spreker is ook zuinig. De lengte of de complexiteit van een woord speelt daarom ook een rol. Hierdoor kan het zijn dat een spreker een korter woord dat minder goed uitdrukt wat zij wil zeggen verkiest boven een langer woord dat wel precies dezelfde features heeft als haar intentie. Een van de taalkundige fenomenen die aan bod komen in hoofdstuk 5 is het inserteren van woorden door tweetalige sprekers. Tweetaligen gebruiken soms een woord uit taal A in een zin die voor de rest volledig bestaat uit woorden uit haar andere taal, taal B, en die ook is gevormd naar de grammatica van taal B. Het woord uit taal A noemen we dan een insertie. Uit eerder onderzoek weten we dat tweetaligen woorden inserteren omdat die woorden de precieze betekenis die de spreker over wil brengen, beter uitdrukken. In hoofdstuk 5 modelleer ik dit gegeven als een constraint, die een woord gebiedt trouw te zijn aan de intenties van een spreker. Echter, er is een tweede, tegenstrijdige kracht die sprekers opdraagt niet te wisselen tussen talen, omdat dit niet economisch is. Een woord uit taal A moet daarom een bepaald aantal features beter zijn dan het woord in taal B om de een insertie te veroorzaken.

De conclusie van deze dissertatie is dat de relatie tussen woorden en betekenissen niet statisch is maar de uitkomst van een proces. Het interpreteren, verwerven en produceren van woorden verloopt via optimalisatieprocessen waarbij tegenstrijdige krachten van verschillende aard een rol spelen.

Curriculum Vitae

In 2004, Lotte Hogeweg received her Bachelor's Degree in Dutch Language and Culture at Utrecht University and in 2005 she obtained her Master's Degree of the program Language Structure and Language Variety, also at Utrecht University. Since January 2006 she has been working as a PhD-student at the Radboud University Nijmegen, under the supervision of Prof. Dr. Helen de Hoop. During this period she was involved in the organization of an international workshop and the subsequent editing of the proceedings, in the teaching of several classes and she presented and published on topics related to the interpretation, acquisition and production of words. As part of her PhD-project, she spent the fall semester of 2007 at the Cognitive Science Department of Johns Hopkins University.