When Apples Mean Oranges:
Lexical De-Entrainment and Alignment Theories

Christina Freihorst, Simón Algorta, Vivien Mast, Robert Porzel

University of Bremen, Bibliothekstrae 1, 28359 Bremen

`ch.freihorst@uni-bremen.de`, `algorta@informatik.uni-bremen.de`,
`viv@tzi.de`, `porzel@tzi.de`

Abstract

This paper investigates the effects of semantic distance on the development of lexical entrainment. For this purpose, the authors developed a card game with three levels of semantic distance. The participants were asked to arrange the cards into a congruent sequential order. By increasing the semantic distance, more words were needed to solve the task and a higher rate of hypernyms was used, demonstrating lexical entrainment. Additionally, results showed that the participants recurred to the use of de-entrained terms on a third stage of the conversation. Based on this we examine what this finding might entail for existing theories on linguistic alignment.

1 Introduction

Referring to objects is a central part of human communication. It is well known that we do not only learn that every object has its name, but also that an object's name is not invariant – in different situations one can refer to the same object as 'tree', 'oak' or 'plant' depending on the context (Hermann & Deutsch, 1976; Furnas, Landauer & Dumais, 1987). The context may hinge on the range of objects from which the referent needs to be distinguished or on social aspects of a situation (Herrmann & Grabowski, 1994). This variability in reference underlies certain principles, such as avoidance of confusion and gauging the expectations of the listener.

A process that plays a central role in reference resolution is lexical entrainment: During the course of a conversation, interlocutors show a tendency to converge on a common set of referring expressions.

In order to examine the processes that underlie reference in a dialogue situation that involves hypernymy[1] and hyponymy[2], we examined how participants deal with the challenge of finding appropriate referring expressions when aligning semantically related but not identical concepts. For this purpose we designed a card game with three levels of increasing semantic distance, where semantic distance increases when the distance between hypernyms and hyponyms increases as defined by the number of steps needed to traverse the WordNet graph from one to the other (Fellbaum, 1994). The two participants got different sets of cards where each card of one participant corresponded to a semantically related card of the other. Participants were not able to see the cards of their partner. The exercise was to order the cards in congruent order, for this purpose the participants had to refer to the cards, developing a strategy for bridging the semantic gap between the corresponding cards. This means, they had to come to understand that when one talks about one referent (e.g. apple), the other needs to consider the related referent within his own set of cards (e.g. orange). Our primary aim was to discover how lexical entrainment changes with increasing semantic distance of the objects that need to be referred to. We assumed that entrainment would become more difficult and take longer with increasing semantic difference between the objects.

In the following sections, we will describe cognitive accounts of reference and lexical entrainment, focusing on the controversial aspects of different theories of entrainment. Then we will present the experimental setup and the results of the experiment. Finally, we will discuss the implications of our findings for the collaborative and automatic entrainment theories, and highlight

---

[1] A hypernym is the superordinate concept of another word, for example, animal is hypernym of cow, and organ is hypernym of lung and stomach.

[2] Hyponymy is the opposite of hypernymy: lung and stomach are both hyponyms of organ.

some issues for further research.

2 Reference in Semantic Theory

The choice of words interlocutors employ to refer to a given object is greatly influenced by extra-linguistic contexts. Our view on reference follows cognitive accounts of semantics (Langacker, 1987; Feldman, 2006), which define a speaker's embodied knowledge of the world and resulting cognition as the foundation of semantics. This view is opposed to the view that the choice of words in an utterance is a function of syntactic or semantic selectional restrictions, in which a word limits the words that can accompany it (Chomsky, 1969). A basis for much research in cognitive semantics is Olson's (1970) statement that "everything has many names and every name 'has' many things." (p. 162). Thus, the relation between words and referents is not a direct relation but is mediated by the context. The mediating component determining the function of a word can be the experience of perceiving objects in a context. It is, therefore, not possible to define 'the meaning' of a word that holds for all contexts, but "the meaning of a word is its use in the language" (Wittgenstein, 1958). In this sense, the main factor influencing the choice of reference "is made so as to differentiate an intended referent from some perceived or inferred set of alternatives" (Olson 1970).

This view is also supported by the contrast set model (Dale and Reiter, 1995), where the choice of words in a referring expression is made in order to rule out the other possible referents within the given physical context.

Besides the context, the addressee plays an important role for the choice of words: A Speaker distinguishes between information she considers given, i.e. information she thinks the listener should already know and accepts as true, and information the speaker considers new, i.e. which she thinks the listener does not yet know. But speakers not only take into account what they think the listener knows, they also expect the listener to make inferences from shared knowledge, which is called common ground (Clark & Bangerter, 2004). This can either be information that is publicly known or joint personal experiences, e.g. items that are perceptually co-present. Nevertheless, "common ground isn't a homogeneous body of well-established propositions" (Clark & Bangerter 2004, p. 35), it is rather

changing all the time in the course of a conversation and far from being totally clear to both interlocutors, since it is uncertain whether some propositions belong to common ground or not. So, a conversation can be seen as establishing and testing out common ground all the time, which only works if both interlocutors work together. Clark and Wilkes-Gibbs (1986) studied the collaborative nature of referring in an experiment where participants had to work together in a referential communication task, one as director and one as matcher. During six trials the director had to get the matcher to arrange twelve cards showing Tangram figures in a specific order. Clark and Wilkes-Gibbs (1986) found that participants needed fewer words and fewer turns per figure in the course from trial one o six. As an explanation they argue that director and matcher collaborate with each other to develop an appropriate reference system. According to Clark and Bangerter (2004) interlocutors initiate a process that has two goals:

- Identification – Speakers want their addressees to identify a particular figure under a particular description.

- Grounding – Both interlocutors try to establish the mutual belief that the addressee has identified the referent well enough for current purposes.

Grounding was defined by Clark and Bangerter (2004) as establishing a thing "as part of common ground well enough for current purposes". An important question that now remains is how the development of common ground actually works. This will be discussed in the following section on *lexical entrainment*.

3 Lexical Entrainment

One process that can be seen as a part of the collaborative behavior that interlocutors show in a dialogue is lexical entrainment (LE). In the course of this linguistic adaption speaker and hearer converge on shared terms. A sample definition is expressed in the following:

> "[I]f *A* talks to *B* and uses a term such as *pointer* to refer to an [sic!] graphically displayed object, i.e. leads in the usage of the term – and *B* (from then on) also employs the term, i.e. follows lead of *A*, then we have a classic case of entrainment." (Porzel, 2006, p. 1)

Every time a speaker selects words to refer to an object, he or she assumes a conceptual perspective for the listener to adopt with regards to the given referent. If there is need to refer to the same object again, interlocutors will generally make use of the same referential conceptualization by reusing the same term(s) or an abbreviated version (Van der Wege, 2009).

Two distinct views of lexical entrainment have emerged: The mechanistic model sees LE more as an automatic process, while the collaborative view emphasizes on strategic cooperative aspects of it. According to the mechanistic model of LE (Pickering & Garrod, 2004), the linguistic representations used to understand and to produce utterances by two interlocutors become automatically aligned on several levels, not just in the syntactic, lexical and phonological elements, but even on the situation model in discussion. Alignment is supposed to "work via a priming mechanism, whereby encountering an utterance that activates a particular representation makes it more likely that the person will subsequently produce an utterance that uses that representation" (Pickering & Garrod, 2004).

Conversely, for proponents of the collaborative view (Clark & Wilkes-Gibbs, 1986), lexical entrainment is part of the conscious, collaborative effort to achieve *identification* and *grounding* (see above). An important requirement for making a reference that the interlocutor will understand is the establishment of mutual knowledge. The first person who makes a reference has to be convinced that the identity of the referent is truly going to become part of the common ground of both interlocutors. The second speaker, trying to understand the reference, should let the first one know, whether or not he/she understands it. One way of achieving this is by using the same expression in the further course of the dialogue. Hence, lexical entrainment can rather be understood as a conscious or strategic process. We will now have a look at the factors that influence this process.

3.1 Factors that Influence Entrainment

Following the collaborative approach, lexical entrainment is regarded to be based on two principles, the Principle of Contrast and the Principle of Conventionality (Clark, 1988; Van der Wege, 2009). These are also the primary principles children employ when learning new words.

According to the Principle of Contrast, children

act on the assumption that any difference in form of a word indicates that there is a difference in meaning. The Principle of Conventionality says that for certain meanings a conventional form exists. When one does not use this form that speakers of a community expect to be used, there has to be a reason, like having another, contrasting meaning in mind.

Van der Wege (2009) applies these principles for the field of reference in general. The principles can be applied to the language of a community, as well as to one single conversation. New words are seen in contrast with words that are already known or have already been established in the course of the conversation. Van der Wege (2009) assumes that not only word meanings are contrasted by speakers but also the words they use in their referring expressions and the conceptualizations of the referent that underlie their choices.

By using this term, she intends to leave open that the linguistic precedents used and maintained by the speakers might be conceptual, rather than linguistic. Following these principles, we can firstly predict a strong preference of speakers to continue using an established conceptualization when referring to the same referent. For example, a speaker who started to refer to a particular shoe as a 'black loafer' will continue to call it 'black loafer' when referring to it again instead of choosing a new reference phrase like 'shoe' (Brennan & Clark, 1996). Secondly, Van Der Wege (2009) predicts lexical differentiation: When referring to a new referent, there should be a "strong preference to use a reference phrase and corresponding referential conceptualization that contrasts with other previously established referential conceptualizations." (p. 449)

Another factor that influences the choice of a referring expression is the context of established references within a conversation. When referring to the same referents multiple times with the same conversational partner, speakers often underspecify referents, as in the following example of Clark and Wilkes-Gibbs' (1986, p. 12):

1. a person who's ice skating, except they're sticking two arms out in front

2. the person ice skating that has two arms

3. the person ice skating, with two arms

4. the ice skater

Even if the shortened references (such as 'ice skater') would be ambiguous for a third person, in the historical context of the conversation the reference will be clear for both interlocutors.

When the set of potential referents changes, so that an established conceptualization is no longer unambiguous, speakers may be uncertain between maintaining the established conceptualization and trying to be as unambiguous as possible in the current context (Van der Wege, 2009). This means that the speaker may consciously consider changing the choice of words to adapt to the new context.

In the present study, we wanted to find out what kind of influence semantic distance in form of different hypernyms or hyponyms has on the process of lexical entrainment. A further question was if the results would speak rather in favor of the mechanistic or the collaborative account on LE.

4 Materials and Methods

First, we will discuss our definition of semantic distance which starts from the concept of hypernymy/hyponymy. Furthermore, the experimental setup and execution are discussed in the subsequent section. The last section deals with the analysis of the data and the program that was implemented for this purpose.

4.1 Hypernymy and Semantic Distance

Hypernymy and Hyponymy are two different ways in which word senses can be related. For example, *animal* would be the hypernym of *bear* and *walrus*, conversely they are the hyponyms of *animal*. A word can also be a synonym to its hypernym in contexts where it is used to specify the same intended referent: "Thus, 'I took your money' is synonymous with 'I took the five dollars' if the five dollars is your money." (Olson, 1970, p. 267).

We based our concept of semantic distance on hyponymy and hypernymy relationships in the lexical database of English WordNet 2.1 (Budanitsky & Hirst, 2001; Gurevych & Niederlich, 2005). We started by identifying how many common hypernyms two nouns have in WordNet 2.1. This semantic distance is a measure to compare whether two nouns are more or less similar than two other nouns. As an example we take the following three pairs of nouns:

Fish - Fish

Whale - Giraffe

Dinosaur - Butterfly

"Fish" obviously has the same amount of hyponyms "fish" has, so this is the most similar two nouns can get, i.e. identical (Table 1). The semantic similarity of "whale" and "giraffe" is given by the first hypernym in which they coincide, which is, according to WordNet, "placental". "Placental" has 9 hyponyms so "whale" and "giraffe" would have a measure of 10 in the practical way of comparing them with the semantic similarity of "dinosaur" and "butterfly". "Dinosaur" and "butterfly's" first common hypernym is "animal" that has 5 hyponyms. Following from the amount of com-

Table 1: Levels of semantic similarity and examples.

Semantic Similarity	Noun 1	Noun 2	Common Hypernyms
1	Fish	Fish	Absolute similarity = identity
2	Whale	Giraffe	Placental, Mammal, Vertebrate, Chordate, Animal ...
3	Dinosaur	Butterfly	Animal, Organism, Living thing, Physical Object ...

mon hypernyms we developed 3 levels of semantic similarity: Level 1 included words which have all hyponyms in common in addition to the same definition, which meant that both participants had the same image on their card. For Level 2, the definition in WordNet had to be different and most of the terms had at least one uncommon hypernym. The terms for Level 3 had at least two uncommon hypernyms. The final categorization was performed by four raters in a separate evaluation experiment. All raters categorized perceived semantic distance of pairs of images. Only those card sets were included where all raters agreed on the semantic distance.

4.1.1 Setup and Execution

The general experimental set-up was inspired by Clark & Wilkes-Gibbs (1986), but the content and the number of the cards were different. The original task was restricted to ordering identical sets of cards in the same order. In the present experiment, the images on the corresponding cards were semantically related, but not identical, making reference harder and enforcing the development of a matching strategy.

Two participants were seated opposite to each other. They were separated by a wall, so that they could not see each other's cards. Each one got five cards in a sequence randomly chosen by the experimenter; whereby for each card of one participant, there was one semantically related card in the partner's set. They were told that the goal was to arrange their cards in the same sequence as the other participant. One of the participants was the 'leader', which means he had to lead the other one ('follower') to arrange the cards in the correct sequence. This role was alternated after each completed sequence. Each couple did four trials in arranging the cards in one of the three levels. Throughout the four trials, the same cards were used.

In total, 50 people (25 couples, randomly paired) were asked to take part in the experiment. They were all students between 18 and 31 years old. The experiment was introduced to the participants as a "card game" and "only a warm-up" for another subsequent experiment to make sure that the participants would not care too much about what they said.

The speech of the participants was recorded and transcribed. 18 text files were considered useful data as input for the analysis, as some of the data had to be rejected due to some participant's lacking knowledge of German or other complications. Four of these 18 couples had done Level 1 of semantic distance; seven, respectively, had done Level 2 and Level 3.

4.2 Analysis

A program was implemented to process the transcription of the recorded conversations. First, two kinds of results were analyzed:

- Amount of words used by the two participants for every trial.

- Frequency of all the nouns uttered which referred to the content depicted on the cards, distinguishing whether they were hyponyms or hypernyms.

Moreover, the course of entrainment during the 4 trials was analyzed. Therefore it was counted as entrained reference, when a speaker used a referring expression that had been used before by the other speaker; in which usage by the other speaker may have been at any prior point in the experiment. We also counted a reference as entrained

when it could unambiguously be identified as a reduced form of a reference the other speaker had used before (e.g. "the soccer goal" = "the goal"). A referring expression used by a speaker was considered non-entrained when it had not been used before by the other speaker in the whole experiment. When a new referent was introduced, the reference was always non-entrained.

5 Results

The following graph shows how the average number of words uttered by each of the participants varied on each of the different levels and trials. Generally, the further the semantic distance between the cards, the more words participants needed in order to solve the task, as shown in Figure 3. For Level 3 the number of words was much higher for the first two turns compared to Level 1 and Level 2. For Level 2, there were still a lot more words needed than for Level 1. But, in the course of the interaction, the dispersion of the number of words on the three levels decreased.

While for turn one, the average amount of words in Level 2 is almost 50 times higher (990 words) compared to Level 1 (19 words) and 134 times higher (2015 words) in Level 3, for Trial 4 the amount of words is below 250 for all levels with relatively small differences between the different levels.
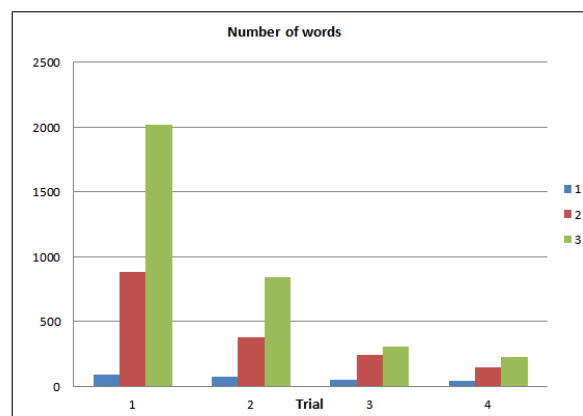

Figure 1: Average number of words in the course of the four trials for Level 1 (blue), 2 (red) and 3 (green).

Figure 2 shows the percentage of hypernyms for all cases where referring expressions were used, i.e. all cases of words with which the participants referred to the objects on the cards.

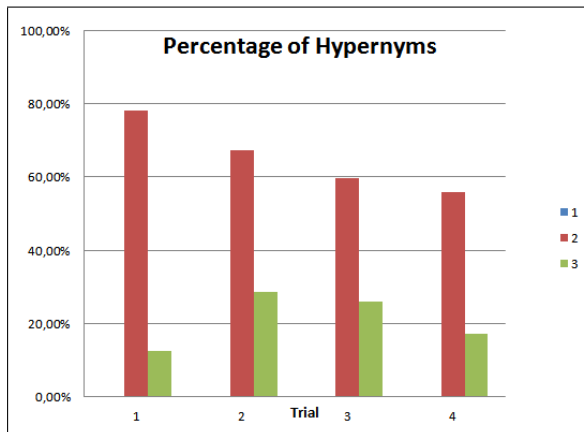While for Level 1 the rate of hypernyms is 0% throughout all trials – which means that, as was ex-

Figure 2: Percentage of Hypernyms per Trial in Level 2 (red) and Level 3 (green).

pected, no hypernyms at all were used, for Level 3 the number of hypernyms increased in the second trial and then decreased in the third and fourth trial. For Level 2 a slight overall decrease from Trial 1 to Trial 4 can be observed.
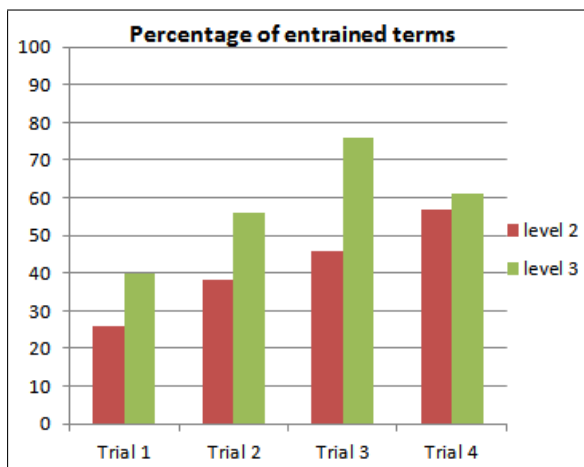

Figure 3: Percentage of entrained terms (of all referring expressions) in Level 2 (red) and Level 3 (green).

The analysis of the number of entrained terms shows that for level 2 slightly more entrained terms are used in each trial (from 26% in trial 1 to 57% in trial 4) while in level 3 the percentage of entrained terms first increases and then drops from 76% in trial 3 to 61% in trial 4 (s. figure 3).

We will now provide some samples from our data. Participants that show a low percentage of entrainment did not entrain for the majority of the terms used. Example 1 gives evidence that entrainment does not occur in all cases (i.e. not for all referring expressions used by a participant

pair). Example 1 shows all utterances referring to the pair SHIRT – PANTS in the dialogue between Participants A and B, who take turns in taking the role of leader (L) and follower (F). The example is from Level 2, having an intermediary semantic distance between corresponding terms. Certain references are not entrained at all: each participant is stating what is on their card, and relying completely on the partner to perform the matching. We call this *lexical non-entrainment*.

Example 1

Trial 1
A (L):   Ich hab ganz links, äh, 'n **Hemd**. Ich hab ganz links, ja... Äh, dann kommt 'ne Ananas als nächstes.
*I have on the very left, [HES], a **shirt**. I have completely left, yes, [HES] then comes a pineapple next.*

Trial 2
B (L):   Dann hab ich, äh, Orangen. Ja, Orangen.
Dann hab ich Delfin. Und 'ne **Hose**.
Then I have [HES] oranges, yes, oranges.
*Then I have a dolphin and some **pants**.*

Trial 3
A (L):   Also, ganz links hab ich wieder das **Hemd**.
*Well, on the very left I have the **shirt** again.*

Trial 4
B (L):   Ich hab jetzt Delfin, und dann den Baum. **Hose**, ähm, Baseball und Orange.
Now I have dolphin and then a tree.
***Pants** [Hes] baseball and orange.*

This effect did not occur in the Level 1 data, as the initial referential expressions used were already identical.

Example 2 shows all utterances relating to the pair FOOTBALL GOAL – BASEBALL BAT from Level 3 between participant A and B who take turns in taking the role of leader (L) and follower (F):

Example 2

Trial 1

A (L): Äh, rechts Walnuss, Schmetterling, **Tor**, Schuh und, äh, – Gott was ist das? – irgend'ne Pflanze.
*[Hes], on the right walnut, butterfly, **goal**, shoe and [Hes] – God what's that? – some kind of plant.*

B (F): Ah, ok. Sag nochmal, Chef.
Ah, ok. Say it again.

A (L): Äh, Walnuss, Schmetterling oder Motte, eins von beiden. **Fussball-tor, Handballtor, irgend'n Tor**, ein wunderschöner Schuh.
*[Hes], walnut, butterfly or moth, one of both. **Football goal, handball goal, some kind of goal**, a lovely shoe.*

Trial 2

B (L): **Baseballkeule.**
Also, was anzuziehen, 'ne Pflanze, ne? Frucht, Tier, **Sportgerät**.
Baseball bat.
*So, something to dress, a plant, right? Fruit, animal, **sports equipment**.*

Trial 3

A (L): Also, ganz vorne **das Sportgerät, Tor**, Pflanze, äh, fleischfressende Pflanze. Ähm, die Walnuss, der Schuh und der Schmetterling.
*So, right ahead the **sports equipment, goal**, plant, [Hes], carnivorous plant. [Hes], the walnut, the shoe and the butterfly.*

Trial 4

B (L): Dinosaurier, Gurke, Baum, **Baseballschläger**, Mütze.
*Dinosaur, cucumber, tree, **baseball bat**, cap.*

As can be seen in this example, from Trial 1 to Trial 4 fewer words are needed to reach the goal in each turn. In Trial 1, the participants have not reached the stage of entrainment yet, the hyponym 'goal'/'football goal' is used. In Trial 2, participant B introduces the hypernym, 'sports equipment', to make sure that each of them has understood what the task is about. Participant A follows the usage of the hypernym in Trial 3. Nevertheless, in Trial 4 B goes back to the hyponym. The hypernym is not necessary for their communica-

tion, as both know that they are indirectly referring to it. This phenomenon we term *lexical de-entrainment*.

It is clear this process cannot happen in that data obtained in our Level 1 experiments, as the entrained terms were identical to the initial referential expressions used. Thus, there was no need to go to another lexical expression in the first place, and therefore no way to return to an initial state. In Level 3 data, we observed this process in 4 out of 7 dialogues, i.e. the percentage of entrained terms decreased from trial 3 to trial 4. Example 3, taken from level 3, illustrates *lexical de-entrainment* again.

Example 3

Trial 1

[...]

A(L): dann habe ich ... eine **Pflanze**
*I have .. a **plant**.*

B(F): mm, ja, ich habe einen **Baum**, vielleicht ist das so ein bisschen das gleiche.. und ich habe einen **Hut**, das ist vielleicht...
*[HES] yeah I have a **tree**, maybe that's kind of the same, and I have a **hat**, maybe that's...*

A(L): Das ist schon mal gut, dann habe ich ein **Sportgerät** als **Tor**.
*That's very good already; I also have **sports equipment** as **goal**.*

[...]

A(L): Das ist schon mal gut...und **Schmetterling** als **Tier** vielleicht.
*That's already good, and a **butterfly** as **animal** maybe.*

[...]

Trial 2

B(L): Also, erst das **Tier**.
*So, first the **animal**.*

A(F): Ja.
Yeah.

B(L): Dann die **Pflanze**, **Kleidungstück**.
*Then the **plant**, **clothing piece**.*

[...]

B(L): Das **Sportsding** und dann das **Essens-**... mh
*The **sports thing** and then the **eating** [HES]*

Trial 3
A(L): Am Anfang habe ich den **Schmetterling**, das **Tier**.
*At first I have the **butterfly**, the **animal**.*

B(F): Ja.
Yeah.

A(L): Das **Sportsgerät**, das **Tor**.
*The **sports equipment**, the **goal**.*

[...]

A(L): **Kleidungstück**, den **Schuh**.
***Clothing piece**, the **shoe**.*

[...]

A(L): Dann die **Walnuss** als **Nahrung**.
*Then the **walnut** as **food**.*

[...]

A(L): und die **Pflanze**.
*And the **plant**.*

Trial 4
B(L): Ok **Mütze**, **Baum**, **Dinosaurier**, **Gurke** und **Baseballschläger**.
*Ok **hat, tree, dinosaur, cucumber** and **baseball bat**.*

Participant B did not address the entrained hypernyms in Trial 4 to accomplish the goal. She referred to the cards she held in her hand ignoring the already entrained hypernyms and knowing that her cards were different to A's. She *de-entrained*.

6 Discussion

In our experiments we found – as could be expected – that the larger the semantic distance between corresponding cards, the more words per trial were needed to perform the task. Also, the decrease in word number from Trial 1 to Trial 4 was higher for the Levels 2 and 3 than within Level 1.

This directly reflects the higher collaborative effort needed to establish common ground. While for semantically closely related objects the listener could easily infer which object the speaker was referring to, with a high semantic distance the knowledge of which objects correspond to each other needed to be built up during the task. By the third or fourth trial, in most cases common ground had been fully established, therefore the dispersion of the number of words on the three levels decreased.

At this point both participants usually knew to which objects they were referring and the words uttered did not matter in order to complete the indicated task. In this way, the expressive distinction between hypernym and hyponym had been overcome. In some cases, such as Example 1, participants reached this stage very soon and therefore did not need to rely on lexical entrainment at all for solving the task. In other cases, after entrainment had been used for establishing common ground, at some point lexical de-entrainment occurred, as the previously entrained terms were not needed anymore.

In an analogy to a Hegelian Spiral one can think of de-entrainment as starting with an initial state of non-entrained terms, which – through processes of alignment – turns into a second state in which terms become more and more entrained. Lastly, speakers can reach a third state where terms become de-entrained again, which looks on the surface almost identical to the first level, but now a crucial conceptual change has occurred in the interlocutors' understanding of the de-entrained terms. In some cases, however, the step of lexical entrainment can be skipped, reaching the third stage of common ground directly.

The theoretical implications of these findings are clear: If entrainment was to be an automatic process based on basic priming and joint action principles there would be no reason or even mechanism to trigger de-entrainment processes. This means that speakers would remain in phase two which would reinforce itself more and more through automatic processes. If we are dealing with collaborative strategies that serve multiple goals, e.g. mutual understanding as well as economy, scenarios can be envisioned in which it becomes feasible to drop previously entrained terms for the sake of one's own cognitive economy without putting mutual understanding at risk. Or, in the more extreme case, mutual understanding may be reached so early in the dialogue that the process of entrainment is simply not necessary. In our opinion, such a scenario is manifested in our data.

When it becomes conceptually evident that each speaker has only one instance of the hypernym at

hand, e.g. A has an *apple* and B has an *orange* as instances of the hypernym *fruit* – then A's apple becomes the conceptual counterpart of B's orange. As a consequence, the previously established and entrained hypernym *fruit* can be abandoned, because A knows that B will understand his reference to the apple to refer to her orange.

In the data set we observed a decline in the number of hypernyms used after a while, which is – in our minds – insurmountable with an automatic view on entrainment, since this view would predict at rising or at least a constant level of entrained terms.

6.1 Future work

The phenomenon of lexical de-entrainment should be studied further with larger-scale studies. In order to quantify the de-entrainment level a conservative metric could take the maximal level of entrainment and calculate the integral between the actual decline of the curve and an assumed constancy at that level. This integral, therefore, quantifies the level of de-entrainment over time, based on the prior level of entrainment. Having more data would also enable to give comparative metrics concerning the slopes of the entrainment and de-entrainment curves.

A further goal should be to gain further insight into the specific conditions that cause lexical de-entrainment in order to get a better understanding of the relationship between the collaborative striving for mutual understanding, and the desire to save cognitive effort.

7 Acknowledgements

References

Brennan, S. E. & Clark, H. H. (1996). Conceptual pacts and lexical choice in conversation. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 22(6), 1482-1493.

Budanitsky, A. & Hirst, G. (2001). Semantic distance in WordNet: An experimental, application-oriented evaluation of five measures. *Workshop on WordNet and Other Lexical Resources, Pittsburgh, PA* (pp. 29-34).

Chomsky, N. (1969). *Aspects of the theory of syntax.* Cambridge, Mass.: M.I.T. Press.

Clark, E. V. (1988). On the logic of contrast. *Journal of Child Language*, 15, 317-335.

Clark, H.H. & Wilkes-Gibbs, D. (1986). Referring as a collaborative process. *Cognition*, 22, 1-39.

Clark, Herbert H. & Bangerter, A. (2004). Changing ideas about reference. In D. Sperber & I.A. Noveck (Eds.), *Experimental Pragmatics*. Hampshire, New York: Palgrave Macmillan.

Feldman, J. (2006). *From molecule to metaphor: A neural theory of language.* Cambridge, MA: MIT Press.

Fellbaum, C. (1994). *WordNet: An electronic lexical database.* Cambridge, MA: MIT Press.

Furnas, G., Landauer, T., & Dumais, G. (1987). The vocabulary problem in human-system-communication: an analysis and a solution. *Communications of the ACM*, 30 (11), 964-971.

Gurevych, I. & Niederlich, H. (2005). Accessing GermaNet data and computing semantic relatedness. *Companion Volume of the 43rd Annual Meeting of the Association for Computational Linguistics* (pp. 5-8).

Herrmann, T. & Deutsch, W. (1976). *Psychologie der Objektbenennung.* Bern: Hans Huber.

Herrmann, T. & Grabowski, J. (1994). *Sprechen: Psychologie der Sprachproduktion.* Heidelberg: Spektrum Akademischer Verlag.

Langacker, R. (1987). *Foundations of cognitive grammar.* Stanford: Stanford University Press.

Olson, David R. (1970). Language and thought: aspects of a cognitive theory of semantics. *Psychological Review*, 77, 257-273.

Pickering, M. J. & Garrod, S. (2004). Towards a mechanistic psychology of dialogue. *Behavioral and Brain Sciences*, 27, 169-226.

Porzel, R., Scheffler, A. & Malaka, R. (2006). How entrainment increases dialogical effectiveness. *Proceedings of Workshop on Effective Multimodal Dialogue Interfaces*, Sydney.

Van der Wege, M. (2009). Lexical entrainment and lexical differentiation in reference phrase choice. *Journal of Memory and Language*, 60, 448-463.

Wittgenstein, L. (1958). *Philosophical investigations.* Oxford: Basil, Blackwell & Mott.

Dale, R., & Reiter, E. (1995). Computational Interpretations of the Gricean Maxims in the Generation of Referring Expressions. *Cognitive Science*, 19(2), 233-263.