Do longer lines take longer?

Reconsidering the cognitive reflections of spatial duration metaphors: Evidence from Dutch

Marion Baksteen (1160001)

Research MA thesis Linguistics
Leiden University
Faculty of Humanities

Supervisors: Dr. E.I. Crevels
Dr. S. Gryllia
Second reader: Dr. N.Q. Emlen

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> "Plans fail for lack of counsel, but with many advisers they succeed."
> (Proverbs 25:22, NIV)

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Abstract

The conceptual link between space and time is accounted for by two different theories: Conceptual Metaphor Theory (CMT, Lakoff and Johnson 1980) and A Theory of Magnitude (ATOM, Walsh 2003). Within a linguistic framework, CMT provides evidence for an asymmetric conceptual link between space and time, opposed to the symmetric link predicted by ATOM. Casasanto and Boroditsky (2008) and Casasanto (2010) presented evidence in favour of CMT from non-linguistic psychophysical tasks. Longer lines appeared to positively affect participants' estimation of duration, analogous to metaphors for duration using spatial words such as *long* and *short*, but duration did not influence the perception of space (Casasanto and Boroditsky 2008). A subsequent study revealed language specific differences in effects of different stimulus types, parallel to the typical duration metaphors found in these languages (Casasanto 2010). The present investigation of Dutch shows that the relation between duration metaphors and the perception of space and duration is less straightforward than what might be expected on the basis of the accounts of Casasanto and Boroditsky (2008) and Casasanto (2010). The results of an experiment with speakers of Dutch reveal a symmetric link between space and duration in the case of space presented in the form of one-dimensional length, but an asymmetric link is reported in case of more-dimensional size. Overall, this provides evidence for ATOM rather than CMT.

Contents

List of abbreviations

1	first person
2	second person
3	third person
ADJZ	adjectivizer
AUX	auxiliary
C	common (not neuter)
CONC	concessive
DEF	definite determiner
DEM	demonstrative
DIM	diminuative
DIST	distal
F	feminine
FUT	future
INDEF	indefinite determiner
INF	infinitive
M	masculine
N	neuter
NEG	negative
NMLZ	nominalizer
PTCL	particle
PL	plural
POSS	possessive pronoun
PP	perfect participle
PRO	pronoun
PRS	present
QUANT	quantifier
PST	past
REC	reciprocal
REFL	reflexive pronoun
SG	singular

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1. Introduction

1.1. Time in language

Time is a feature of great interest in linguistics. It is intriguing that an intangible phenomenon such as time is represented so strongly in the grammars of human languages. Over centuries, linguists have described TAM systems for many languages, systems that reflect temporal experiences of the speakers of these languages. Another interest regarding time and language is found in the study of how time as a concept is represented in linguistic utterances. Well-known metaphors, such as 'time flies when you're having fun', reflect our ideas about time, and possibly shape them at the same time. Moreover, not only do we talk about the concept of time as such in metaphors, but a whole range of constructions we use to discuss temporal arrangements make use of metaphors as well. Take for example the way we tend to talk about future events as 'coming events', or about the past as 'laying behind us'. Though a maybe less well-studied subject than the grammatical encoding of time, there exists a vast amount of literature on this matter, not only from a linguistic perspective, but for example also from psychological and philosophical perspectives. Relatively new in this area of study is the interest in the link between time and space. Though it has long been observed that many languages discuss time in terms of space, this notion has only relatively recently begun to be investigated in a structured way.

The current thesis is concerned with this link between space and time, in languages, but also with respect to the cognitive reality of such a link. Specifically, attention will be paid to so-called 'duration metaphors' in Dutch, expressions that find their source in the semantic domain of space, but that describe duration. The thesis also reports on an experiment which tests possible effects of such metaphors on the perception of space and duration. However, before turning to that, it is important to be aware of certain developments in this field of investigation.

1.2. Time and Space

One of the pioneering studies regarding the link between time and space is found in the work of Clark (1973). In this paper, Clark argues that English time expressions are based on a spatial metaphor. He proposes two spatial metaphors of time: *moving ego* and *moving time* (Clark 1973:50). In explaining these metaphors, Clark compares time to a highway of discrete events in a successive order. The different perspectives one can take with respect to this highway result in the two different metaphors. According to one perspective, speakers (the ego) are moving along this highway, so that future time is ahead of the ego and past time behind the ego, resulting in the *moving ego* metaphor. An example Clark gives of this metaphor is:

(1) We are just coming into troubled times.
(Clark 1973:51)

The other perspective reflects the highway of time as moving past the ego, from front to back, resulting in the *moving time* metaphor, as in:

(2) Friday arrived before we knew it.
(Clark 1973:50)

In the years following this paper, the notions of *moving ego* and *moving time* were taken up by many scholars in the description of spatial metaphors of time. An important impulse to the development of more specific theories on such metaphors was given by the work of Lakoff and Johnson (1980, 1999) and Lakoff (1993), who initiated the framework of Conceptual Metaphor Theory (CMT).

In CMT, the metaphorical link between a target domain, for example 'time', and the source domain from which it receives its terminology, for example 'space', is thought to reflect a real link in cognitive sense. Metaphors found in daily use are argued to reflect the way the concepts discussed are conceptualised. In the tradition of CMT, metaphors are usually represented in (small) caps, such as: TIME PASSING IS MOTION (Lakoff 1993:14). This metaphor is said to account for a wide range of spatial expressions used for time. Two special cases of this metaphor are proposed: TIME PASSING IS MOTION OF AN OBJECT and TIME PASSING IS MOTION OVER A LANDSCAPE. These metaphors cover respectively the *moving time* and *moving ego* metaphors of Clark, but are broader. To illustrate, see the following examples:

(3) The time will come when…
(4) Let's put all that behind us.
(Lakoff 1993:14)

Both (3) and (4) are instances of TIME PASSING IS MOTION OF AN OBJECT. Of these two examples only (3) would probably also be classified as *moving time*. On the other hand, (4) cannot without difficulty be regarded as *moving time*. In (4) there is an aspired movement of some temporal event/experience, described as 'all that', towards the backside of the ego. However, this movement is not the natural flow of time from front to back as perceived by an ego. Instead, this aspired movement is induced by the ego itself, as is understood from 'let's put'. Hence it cannot really be stated that example (4) is an instance of a *moving time* metaphor. Something similar can be said for TIME PASSING IS MOTION OVER A LANDSCAPE compared to *moving ego*:

(5) We're coming up on Christmas.
(6) His stay in Russia extended over many years.
(Lakoff 1993:14)

While (5) and (6) are both examples of TIME PASSING IS MOTION OVER A LANDSCAPE, only (5) can be regarded as *moving ego* without difficulties. In (6) we cannot really speak of a *moving ego* as it literally states that the ego is staying in the same place. Thus, while the metaphors for time as movement proposed by Clark (1973) and Lakoff (1993) partly overlap, they cannot be used interchangeably.

In this way, different linguists proposed various adapted, complementing or new metaphors based on their own data for different languages, and the body of literature on this matter grew (see for example Alverson 1994, Yu 1996, Dahl 2005). Specifically with respect to the frames of reference proposed by Levinson (2003) for spatial orientation in languages, studies appeared applying this to temporal metaphors (Bender et al. 2005, Núñes and Sweetser 2006, Moore 2006, 2011, 2014, Bender et al. 2010, Boroditsky and Gaby 2010, Shinohara and Pardeshi 2011, Brown 2012, Fedden and Boroditsky 2012, Gaby 2012, Núñes et al. 2012). Based on such studies, several linguists have proposed a taxonomy of temporal frames of references (see for example Zinken 2010, Tenbrink 2011, Evans 2013a, 2013b). For an

extensive review of the state of the art in this field of investigation, I refer to the comprehensive work of Bender and Beller (2014).

Not surprisingly, alongside the investigation of such conceptual metaphors and temporal frames of reference in different languages, interest rose in the question to what extent we can speak of a cognitive reality of a spatial representation of time. Many of the mentioned studies already incorporate part of that question in the discussion of their findings. Other studies were designed specifically to give insight in this question. A popular task used in such studies involves the ambiguous expression 'Next week Wednesday's meeting has been moved forward two days', in which people have to respond to the question on which day the rescheduled meeting will take place. The two possible interpretations of this expression reflect either a *moving time* or a *moving ego* perspective. From a *moving time* perspective the correct answer would be Monday, as the forward movement of time implies its coming closer to the ego. From a *moving ego* perspective the correct answer would be Friday, as the movement of ego means that moving forward implies moving further into the future.

As said, this task was implemented in different studies. Boroditsky and Ramscar (2002) for example found that the answer people would give could be manipulated by priming them with a picture task involving either movement of an object towards the ego or movement of the ego towards an object. Likewise, the real experience of motion also seemed to influence the answer people would give. A questionnaire amongst people in an airport revealed that people who had just flown in were significantly more likely to answer from a *moving ego* perspective than people who were about to fly. Also, people who were about to fly were more likely to answer from a *moving ego* perspective than people who were at the airport to pick someone up (Boroditsky and Ramscar 2002:186).

A side note to this finding is that within the 'picking up people at the airport' group there was no significant difference between the number of people who answered from a *moving time* perspective and the ones that answered from a *moving ego* perspective. So, although you might expect this group of people to be more likely to conceive time as coming towards them instead of moving through time themselves, as they are waiting for people coming towards them, there is no evidence for this in the data. Actually, it might be the case that for English, in a neutral condition a *moving time* and *moving ego* perspective are equally likely to occur, and that experiences of (anticipated) motion can only facilitate the *moving ego* perspective. On the other hand, the lack of motion as experienced by the ego that is implied in the *moving time* perspective, does not seem to be a sufficient basis for influence of an ego's experience on the choice of perspective. The study of Boroditsky and Ramscar (2002) is but one out of many studies on the cognitive reality of a spatial representation of time as found in language. Others include for example Matlock et al. (2005), Fuhrman et al. (2011), Bender et al. (2012), Lai and Boroditsky (2012), and de la Fuente et al. (2014). However, not every experiential link between space and time is explained by linguistic metaphors, see for example Bergen and Lau (2012), and Sousa (2012) on the influence of writing direction on the way people map space onto time.

So far, the mentioned studies all discuss the linguistic relation between time and space from the perspective of temporal frames of reference. In other words, how different events relate to one another in temporal respect, or how particular events relate to the temporal ground of the speaker (the ego). But the semantic domain of time covers a much greater range of topics.

Haspelmath (1997) summarizes claims on the link between temporal and spatial expressions found in previous linguistic studies as follows:

(i) Temporal expressions are identical with spatial expressions.
(Wierzbicka 1973, Clark 1973, Jackendoff 1983)

(ii) Temporal expressions are based on spatial expressions.
(Meyer-Lübke 1899, Gamillscheg 1957, Lyons 1977, Langacker 1987, Wunderlich 1985)

(iii) Speakers conceive of time in terms of space.
(Gamillscheg 1957, Langacker 1987)

(Haspelmath 1997:18)

There is a hierarchy in these claims, with (i) having the least and (iii) the most consequences. In this list, Haspelmath does not refer to CMT, but the work of Lakoff and Johnson (1980, 1999) best fits the claim in (ii) and to a certain extent also the claim in (iii). CMT does hypothesize that speakers conceive of target domains in terms of the source domain from which they get their metaphors, but the CMT framework does not provide directions to test such hypotheses. A theory that is often mentioned as opposing CMT is A Theory of Magnitude (ATOM), as proposed by Walsh (2003). According to ATOM, time, space, and quantity (also referred to as number) are part of a domain-general magnitude system. Where CMT stems from linguistics, ATOM is based on brain studies. For an extensive discussion of the differences between CMT and ATOM, and a review of the evidence for either of the two theories, I refer to Winter et al. (2015).

The main difference between CMT and ATOM is the way they view the (a)symmetry between the domains of space, time, and quantity. This (a)symmetry is found on domain as well as directional level. Domain (a)symmetry refers to the extent to which different domains are linked. Directional (a)symmetry refers to the extent to which two linked domains influence each other. Overall, ATOM advocates domain symmetry as well as directional symmetry. In other words, according to ATOM quantity and time are as likely to be linked as space and time (domain symmetry), and space might influence time to the same extent as time influences space (directional symmetry). CMT on the other hand supports an asymmetric view. According to CMT, there are source domains and target domains, target domains do not influence source domains to the same extent source domains influence target domains[1] (directional asymmetry). A link between different target domains is not necessary for CMT (domain asymmetry), and does not exist the case of number and time. According to CMT, based on linguistic evidence, the only link time and number might display, goes via the domain of space (see Winter et al. 2015).

Winter et al. (2015) discuss evidence for domain and directional (a)symmetry from both perspectives, and conclude that, unlike the way they are often presented, CMT and ATOM are not completely incompatible theories. Precisely because evidence for both theories usually

[1] Asymmetry is distinguished from unidirectionality; there are examples of time expressions metaphorically used to indicate space (e.g. 'I am five minutes away from the library'), but they are claimed to be less frequent than spatial expressions used to indicate time.

comes from different disciplines and focuses on different aspects of the links between the domains, the theories might complement each other. In this respect, they emphasize the focus of ATOM on low level perception, and the focus of CMT on the understanding and reasoning about complex concepts (Winter et al. 2015:220).

1.2.1. Duration and Space

So far I have discussed two theoretical frameworks, CMT and ATOM, in the light of the link between time and space. Time is a very broad concept, and thus far, the focus has merely been on the structuring of events in time, and the way languages rely on the domain of space in describing such events. As mentioned, there exists a vast amount of linguistic literature on this topic, reviewed by Bender and Beller (2014). The relation between duration and space, on the other hand, has been studied from different disciplines, but has received far less attention from linguists than the structuring of events in time. From the perspective of ATOM, it is very likely that a link exists between space and duration, since duration is by definition that aspect of time that has to do with magnitude. Also from the perspective of CMT, it is likely that space functions as a source domain for duration metaphors. With respect to that, the study of Galton (2011) on shared attributes of space and time gives useful insights.

Galton (2011) argues time has four key attributes: *extension, linearity, directionality* and *transience*. Of these four attributes, three are shared with the domain of space: *extension, linearity*, and *directionality*. Based on these shared attributes, space can function as a source domain for time metaphors. With respect to extension, linearity, and duration, Galton writes:

> "The extendedness of time seems to consist in the fact that its nature is such that what is *in* time […] can be separated, so that even things that are otherwise identical, such as the same action by the same subject in the same place, can be numerically distinct solely by virtue of occupying distinct times. Duration might then be regarded as a measure of the extent of their separation, but it does not seem to be possible to define this without reference to what comes *between* the two times – a concept that relates to linearity rather than bare extension."
>
> (Galton 2011:697)

In other words, there is an aspect of time that is best described as *extension*, which makes it possible to distinguish between different moments. The concept of duration, which in itself might be regarded a sub-concept of the broader concept of time, is linked to this attribute of time. Yet according to Galton, duration requires another attribute of time, namely linearity: the fact that time is one-dimensional[2]. This conclusion appears to be based on an English perspective on duration metaphors; elsewhere in his paper, Galton mentions the use of *long* or *short* to refer to duration as an example of spatial metaphors for time exploiting the attribute of linearity (Galton 2011:700). However, this might not be a universal way to describe duration. As opposed to duration, the structuring of events in time relies more on the attributes of linearity and directionality instead of extension.

[2] With respect to the discussion on ATOM and CMT it is interesting that Galton, in his attempt to define the attributes of time without using spatial terminology, resorts to terminology from the domain of quantity/number. For example, he defines linearity as: "relative to a given moment of time, it requires only *one* number to specify the position of another moment" (Galton 2011:697).

I have not found any highly detailed accounts on metaphors for duration from a CMT perspective. Though various studies discuss the effect of space on duration estimation (see for example Xuan et al. 2007, Casasanto and Boroditsky 2008, Bottini and Casasanto 2010, Casasanto et al. 2010, Srinivasan and Carey 2010, Cai and Connell 2015), an extensive description of the metaphors on which the experimental set-up is based, is often no core goal of the study. According to the positions they take on the link between language and the conceptualisation or perception of space and duration, the mentioned studies can be classified in three different groups:

(i) No consideration of linguistic metaphors at all.
(Xuan et al. 2007)

(ii) Linguistic metaphors are brought up as conceptual metaphors influencing participants' perception of space and duration.
(Casasanto and Boroditsky 2008, Casasanto 2010, Bottini and Casasanto 2010, Casasanto et al. 2010, Srinivasan and Carey 2010)

(iii) Linguistic metaphors are considered as irrelevant for participants' perception of space and duration.
(Cai and Connell 2015)

Xuan et al. (2007) concluded on the basis of different stimuli, for example pictures of few and pictures of more dots, that the size of a stimulus affects the estimation of duration. However, since no link to linguistic metaphors is made, I will refrain from further discussion of this paper for the current moment (but see footnote 23, chapter 4). The study of Xuan et al. (2007) is just one example to illustrate this group of non-linguistic studies; many more have been published, often with reference to ATOM (see Winter et al. 2015 for references).

The studies in group (ii) are based on CMT, their aim is to test claims made by CMT that we perceive abstract concepts in the way linguistic metaphors describe them. Casasanto and Boroditsky (2008) describe several experiments including visualised spatial displacement, they report a positive correlation between displacement and duration estimation, and link this to English referring to durations as either *long* or *short*. Casasanto (2010) builds forth on these experiments by designing a different kind of stimulus to match languages that use other spatial terminology to refer to duration. On the basis of experiments carried out among participants speaking different languages, Casasanto (2010) concludes that the language a participant speaks determines which type of stimulus affects most the perception of duration. In another study, Casasanto et al. (2010) found similar asymmetric relations between time and space in children carrying out duration and space estimation tasks. This led them to the conclusion that CMT gives a better account of the relation between time and space than ATOM (Casasanto et al. 2010:403)

Bottini and Casasanto (2010) specifically contrast ATOM and CTM, favouring the latter on the basis of two experiments with speakers of Dutch. In the first experiment, participants had to estimate the duration of stimulus words of which the semantics referred to different spatial lengths (e.g. *pencil* and *footpath*); results showed an effect of implicit spatial length on duration estimation. In the second experiment, people had to estimate the exact spatial length of stimulus words referring to events with different durations (e.g. *blink* and *season*); results

showed no effect of implicit duration on the estimation of spatial length. This led Bottini and Casasanto (2010) to the conclusion that the link between space and time is asymmetric in direction; space influences time perception, but time does not influence space perception, congruent with the pattern found in metaphors from space as source domain to time as target domain.

Based on experiments with congruent and incongruent space/time stimuli (short stimuli with long durations, long stimuli with short durations), Srinivasan and Carey (2010) also report that participants link spatial length and duration. The experimental design did not allow for conclusions on the direction of this link. However, since they found the same effect in 9 month old infants, they concluded it is not possible to explain the way humans link space to time based on metaphors found in language. Rather, they support the view that language might influence the link that is already perceived by humans before any language is acquired.

Contrary to these studies from group (ii), Cai and Connell (2015) favour ATOM over CMT. Based on experiments with stimuli of which the spatial features were perceived through different senses, they put forward a different view on the relation between space and time. Rather than assuming a reported asymmetric relation in which space influences time accounts for the complete domains, they focus on differences in acuity of perceptual modality. In that way, they found that duration affects space perception if space is perceived through touch (low perceptual acuity). On the other hand, space affects the perception of duration if space is perceived through vision (high perceptual acuity). This effect might explain all the effects reported in the studies from group (ii) discussed above, since in all those cases, space was perceived visually.

The study of Cai and Conell (2015) shows that what might seem clear evidence of asymmetry in direction, and thus a support for CMT rather than ATOM, might actually be explained in a different way. This is a reminder that support for a hypothesis is not necessarily evidence that the hypothesis is true (correlation does not equal causation). Yet, conclusions on implications of found effects are rather far reaching for some of the discussed studies. In particular Casasanto links his investigations of the relationship between space and duration to the debate on linguistic relativity (Casasanto 2008:70-75, Casasanto 2010, Casasanto 2016:160-162).

The discussion on linguistic relativity, often referred to as the Sapir-Whorf hypothesis, is concerned with the relation between language and thought. The extreme version of this hypothesis is that language and thought are inseparable, in which language determines and limits speakers' thoughts (based on von Humboldt 1988 [1836], Sapir 1924, Whorf 1956). This view since long is rejected by most linguists, but moderate versions of the theory are gaining ground. An early moderation of the idea of linguistic relativity, is the nuanced version that language, specifically with respect to grammar, does not so much determine what speakers *can* pay attention to, but rather what they *must* pay attention to (see e.g. Boas 1938:132-133, Jakobson 1959:236, Slobin 1996). On the other hand, studies on gender, colour terms, and space reveal that language to a certain extent does influence speakers' perception of the world.[3] And

[3] For an extensive discussion on the development of theories concerning linguistic relativity and recent anthropological linguistic research into this matter, I refer to the popular, accessibly written, account of Deutcher (2010).

related to space, time is now also being presented as perceptually influenced by language. This latter claim is the focus of the present thesis.

1.3. Research question, method and terminology

Often, the studies of Casasanto and Boroditsky (2008) and Casasanto (2010) are the only studies referred to as evidence for an asymmetric link between space and time, based on conceptual metaphors. Yet a critical review of these studies is lacking. The aim of the current thesis is twofold. On the one hand it strives to provide a critical review of Casasanto and Boroditsky (2008) and Casasanto (2010), with a focus on methodology. On the other hand, a case study on Dutch, consisting of a corpus investigation and a psyhophysical experiment, is carried out to provide new evidence on the relation between linguistic metaphors and the conceptualisation of space and time. The main research question is:

> Does evidence from Dutch confirm the findings of Casasanto and Boroditsky (2008) and Casasanto (2010) that the link between time and space is asymmetrical, congruent with patterns in linguistic metaphors?

Note that I am hesitant to use the term *conceptual metaphor*. Rather, I prefer to speak of *linguistic metaphors,* until conclusive evidence is provided that these metaphors indeed reflect deeper cognitive conceptualisations.

One of the aims of the section 1.2 was to illustrate the diversity in studies on space and time in linguistics and beyond. Not surprisingly, the terminology for specific core concepts in this field of investigation is almost equally diverse. For the sake of clarity, in this section, I list the working definitions I use for several concepts that are referred to throughout the thesis. Whenever relevant, other concepts are defined when introduced in the different chapters.

> Time metaphor
> A linguistic utterance about (a part of) the semantic domain of time including terminology or constructions characteristic for another semantic domain.
>
> Spatial time metaphor
> Time metaphor including terminology/constructions from the semantic domain of space.
>
> Temporal frame of reference
> Spatial time metaphor that places (a) temporal event(s) in a certain position with respect to either (an)other temporal event(s) or (an)other entity(/entities).
>
> Duration metaphor
> Spatial time metaphor about the time span of a temporal event, or about duration in general.

Duration metaphors also occur as non-spatial time metaphors, such as in *a good hour*, indicating an hour that is felt to take long. Though this expression is metaphoric, it does not include spatial terminology. Since these metaphors are not considered within the scope of this thesis, *duration metaphor* always refers to spatial duration metaphors unless indicated otherwise.

The remainder of this thesis is structured as follows. Chapter 2 introduces the papers by Casasanto and Boroditsky (2008), and Casasanto (2010) that led to the present investigation of

Dutch duration metaphors. Though the main points of these papers are summarized in this chapter, the focus will be on the linguistic analysis that formed the basis for the different experiments of these studies. In the following chapter, chapter 3, suggestions from chapter 2, on improvements for linguistic investigation of duration metaphors, are applied in a corpus-based study of Dutch duration metaphors. On the basis of this analysis, chapter 4 returns to Casasanto and Boroditsky (2008) and Casasanto (2010) in a discussion of their implementation of linguistic findings in psychophysical tasks. This chapter ends with a proposal for implementation of the findings of the Dutch linguistic investigation of chapter 3 in an experimental setting to test the relationship of these linguistic features with the perception of time and space. Finally, chapter 5 reports on this experiment, which was carried out among 20 native speakers of Dutch. A general conclusion is found in chapter 6.

2. Theory: linguistic investigation

2.1. The studies

The present investigation of Dutch duration metaphors is in reaction to the studies of Casasanto and Boroditsky (2008) and Casasanto (2010). The starting point of Casasanto and Boroditsky (2008) is that in languages, the relation between time and space is asymmetric. They argue that English exhibits much more expressions of time from which the terminology is borrowed from the domain of space, than expressions of space that borrow terminology from time. An example would be "a *long* vacation and a *short* concert" (Casasanto and Boroditsky 2008:580). Though not explicitly stated, from these examples it is clear that Casasanto and Boroditsky are concerned with duration metaphors rather than temporal frames of reference. Based on this premise, they hypothesize that, if the relation between time and space goes beyond language use and is also reflected in our non-linguistic thinking of time and space, we would expect an asymmetric relationship there as well. To test this, they developed the growing line task, a task in which participants view a line that is horizontally growing on a screen. At a certain point the line disappears, after which participants either have to estimate the maximal length of the line they just saw, or the timespan that the line took to grow.

Six different variants of this experiment were carried out[4]:

1. Growing lines, as described above.
2. Growing lines, selective attention. People were told before every stimulus whether they had to answer the space- or the time-question afterwards.
3. Growing lines, temporal frame of reference. The time frame in which the stimuli were shown, were proportional to the length of the line and its growing speed.[5]
4. Growing lines, concurrent tone. The stimulus time was not only made available through the growing time of the line, but also through a constant tone that accompanied the growing time of the line.
5. Moving dot. Similar to growing lines, but instead of a growing line, a dot was shown that moved horizontally along the screen. For the space-question, participants had to indicate the starting and finish point of the moving dot.
6. Stationary line. Instead of a growing line, a stationary line was displayed on the screen for a certain time.

All six experiments roughly showed the same results. In all six, the length of the line (or the length of the path, in case of the moving dot) influenced the estimation of duration. On the other hand, the actual duration did not influence the estimation of length.

Although these are very interesting findings, some critical comments might be in order. First, there is the issue of growing speed. By using a growing line, or a moving dot, more information is provided than merely duration and length, namely the growing speed of the line.

[4] Based on Casasanto and Boroditsky (2008); an earlier report of these experiments is found in Casasanto and Boroditsky (2003), based on Casasanto's doctoral dissertation (2005).

[5] It is not completely clear from their explanation what Casasanto and Boroditsky mean by this. Apparently, before and after the presentation of each line, a period of delay was inserted. In other words, the total duration of a stimulus became the time the line would have taken to grow from the left edge towards its actual starting point plus the time it would have taken to grow from its final point towards the right end of the screen, plus the time the line actually was growing on the screen.

The analysis of the data did not include a test of the effect of growing speed on either estimation of time or estimation of space, this point will be discussed in more detail in chapter 5. However, it is striking that the effect of length on duration estimation in experiment 6, the only experiment that did not include growing speed, though still significant, is less significant than in the other five experiments (cf. Casasanto & Boroditsky 2008:581-587). A maybe even more striking detail is the number of participants that did the different experiments. This ranges from 9 to 19 people per experiment. It is interesting that the experiment in which 19 people participated, is experiment 6, the one with the less significant results.

In another study, Casasanto (2010) builds forth on the findings of Casasanto & Boroditsky (2008), by linking performances to linguistic backgrounds. Comparing temporal metaphors in different languages, he distinguishes two different types of metaphors for duration: *Distance Metaphors*, such as *a long time*, and *Amount Metaphors*, such as *much time*. For these two expressions, Casasanto elicited equivalents from native speakers of French, Spanish and Greek. Subsequently, these expressions were inserted as a search term in Google, and the number of hits was noted. It appeared that for French and English, the distance metaphor was much more frequent (more than 70% of all instances) than the amount metaphor. On the other hand, for Greek and Spanish it was the other way around and the amount metaphor was much more frequent (more than 80% of all instances) than the distance metaphor (Casasanto 2010:467). Based on these frequencies, Casasanto classified the different languages as either distance metaphor preference or amount metaphor preference.

When reconsidering the growing line task, it is possible that a linguistic preference for either distance or amount metaphors could influence the result, as the growing line task is clearly about distance rather than amount. To check whether evidence could be found that speakers of a distance metaphor language perceive time differently than speakers of an amount metaphor language, another task was designed. As an amount metaphor counterpart of the growing line task, Casasanto developed the so called 'filling tank task'. As the name says, in this task people viewed a schematically drawn tank gradually filling with water. After each stimulus, participants either had to indicate how full the tank had become or how long they had seen the tank being filled. It was predicted that speakers of an amount metaphor language would show a stronger effect of space on duration estimation for the filling tank task than the growing line task. Speakers of distance metaphor languages, on the other hand, are expected to be more influenced by space in the estimation of duration, when participating in the growing lines task rather than the filling tank task. These hypotheses were confirmed when the results of the two experiments were compared for Greek (amount metaphor) speaking and English (distance metaphor) speaking participants (Casasanto 2010:469-471).[6]

The findings of Casasanto (2010) are even more far reaching than those of Casasanto and Boroditsky (2008). Both studies conclude that there is a directionally asymmetric link between space and time in our non-linguistic conceptualization of time as well as in the languages we speak. But besides that, Casasanto (2010) concludes that the way a particular language presents the link between space and time, influences the way time is perceived by speakers of that language. Or, in his own words:

[6] A preliminary report on this experiment and the accompanying linguistic investigation was published by Casasanto et al. (2004), and is found in Casasanto's doctoral dissertation (2005) as well.

> "Results are incompatible with the Shallow View of language-thought relations, and provide some of the first evidence for the view that language has Deep influences on nonlinguistic mental representation […]"[7]
> (Casasanto 2010:474-475)

With this conclusion, Casasanto (2010) is skating on thin ice, entering the field of linguistic relativity, a phenomenon which mere existence is highly debated. If his conclusions are valid, they have implications for the status of linguistic features as predictors of cognitive conceptualizations. And, indeed, the results are quite impressive at first sight. Summed up, Casasanto's findings are that:

1. Speakers of 'distance metaphor languages' exhibit significantly more distance interference in the estimation of duration than amount interference.
2. Speakers of 'amount metaphor languages' exhibit significantly more amount interference in the estimation of duration than distance interference.
3. Training[8] of English speakers in either distance or amount metaphors resulted in even stronger effects when executing the filling tank task. Participants trained in distance metaphors showed less amount interference than untrained participants. Participants trained in amount metaphors exhibited significantly more amount interference than participants trained in distance metaphors (Casasanto 2010:471-473).

It seems indeed likely to assume that these results provide evidence for a *Deep View* on the influence of language on thought. However, a closer examination of the premises and methodology of these studies, might provide a new perspective on the reliability of these results and conclusions. Specifically the classification of languages as either preferring amount metaphors or distance metaphors is crucial for the conclusions Casasanto draws with respect to deep influences of language on mental representations. Therefore, this specific aspect of Casasanto's (2010) report will be reviewed in the remainder of this chapter.

2.2. Distance and amount metaphors

As discussed in the previous section, Casasanto (2010) uses the terms *distance* and *amount metaphor* to describe two different types of metaphors languages use in the description of durational time. These metaphors are also referred to as *1-Dimensional metaphors* and *3-Dimensional metaphors*, respectively. However, the line of reasoning Casasanto provides for this dichotomy is slightly confusing. He starts the discussion of different types of metaphors for duration by providing the following examples from Greek and their English equivalents:

[7] For an explanation of what exactly is meant by *Shallow* and *Deep View*, see Casasanto (2010:460-461). In short, the *Shallow View* represents the idea that linguistic structures merely influence thinking that includes language, whilst the *Deep View* represents the idea that language also influences non-linguistic thinking.

[8] Participants had to fill in blanks in 192 comparative sentences, of which half were about duration of events and half about features of physical objects. Participants being trained in amount had to choose between *more* and *less*, and participants being trained in distance between *longer* and *shorter* (Casasanto 2010:472).

(7) Greek (Indo-European)

a. *megali* *nychta*
big night
'long night'

b. *megali* *schesi*
big relationship
'long relationship'

c. *parti* *pou* *kratise* *polý*[9]
party REL last.PST much
'long party'

d. *synantisi* *pou* *diekese* *polý*
meeting REL last.PST much
'long meeting'

(Casasanto 2010:467)[10]

Based on these examples, Casasanto argues that where English uses distance metaphors, Greek rather expresses duration "in terms of 3-dimensional size or amount" (Casasanto 2010:467). Indeed, I think it is a fair conclusion that (7a) and (7b) express duration using size terminology, and (7c) and (7d) using amount terminology. However, directly after this observation, both expression types are subsumed under the cover term *amount metaphor* without further explanation. The remainder of the paper does not mention a word on a difference between size and amount in durational metaphors and possible implications for the conceptualization of time.

I believe this lack of explanation is possibly due to a superficial examination of the linguistic material. As Casasanto is trained in Brain & Cognitive Sciences, his expertise in this study is mainly reflected in the investigation of the conceptualization of time and not in the analysis of the languages of which speakers are investigated. For example, it appears that, probably because Greek *polý* is translated in English as 'much' in examples (7c) and (7d), Casasanto assumes that amount metaphors always concern 'mass' cases. This is clear from the fact that in the experiment he makes uses of a schematic drawing of a container being filled with water, which is a mass noun. Linguistically, *time* is a mass-noun, but since we deal with a very abstract concept, it is problematic to assume that conceptually time is a mass entity as well. Especially when considering the duration aspect of time, which is usually referred to in distinct countable units, such as days, minutes, hours, etc. From a linguistic point of view, a legitimate question to ask would be whether Greek indeed uses amount metaphors in this 'mass' sense, or that it could also be a more 'count' sense.

[9] Casasanto uses the obsolete transcription of Greek upsilon, transcribing it with *i*. However, I use the modern standard transcription *y*, to avoid confusion with iota, which is also transcribed as *i*.

[10] In this discussion, the examples are presented as if Greek was the origin for the comparison between English and Greek. However, the way Casasanto presents these data and the fact that all English equivalents are noun phrases, while (7c) and (7d) are relative clauses in Greek, gives the impression that English was the base language and the Greek equivalents were elicited. This is a relevant difference, as it might indicate a bias towards English. Maybe Greek exhibits even more different types of duration metaphors, but they might not be provided when speakers of Greek are asked to give the best Greek equivalent for a specific English expression.

And indeed, when looking into this question, it appears that there is a difference between English and Greek in this respect. English distinguishes between two quantifiers: *much* for mass nouns and *many* for count nouns. Greek on the other hand, uses one adjective, *polýs*, in combination with mass as well as count nouns. In adverbial position, the neuter singular form of this adjective, *polý*, is used (Holton et al. 1997:80, 92). It is thus questionable whether the filled container task is an appropriate measurement to test the influence of amount metaphors on the conceptualization of time.

Besides the problem of the questionable implementation of the amount metaphor in the filled container task, the categorization of languages as having a preference for amount metaphors or distance metaphors is problematic as well. Firstly, as discussed, Casasanto subsumes under amount metaphor both metaphors denoting size in the sense of 'a specific entity's measurement' as well as amount in the sense of 'a certain quantity of distinct entities'. In other words, no distinction is made between mass amount and countable amount in the labelling of linguistic expressions. The way in which Casasanto examined the preference for the different metaphors is maybe even more problematic. When considering the expressions in example (9) it is obvious that all denote some sense of durational time, even though none actually includes a word that explicitly means time or duration. Remarkably, after providing this evidence that durational metaphors do not necessarily include the word 'time', Casasanto, without further explanation, merely checks frequencies of two expressions: *long time* and *much time* (Casasanto 2010:268). However, it does not necessarily follow that, if the equivalent of one of these expressions is more frequent in a language than the equivalent of the other expression, all durational expressions in this language follow that pattern. Theoretically, it might very well be possible that the frequency of *long time* as an expression in a certain language as compared to the frequency of *much time* is not representative for the ratio of distance versus amount metaphors as a group.

Casasanto carried out his linguistic investigation by counting Google hits for the translation equivalents of *long time* and *much time* in four languages (English, French, Greek and Spanish). From a linguistic point of view, the internet is generally not considered the most ideal corpus for an investigation how a certain expression is used in a particular language (see also Everett 2013:125). Frequency counts carried out by the Google search engine are no reliable predictors of frequency in use. The internet contains much duplication of the same texts, so one actual instance of use will be counted several times. Besides, different text types are not balanced, nor is every type of language use represented. In short, the strong preferences Casasanto found for either distance or amount metaphors in the four languages he investigated could be questioned. An evaluation of the way in which Casasanto transferred the linguistic findings to a test condition to investigate the influence of these linguistic features on cognition also gives rise to some interesting points for discussion. But before turning to that topic, some further issues that might arise when trying to classify a language on the basis of duration metaphors are considered in a discussion of Dutch data.

3. Duration metaphors in Dutch

3.1. Language and data

Dutch (Indo-European, Low Franconian), is spoken by approximately 15,700,000 people in the Netherlands (European Commission 2012), of which it is the national language. Together with the speakers from Aruba, Belgium, the Caribbean Netherlands, Curacao, Sint Maarten and Suriname, the total population of Dutch consists of 22,040,690 speakers (Lewis et al. 2016). It has SVO word order in main clauses, with SOV word order in subordinate clauses. Its inflectional morphology is strongly suffixing, noun phrases are head final with prepositions (for a detailed typological profile see Dryer and Haspelmath 2013). Though being a very widespread language, with a long tradition of linguistic investigation, as far as I know, no systematic account of temporal metaphors exists for Dutch. In the present study, a first attempt towards such an account is made. Since this study is a reaction to the ones by Casasanto and Boroditsky (2008) and Casasanto (2010), the focus is on duration metaphors.

The data that form the basis of this description are from two reference corpora: the Stevin Nederlandstalig Referentiecorpus (SoNaR) and the Corpus Gesproken Nederlands (CGN). SoNaR is a corpus of contemporary written Dutch, containing 500 million words (Oostdijk et al. 2013). It includes written to be read as well as written to be spoken material from a wide variety of text types from different conventional and new media. The corpus was developed between 2008 and 2011, in a project that was carried out by different universities from the Netherlands and Belgium, coordinated by Radboud University. SoNaR is available online via OpenSoNaR. CGN is a smaller corpus of annotated spoken Dutch. It contains about nine million words, from which approximately a third were recorded in Belgium and two thirds in the Netherlands. The corpus is not available online, but a free license is available for scientific purposes. Since pronunciation forms no part of the current investigation, merely the annotations (Nederlandse Taalunie 2014) were used.

3.2. Methodology

In the description of Dutch duration metaphors, three different types will be distinguished:

1. Distance metaphors
2. Size metaphors
3. Amount metaphors

This distinction is based on the previous evaluation of distance and amount metaphors as discussed by Casasanto. Duration metaphors are described in this thesis in three different groups rather than as a whole, because implications for space-time relations can be easily connected to these three groups: distance metaphors might facilitate the effect of spatial length on duration estimation, size metaphors might facilitate the effect of physical largeness on duration estimation, and amount metaphors might facilitate the effect of number of distinct entities on duration estimation. The aim of this section is thus to determine to what extent evidence for such a tripartite division of duration metaphors can be found in Dutch. Distance metaphors are defined similarly to Casasanto's distance metaphor; as a working definition, I will use:

Distance metaphor
A distance metaphor is a duration metaphor containing terminology that is also used to talk about 1-dimensional space, or length.

Where Casasanto uses amount metaphor as the 'more-dimensional' counterpart of distance metaphor, I distinguish between two different types, based on the discussion in 3.4.2; I will use the following working definitions:

Size metaphor
A size metaphor is a duration metaphor containing terminology that is also used to talk about physical dimensions of specific entities.

Amount metaphor
A number metaphor is a duration metaphor containing terminology that is also used to talk about physical amounts of distinct entities, including quantifiers.

In terms of CMT, the conceptual metaphor underlying distance metaphors might be described as DURATION IS DISTANCE, for size metaphors it might be DURATION IS A SPECIFIC ENTITY'S PHYSICAL DIMENSIONS and for amount metaphors: DURATION IS A NUMBER OF DISTINCT ENTITIES.

For a language like English, which distinguishes between different quantifiers for mass and count nouns, it might be justifiable to discuss mass quantifiers under size metaphors and count quantifiers under number metaphors. Although time in Dutch is a mass noun (because in combination with a quantifier, the singular form is used), the plural form of *tijd*, *tijden*, is also frequent, but not in combination with quantifiers. Besides, Dutch does not distinguish count quantifiers from mass quantifiers: quantifiers have the same form, regardless whether the noun they are modifying is a mass noun or a count noun, compare (8a) and (8b):

(8) a. *veel* *water*
much/many water
'much water'

b. *veel* *kind-eren*
much/many child-PL
'many children'

c. *veel* *tijd*
much/many time
'much time'

For those reasons, I do not believe there is enough evidence to assume that Dutch duration metaphors including quantifiers, such as (8c)[11], might only facilitate the link between mass amounts and duration. I am not trying to say that there is no difference in Dutch between count nouns and mass nouns. Conceptually there is a difference, and there are certain quantifiers that for that reason only go with count nouns, such as *een paar* 'a few'. However, all quantifiers that can go with mass nouns can also go with count nouns. When trying to find implications for

[11] On the status of *veel tijd* as duration metaphor, see section 3.3.3.

cognitive representations based on linguistic structures, this is an important piece of data. That is to say, it implies that wherever a quantifier occurs in a Dutch expression with a mass noun, the representation of this quantifier in the brain includes quantifications of distinct entities as well. Given that *tijd* is such a mass noun occurring with quantifiers, it might very well be possible that the experience of time is also cognitively linked to amounts of distinct entities.

Although this threefold distinction between distance, size and amount metaphors will structure the discussion of Dutch duration metaphors, it is not the starting point for the investigation of these metaphors. The aim of the present section is to discuss to what extent such a distinction makes sense in view of the data. As discussed in section 3.1, the data for this investigation comes from SoNaR and CGN. However, the crucial point is how this data is investigated. If a corpus is searched for a specific expression, obviously, no expressions will be found that were not already known beforehand. If, in that way, a threefold distinction is the starting point for an investigation, only expressions that fit one of these three types will be found. To avoid such a bias towards a threefold distinction, firstly several n-gram investigations were carried out. For example, SoNaR was investigated for combinations of *tijd* preceded by any possible word. Outcomes were automatically ordered by decreasing frequencies. Subsequently, by qualitative examination of the outcomes, I decided which expressions in the frequency lists should be considered duration metaphors and which not. Sometimes, outcomes inspired new corpus investigations. For example, if both *lange tijd* 'long time' and *langere tijd* 'longer time' occur relatively frequently, it might be interesting to investigate the corpus for *lang* (as lemma) *tijd*. In that way, the use of *lange tijd* as well as the use of *langere tijd* (comparative) and *langste tijd* (superlative) is displayed. Moreover, also possible writing errors of the adjective are included in this way.

Unfortunately, only SoNaR has this n-gram search function. It is possible to search in the CGN for n-grams, but the outcomes are all listed as distinct hits, instead of frequencies grouped per n-gram. Therefore, the SoNaR n-gram investigations form the basis of this study, be it that comparisons are made with frequencies found in the CGN.

3.3. Analysis

Table 1 includes the frequencies of the 10 most frequent duration metaphors found in SoNaR by searching for 'any word + *tijd* as lemma', and their frequencies in the CGN.

	SoNaR	CGN	Translation
lange tijd	12,531	114	long time
geen tijd	9770	297	no time
hele tijd	9212	599	all the time
korte tijd	7726	99	short time
enige tijd	6734	37	some time
veel tijd	5881	194	much time
meer tijd	5215	127	more time
geruime tijd	3891	20	quite some time
wat tijd	2527	58	some time
weinig tijd	2315	60	few time[12]

Table 1. Top 10 most frequent duration metaphors in SoNaR. Token frequencies in SoNaR and CGN

The expressions in table 1 are duration metaphors, since the words modifying *tijd* are also used in spatial sense when modifying nouns not related to the temporal domain. The only debatable expression in this respect is *geruime tijd*. Etymologically, *geruime* is derived from the spatial adjective *ruim* 'wide', and started being used in temporal sense, besides spatial sense, in *Vroegnieuwnederlands* (Early Modern Dutch, 1500-1700). Since the 18th century its spatial use got lost ("ruim 2" 2003). According to the *Dikke van Dale*, nowadays, *geruime* is merely used as an attributive adjective modifying temporal nouns ("geruime" 2016). However, SoNaR includes at least nine instances of *geruime afstand* 'considerable distance', in clearly spatial sense, such as:

(9) *Ze staan op **geruime afstand** van elkaar* […]
PRO:3PL stand.PL on[13] some distance from PRO:REC
'They are located on considerable distance from each other […]' (about the flowers of a particular bush)

Classifying the duration metaphors in table 1 as either distance, size or number metaphor is not completely straightforward. The expressions *lange tijd* and *korte tijd* are classified as distance metaphor, as they irrefutably include terminology that is also used to talk about space, namely the adjectives *lang* 'long' and *kort* 'short'. Likewise, the following expressions can be classified as number metaphors right away: *enige, veel, meer, wat* and *weinig tijd. Hele tijd* could be classified as a size metaphor, although 'proportional metaphor' might perhaps be a more suitable descriptive term for this specific case. That leaves *geen tijd*, and *geruime tijd* as unclassified duration metaphors. As *geen tijd* describes a lack of duration, it could be argued that this is not a distance metaphor. However, if regarded as one, it would be classified as a

[12] The proper English translation of *weinig tijd* is 'little time'. However, 'little time' arguably is a size metaphor, but *weinig tijd* is not. To avoid confusion on that point, I have chosen the more literal translation with the unambiguous quantifier 'few', even though this quantifier does not modify mass nouns in English.

[13] Dutch makes widespread use of prepositions. I prefer to gloss prepositions with a lexical gloss instead of a common grammatical gloss PREP, to highlight this wealth of prepositions. Although in different contexts, a Dutch preposition might be translated best with different English prepositions, for the sake of consistency (and to do justice to the Dutch prepositional system), every preposition is glossed with the same lexical gloss throughout this thesis. The English translation that is added to each Dutch example contains the preferred English translation of the Dutch preposition for the specific context. For an extensive discussion of the different senses of several high frequent Dutch prepositions, I refer to Colombo and Floris d'Arcais (1984).

number metaphor. Since the status of *geruime tijd* as a duration metaphor is debatable, I will leave it unclassified here. On the basis of this classification, the relative frequencies of the duration metaphors in the different groups show that number metaphors are more frequent than distance metaphors in both SoNaR and the CGN, even if *geen tijd* is not included as number metaphor (see figure 1).

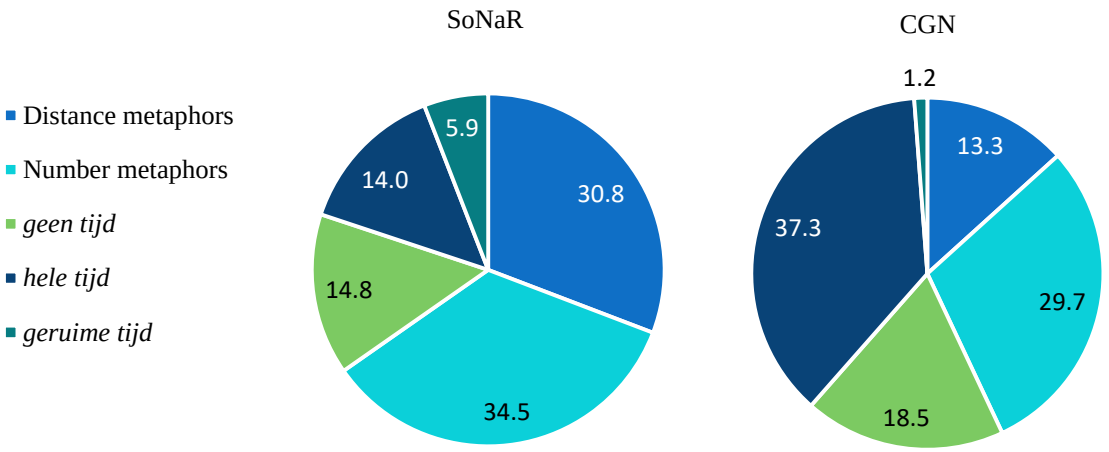

Figure 1. Distribution of SoNaR's top 10 most frequent duration metaphors in SoNaR and CGN in percentage of total tokens.

Figure 1 shows the relative frequencies in SoNaR and CGN of the different groups of duration metaphors discussed above. These only include the frequencies of the top 10 most frequent duration metaphors including the word *tijd*, as described in table 1. Based on these data, it is impossible to conclude which type of duration metaphor is most prevalent in Dutch. While in SoNaR, distance and number metaphors are almost equally frequent (respectively 30.8% and 34.5%), in CGN, number metaphors are clearly more frequent than distance metaphors (29.7% compared to 13.3%). Then there is the issue of size metaphors, which are, if *hele tijd* is regarded as one, the most prevalent metaphors in CGN. Altogether, merely looking at the most frequent duration metaphors including the word *tijd*, does not provide sufficient evidence to describe the preferences of duration metaphors in Dutch. Therefore, the three different types of duration metaphors are discussed in more detail below, including moreover, investigations of durational metaphors that do not contain the word *tijd*.

3.3.1. Distance metaphors

The only distance metaphors mentioned in the previous section were *lange tijd* and *korte tijd*, yet another prevalent Dutch distance metaphor is found in the use of *lang* as a temporal adverb, for example as in (10):

(10) *Het* *kan* *nog* ***lang*** ***dur-en*** *voor* *het* *genezen* *is.*
PRO:3SG.N AUX.PRS.3SG yet long last-INF for PRO:3SG.N heal.PP AUX.PRS.3SG

'It may still take long before it is healed.'

(SoNaR)

Investigations of n-grams for ‘lemma: *lang* + lemma: *duren*’ and for ‘lemma: *duren* + lemma: *lang*’, reveal that this duration metaphor occurs 5672 times in SoNaR and 201 times in CGN. Its counterparts with *kort* occur less frequent in both corpora, with 164 hits in SoNaR and 16 hits in the CGN. However, many instances of *lang duren* are actually instances of its negation: *niet lang duren* ‘not take long’. Actually, this negation accounts for 534 of the 5672 SoNaR hits, and 37 of the CGN hits. Still, when this is taken into account, the ‘long distance metaphor’ occurs more often than the ‘short distance metaphor’.

Widely used is the adverb *lang* modifying *geleden*, the past participle of the verb *lijden* ‘to pass’: *lang geleden*. This verb does not occur in temporal sense any more in present day Dutch, except for in frozen construction, such as *lang geleden* ‘long ago’, see (11):

(11) ***Lang geleden*** *heeft* *hij* *een* *ander* *boek* *gepubliceerd,*
long ago AUX.PRS.3SG PRO:3SG.M INDEF other book publish.PP

toen *hij* *nog* *naar* *de* *universiteit ging.*
when PRO:3SG.M still to DEF.C university go.PST.3SG

‘Long ago, he published another book, when he was still in college.’

(SoNaR)

Uses of *lang geleden* referring to a remote past as in (11) are most frequent in SoNaR. However, we need to be careful with taking the frequency count of *lang geleden* as an indicator of the frequency of *lang geleden* as a distance metaphor for a long durational distance in the past. As it happens, of the 9294 hits of *lang geleden*, at least 1772 are actually negations of this expression, indicating a short duration. See, for example:

(12) *Het* *project* *is* ***nog*** ***niet*** ***zo lang*** ***geleden*** *stopgezet.*
DEF.N project be.PRS.3SG yet NEG so long ago stop.PP

‘The project was stopped not yet that long ago.’

(SoNaR)

Actually, a negation of *lang geleden* occurs more frequently to indicate a short duration than its antonym *kort geleden* ‘short ago’.[14] To be precise, SoNaR includes merely 791 instances of *kort geleden*, of which only 1 is a negation of *kort geleden*, presented in example (13). In fact, this one instance of *niet zo kort geleden* actually seems to be a mistake, a permutation of the words *niet* en *nog* or an accidental use of *kort* instead of *lang*:

[14] As a native speaker of Dutch, intuitively I would say that *niet (zo) lang geleden* usually indicates a remoter past than *kort geleden* in absolute temporal sense. However, *niet (zo) lang geleden* will be used when the subjective experience of the time span is perceived to be short. In that sense, *niet (zo) lang geleden* and *kort geleden* are not semantically, or pragmatically, interchangeable. The relative low frequency of *kort geleden* compared to *lang geleden*, should thus not be explained by stating that *kort geleden* and *niet (zo) lang geleden* should be grouped together as antonym of *lang geleden*. Rather, the difference in frequency might be explained by the presence of several temporal adverbs in Dutch to describe a short timespan into the past, such as *recentelijk*, *onlangs* and *pas (geleden)* ‘recently’. Whereas, for *lang geleden*, merely one temporal adverb could be used as alternative: *vroeger* ‘in the past’.

(13) *Heb* *je* *niet* *zelf* ***nog*** ***niet*** ***zo kort*** ***geleden*** *gemeld* *dat*
AUX.PRS.3SG PRO:2SG NEG REFL yet NEG so short ago report.PP that

door *de* *ziekte* *van* *X* *de* *aandacht* *voor* *Y* *zijn* *problem-en*
through DEF.C illness from X DEF.C attention for Y POSS:3SG problem-PL

er *bij* *in-geschoten* *is????*
PTCL by in-shoot.PP AUX.PRS.3SG

'Did not you mention yourself, not yet that short ago, that because of X's illness, consideration for Y's problems is lacking?'
(intended reading of 'not yet that short ago' probably: recently)[15]

(SoNaR)

An n-gram search of '*lang* (lemma) + noun' shows that there are more distance metaphors than just the ones including *tijd*. A very frequent one is *lange termijn* 'long term' (8811 hits SoNaR), which usually occurs in the context of anticipated events or consequences of something that take place after or during a long duration, as in:

(14) ***Op*** ***lang-e*** ***termijn*** *zal* *die* *weg* *mogelijk* *wel*
on long-DEF term AUX:FUT.3SG DEM:DIST road possibly surely

verbreed *worden* *door* *de* *gemeente.*
broaden.PP become through DEF.C municipality

'In the long term, that road probably will be broadened by the municipality.'

(SoNaR)

The construction *op lange termijn* is the equivalent of *op de lange duur* 'on the long duration', illustrated in example (15), which is used in the same contexts, but is less frequent (256 hits in SoNaR):

(15) ***Op*** ***de*** ***lang-e*** ***duur*** *kan* *die* *aanpak* *de*
on DEF.C long-DEF duration can.PRS.3SG DEM:DIST approach DEF.C

vrijgevigheid *van* *de* *mens-en* *ondermijn-en.*
generosity from DEF.C people-PL undermine-INF

'In the long term, that approach might undermine the generosity of the people.'

(SoNaR)

[15] This example comes from an online forum for parents and is part of a discussion on disabled children. For ethical reasons, I replaced the children's names with X and Y. The utterance is a response to a post in which someone mentions that parents with a disabled child tend to make this child extremely important. A spelling mistake in a previous sentence, the use of four question marks instead of one and an unusual choice of a preposition in the sentence following this example, contribute to the impression that this sentence was not composed with much consideration for formulation. Besides, it concerns a delicate topic and the utterance appears to be emotionally charged. Moreover, if *nog niet zo kort geleden* is taken literally, it would mean something like 'a considerable time ago', which would weaken rather than enforce the point being made, namely that somebody is being inconsequent. All in all, I think it is a fair conclusion to say that the intended reading is different from what was actually written down.

Even though *termijn* and *duur* are both clearly nouns from the semantic domain of duration, there are also distance metaphors with nouns less core to the domain of duration. For example *lange dag* 'long day'. The noun *dag* of course belongs to the semantic domain of time, but does not literally mean 'duration' or something similar. Its durational properties follow from its definition as a certain time span, namely 'a seventh part of a week', or 'the time span of one rotation of the world', etc. The durational metaphor *lange dag* usually does not refer to a day that is literally occupying a longer time span than another day, but rather to a day that is subjectively experienced as a longer day. Still, *dag* is semantically close to a word literally meaning duration compared to nouns like for example *stilte* 'silence', which can also occur in a distance metaphor, such as *lange stilte* 'long silence', indicating a silence that lasts for a long duration. In fact, the n-gram search '*lang* (lemma) + noun' resulted in so many different duration metaphors that it became relevant to question why these should be considered as metaphors. What I mean is this: If the construction '*lang* + noun' can indicate a durational sense we need evidence that this construction is mapped from space (source domain) onto time/duration (target domain) before we call this a duration metaphor (see for example Lakoff 1987:288).

Evidence for this might be found etymologically[16]: if the spatial sense of *lang* is older than the temporal sense, this might be a clue that the temporal sense is, at least originally, a metaphor. I have not found clear evidence for that. The etymology of *lang* can be traced back as early as *Oudnederlands* (Early Dutch, 800-1200), attested as an attributive adjective in place names (late 8th century), and as temporal adverb *lango* (10th century) ("lang" 2003). Even if the later attestation of the temporal adverbial use is an indication of a semantic expansion to the domain of time by a metaphoric link, this does not mean that it is still a metaphor in present day Dutch. However, no systematic account has been provided yet of the use of *lang* and *kort* in duration metaphors versus their use in a non-temporal sense.

An n-gram search in SoNaR of *lang* as a lemma followed by a noun, results in 12,207 different n-grams, with a total of 95,717 tokens. Of these combinations, 803 (6.6% of total) had a frequency of at least 10 occurrences in the corpus, together accounting for 78.9% of the tokens. The most frequent one is *lange tijd* (11,233 tokens). The other 11,402 combinations all occur less than 10 times in SoNaR. This raises two questions:

1. Which sense, durational or spatial, is more frequent in the corpus? (comparing tokens)
2. Which sense is more productive: Is the variety of durational combinations different from the variety of spatial combinations? (comparing types)

The scope of this thesis is too small to investigate all these combinations. In order to still be able to investigate the two questions to a certain extent, I took two subsets of the total of n-grams and classified the n-grams in these subsets as either durational, spatial, both durational and spatial (doubtful cases), see for example (16):

[16] Haspelmath (1997:19-20) argues that in order to state that temporal expressions are based on spatial expressions, you need diachronic evidence of a shift. His conclusions on temporal adverbials in various languages are based on such evidence, and he advocates the claim that temporal expressions are based on spatial expressions. However, he does not specifically discuss the temporal adverbial(s) 'long' (and 'short').

(16) *De meeste kind-eren hebb-en echter al de og-en gesloten,*
DEF.PL most child-PL AUX.PRS-PL CONC already DEF.PL eye-PL shut.PP

vermoeid van de ***lang-e tocht****.*
tired from DEF.C long-DEF journey

'However, most children are already asleep (lit. have their eyes shut), tired because of the long journey.'

(SoNaR)

In example 18, *lange tocht* 'long journey', inherently refers to a distance that is spatially as well as durationally stretched. In this specific example it is not clear from the context of *lange tocht* whether a spatial reading is preferred over a durational reading. However, in some cases *lange tocht* is modified by a spatial (as in example 17) or durational (as in example 18) quantifier:

(17) *Twee wek-en lang is hij met de fiets on-der-weg*
two week-PL long be.PRS.3SG PRO:3SG.M with DEF.C bicycle on-the-way

voor de ***1200 kilometer lang-e tocht*** *van Gent naar de*
for DEF.C 1200 kilometer long-DEF journey from Ghent to DEF.C

Mont Ventoux.
Mont Ventoux

'He is travelling by bike for two weeks for the 1200 kilometers long journey from Ghent to the Mont Ventoux.'

(SoNaR)

(18) *We stap-te-n in Basel op de GoodLife Train, om na een* ***8***
PRO:1PL step-PST-PL in Basel on DEF.C GoodLife Train around after INDEF 8

uur lang-e tocht *door de Alp-en in Venetië aan te kom-en.*
hour long-C journey through DEF.C Alp-PL in Venice at INF come-INF

'We boarded the Goodlife Train in Basel, in order to arrive at Venice after an 8 hours long journey through the Alps.'

(SoNaR)

In example (17), *lange tocht* is modified by *1200 kilometer*, stressing its spatial sense. In (18), *lange tocht*, is modified by *8 uur*, emphasising spatial sense. Even though cases in which a quantifier gives extra information on the preferred reading of *lange tocht* exist, it is still the case that *tocht* implies both durational and spatial distance, even when one of the two is more overtly expressed. For that reason, every '*lang* + noun' combination in which the semantics of the noun activate the domains of space as well as duration, is scored 'both'. It would be interesting to chart the prevalence of either spatial or durational sense for each expression in this category, but that falls beyond the scope of this thesis

Instances of '*lang* + noun' that did not fit into one of these three categories (duration, space or both), were classified as 'other'. In this category fall for example cases in which *lang*

is not an attributive adjective, but a temporal adverb, listed as n-gram because it is positioned before a noun, as in (19):

(19) *Door een val in de begin-fase had ik twee rond-en*
through INDEF crash in DEF.C start-phase have.PST.SG PRO:1SG two lap-PL

lang last *van mijn heup.*
long hindrance from POSS:1SG hip

'Due to a crash in the first phase, I was bothered by my hip for two laps (lit. I was having two laps **long hindrance** from my hip).'

(SoNaR)

Often, these cases could be easily isolated, because the agreement of *lang* did not match the noun. For example, if *lang last* in 21 would be a noun phrase with an attributive adjective, *lang* would have had the inflectional suffix *-e*, because of agreement with the (definite) common noun *last*.[17]

As already mentioned, not all 12,207 n-grams were classified in one of the four categories, but a sample was taken to represent the complete data-set, consisting of two subsets of the total of n-grams. These two subsets are:

- The 803 n-grams with token frequencies of at least 10.
- A randomly selected set of 200 n-grams with token frequency below 10.

For the first subset, ratios were calculated for both types and tokens. For the second set, ratios were merely calculated for types. The reason for this selection of two subsets is that the high frequent combinations only represent 6.6% (in type) of the total amount of '*lang* + noun' types. So, it is very well possible that the most frequent n-grams are not representative for the overall distribution of spatial versus durational use of '*lang* + noun'. A random subset of types, irrespective of corresponding token frequencies, might thus provide a better insight in the distribution of the different uses.

Table 2 and 3 include the ratios of the different categories for different orders of token frequency. Table 2 displays ratios of types and table 3 ratios of tokens.

[17] The only context in which *lang* without *–e* can occur as an attributive adjective, is when modifying an indefinite neuter singular noun. In all other cases (definite neuter singular, (in)definite common singular, (indefinite) neuter and common plural), the adjective will have the form *lange* in contrast to the adverb *lang*. Whenever there was doubt whether *lang* in a particular '*lang* + noun' n-gram was an attributive adjective, concordance lines for this n-gram were compared, so that conclusions could be drawn based on the context.

Token frequency	Duration	Space	Both	Other	% of Total types
10,000+	100	0	0	0	0.1
1000-9999	83.3	0	16.7	0	0.7
100-999	46.7	35.6	12.2	5.6	11.2
10-99	31.9	32.0	20.0	16.1	87.9
10+	34.0	32.1	19.1	14.8	100

Table 2. Ratio of types of '*lang* + noun' in percentage of total types for different sub-sets of token frequencies (SoNaR)

Token frequency	Duration	Space	Both	Other	% of Total tokens
10,000+	100	0	0	0	14.9
1000-9999	91.8	0	8.2	0	23.5
100-999	42.6	35.3	13.9	8.2	36.2
10-99	36.4	30.5	18.7	14.4	25.5
10+	61.1	20.6	11.7	6.6	100

Table 3. Ratio of tokens of '*lang* + noun' in percentage of total tokens for different sub-sets of token frequencies (SoNaR)

The bottom row in tables 2 and 3 include the values calculated over all '*lang* + noun' combinations that have a token frequency of at least 10. A very interesting difference is found between type comparisons and token comparisons. Over the complete sub-set, types of duration and space are rather similar (respectively 34.0% versus 32.1%). This indicates that there are only slightly more different constructions referring to duration than there are constructions referring to space. However, when comparing tokens, duration is much more frequently attested than space (respectively 61.1% versus 20.6%). This means that at least some of the constructions that refer to duration are used more frequently than the ones referring to space.

The origin of this difference between duration and space seems to lie in the n-grams that occur over 1000 times in the corpus, represented in the two top rows of tables 2 and 3. These rows show that no combinations referring to space were found with a token frequency of at least 1000. The only '*lang* + noun' combination that occurs more frequent than 10,000 times, is *lange tijd* 'long time', resulting in 100 percent duration constructions for this sub group. The second row indicates that 91.8% of the constructions in frequency group 1000-9999 refer to duration, and 8.2% to both duration and space. On the other hand, in the 10-99 token frequency group the token ratio of durational and spatial constructions is much more similar (36.4% versus 30.5%), and the type ratio is almost equal (31.9% vs. 32.0%). However, n-grams with a token frequency of 1000+ represent merely 0.8% of the total '*lang* + noun' types with token frequency 10+. The more strikingly that this 0.8% of types accounts for 38.4% of the tokens of this subset (equal to 30.3% of all '*lang* + noun' tokens).

The third and fourth row of tables 2 and 3 indicate that for the '*lang* + noun' combinations with token frequency 10-999, type and token distributions of durational and spatial sense are much more similar. There seems to be a tendency that the lower the token frequency, the more spatial types and the less durational types. In these two tables, this trend ends in a practically equal distribution of spatial and durational sense of types with token

frequency 10-99. However, it is possible that for types with token frequencies lower than 10 (93,4% of all '*lang* + noun' types), spatial sense is even more frequent than durational sense. For that reason, also a subset of 200 randomly selected 200 '*lang* + noun' types with a token frequency below 10, was investigated.

Table 4 contains the frequency distribution of this second sub-set. It shows that even among the less frequent types, durational sense is more frequent than spatial sense (for type as well as token comparisons), but the difference is very small.

	Duration	Space	Both	Other
Type	33.5	29.5	11.5	25.5
Token	35.4	30.5	11.0	23.1

Table 4. Frequency distribution of 200 randomly selected '*lang* + noun' types with token frequency < 10, in percentage of total subset (SoNaR)

An investigation of n-grams of *kort* 'short' as a lemma followed by a noun, resulted in similar distributions. SoNaR includes 7208 '*kort* + noun' combination types, with a total of 65,505 tokens. Of these 7208 types, 544 (7.5%) have a token frequency of at least 10, together accounting for 81.9% of the tokens. The most frequent '*kort* + noun' combination in SoNaR is *korte termijn* 'short term', with a token frequency of 9913. Again, the types that occurred over 10 times in the corpus were classified as well as 200 randomly selected types with a token frequency below 10. The results of this investigation are presented in tables 5, 6 and 7.

Token frequency	Duration	Space	Both	Other	% of Total types
1000+	50	0	16.7	33.3	1.1
100-999	46.2	21.2	26.9	5.8	9.6
10-99	51.4	14.0	26.5	8.0	89.3
10+	50.9	14.5	26.5	8.1	100

Table 5. Ratio of types of '*kort* + noun' in percentage of total types for different sub-sets of token frequencies (SoNaR)

Token frequency	Duration	Space	Both	Other	% of Total tokens
1000+	67.7	0	18.9	13.4	51.8
100-999	39.8	25.6	26.4	8.2	24.2
10-99	51.5	12.1	29.5	6.8	24.0
10+	57	9.1	23.3	10.6	100

Table 6. Ratio of tokens of '*kort* + noun' in percentage of total tokens for different sub-sets of token frequencies (SoNaR)

	Duration	Space	Both	Other
Type	38.0	16.5	23.5	22
Token	37.9	16.2	26.4	19.5

Table 7. Frequency distribution of 200 randomly selected '*kort* + noun' types with token frequency < 10, in percentage of total subset (SoNaR)

When comparing the distribution '*lang* + noun' combinations over the four different categories to that of the '*kort* + noun' combinations, there is a difference in ratio of durational and spatial sense. For the '*kort* + noun' combinations, durational sense is much more frequent than spatial sense, regardless of the number of token category. In fact, even the combinations that can have durational as well as spatial semantics are more frequent than merely the combinations that are unambiguously spatial. This is different from the '*lang* + noun' combinations, where durational sense is either more prevalent or equal to spatial sense, but where spatial sense is always more frequent than the combinations that can be interpreted as durational as well as spatial.

All in all, a corpus investigation of '*lang* + noun' and '*kort* + noun' n-grams also did not provide evidence for a metaphoric nature of noun phrases including *lang* or *kort* that are interpreted in durational sense. Durational sense of such noun phrases is more frequent than spatial sense, in terms of types as well as in terms of tokens. Even if there once would have been a metaphoric source for a durational interpretation of an originally spatial expression, the grade of productivity for durational sense suggests that space does not function actively as source domain anymore. In other words, there are so many different '*lang*/*kort* + noun' combinations that refer to duration compared to the ones referring to space, that it is unlikely that all have a direct metaphoric link with a spatial source. Rather, if *lang* and *kort* once solely belonged to the semantic domain of space, a semantic shift towards duration might have taken place at some time. In that case, this shift might be explained in a metaphoric way, but I found no evidence that the productivity of durational use in present day Dutch is still actively grounded in a metaphoric link between space as source domain and time as target domain.

3.3.2. Size metaphors

At the beginning of section 3.3, I discussed that there are no clear size metaphors within the 10 most frequent duration metaphors including the word *tijd* as found in the two corpora. The only doubtful case was *hele tijd* 'whole time'. Although this expression clearly belongs to the semantic domain of time, it is not primarily referring to duration. Actually, there appear to be two different uses of *hele tijd*. When used definitely, it refers to continuity, or iterativity, rather than a specific duration, see example (20). When used indefinitely, it does refer to duration, and can be replaced by the adverb *lang* 'long', compare example (21a) and (21b):

(20) […] *het* *was* ***de*** ***hel-e*** ***tijd*** *van* *'Papa* *kijken!*
DEF.N be.PST.SG DEF.C whole-C.SG time from daddy look-INF

Papa *kijk-en!'* […]
Daddy look-INF

'[…] It was continuously like " Daddy, look! Daddy, look!" […]'

(SoNaR)

(21) a. […] *het* *duur-t* ***een*** ***hel-e*** ***tijd*** *voor-dat* *hij*
DEF.N take-3SG.PRS INDEF whole-C.SG time for-that PRO:3SG.M

antwoord *geef-t.*
answer give-3SG.PRS

'it takes a long time before he answers.'

b. *Het* *duur-t* ***lang*** *voor-dat* *hij* *open-doe-t.*
DEF.N take-3SG.PRS long for-that PRO:3SG.M open-do-3SG.PRS

'It takes long before he opens (the door).'

(SoNaR)

From these examples, it is clear that *hele tijd* can only be regarded a duration metaphor when used indefinitely. As such, it occurs 3550 times in SoNaR, and 127 times in CGN, respectively 36,4% and 21.2% of all instances of *hele tijd* in the corpora. However, the counterpart of *hele tijd*, *halve tijd* 'half time', is merely used definitely, mostly in the form *de helft van de tijd* 'the half of the time', and as such does not function as duration metaphor.

Altogether, there are no unambiguous size metaphors among the ten most frequent duration metaphors including the word *tijd*. The most typical size metaphor would be *grote tijd* 'big time', analogous to Greek *megali*, as discussed in section 2.2. However, in Dutch, *grote tijd* 'big time' is usually interpreted as an important time and not as a long duration, which is illustrated in the following excerpt from an interview with an athlete:

(22) Question:
Je had de ambitie om ook op de 5.000 m een ***grote tijd*** *neer te zetten, maar dat is niet gelukt. Waarom niet?*
'You had the ambition to set a grand time in the 5.000m, but that did not work, why not?'

Answer:
Ik wilde inderdaad onder de 13.40 duiken, zelfs onder de limiet van 13.38…
'Indeed, I wanted to keep it under 13.40, even under the limit of 13.38…'

(SoNaR)

In this example, the interviewer asks the athlete after his intention to set a particular time, referred to as 'a big time'. The athlete describes this time as staying 'under' a particular time. There appears to be no doubt between the interlocutors that 'big time' refers to a short duration. In total, OpenSoNaR merely exhibits 26 hits in 25 documents for *grote tijd*. Of these 26, only 1 refers to a long duration, and as such can be regarded a size metaphor:

(23) *Daar-na waren ze* ***grot-e*** ***tijd*** *afwezig, op enkel-e*
there-after be.PST.PL PRO:3PL big-INDEF.C time absent on some-PL

zwerver-s na.
wanderer-PL after

'After that, they were gone for a long time, except for a few wanderers.'
(about the occurrence of the wolf in the Netherlands)

(SoNaR)

No matches for *grote tijd* were found in CGN. However, this does not straight away indicate that Dutch does not exhibit size metaphors for duration. Size terms are used as adjectives, modifying duration quantifiers[18] to give such an absolute quantifier, for example *uur* 'hour', a more subjective interpretation:

(24) *Een* ***groot uur*** *later was het lek gedicht en kon*
INDEF big hour later AUX.PST.3SG DEF.N leak close.PP and can.PST.SG

iedereen terug naar de kamer of de werkplaats.
everybody back to DEF.C room or DEF.C workplace

'After a big hour the leak was closed and everybody could return to the room or the workplace.'

(SoNaR)

Still, examples as in (24), where *groot* 'big' is used as an adjective modifying a temporal quantifier, are rare. SoNaR includes 11 instances of *groot uur*, of which 8 refer to a television program[19] and only 3 to duration. No matches for *groot uur* were found in the CGN. On the other hand, the antonym of *groot*, *klein*, is used much more frequently in combination with a temporal quantifier, as in (25):

(25) *Het probleem was na een* ***klein uur-tje*** *al opgelost.*
DEF.N problem AUX.PST.SG after INDEF small hour-DIM already solve.PP

'The problem was already solved after a small hour.'
(The problem was solved within an hour or it was solved in less time than expected)

(SoNaR)

[18] Duration quantifiers in this sense are different from quantifiers as discussed in section 3.2. The quantifiers referred to in that section are quantifiers in the most general (spatial) sense, such as: much, some, most. With duration quantifiers, on the other hand, I refer to those quantifiers that specifically belong to the domain of time, the units in which time is measured, such as: hour, minute, day, week etc. In the discussion of duration metaphors, these two types of quantifiers take different roles. Quantifiers in amount metaphors represent the actual spatial element that makes a duration metaphor a metaphor. Temporal quantifiers on the other hand are not the part of the expression that makes it a metaphor. The element that causes the constructions with temporal quantifiers discussed here to become metaphors, are the (spatial) adjectives that modify the temporal quantifier.

[19] The talkshow *Een groot uur "U"* 'a big hour "you"' was broadcast in the Netherlands during the 70's. Interestingly, depending on the length of the program, it was sometimes broadcast as *Een klein uur "U"* 'a small hour "you"'.

The size metaphor in example (25) differs from *groot uur* not only in the adjective that is used, but also in that *uurtje* in (25) is a diminutive, while *uur* in *groot uur* is not. However, *klein uurtje* also occurs without diminutive suffix. For obvious reasons, *groot uurtje* was not attested, *klein uur* and *klein uurtje* are treated the same in this thesis.[20] In some cases, *klein uur(tje)*, even though it describes a duration, functions rather as an indicator of spatial distance, as in example (26) below. This use of *klein uur(tje)* for spatial distance is attested 16 times in SoNaR, and is thus relatively infrequent compared to 548 occurences of *klein uur(tje)* denoting merely duration.

(26) *Het* *bestuursterrein* *in* *Skopje* *ligt* ***op een*** ***klein***
DEF.N administrative.grounds in Skopje lie.PRS.3SG on INDEF small

uur-tje ***rijd-en*** ***van*** *het* *slagveld.*
hour-DIM drive-INF from DEF.N battlefield

'The administrative grounds in Skopje are situated a small driving hour away from the battlefield.'
(It would take somebody an hour by car to reach the battlefield from the administrative grounds.)

(SoNaR)

Interpreting the metaphorical status of expressions such as *op een klein uurtje rijden van het slagveld* in example (27) is very difficult. On the one hand *klein uurtje* is a size metaphor that denotes a duration that is perceived to be short. On the other hand, this expression, which is a temporal metaphor in itself, is used as a measurement for distance in what might be called a metaphoric way. The distance between two particular places in space is described in terms of the time it will take to cross that distance. In this construction, *klein uurtje rijden* takes the place that would normally be taken by a spatial quantifier, as in:

(27) *Haar* *huis* *ligt* ***op*** ***twee*** ***kilometer*** ***van*** *de* *Waddenzee.*
POSS:3SG.F house lie.PRS.SG on two kilometer from DEF.C Waddenzee
'Her house is situated on a distance of two kilometres from the Waddenzee.'

(SoNaR)

Such a temporal quantifier as a metaphor for spatial distance can also occur without clarifying *rijden*, as in:

[20] There might be a slight pragmatic difference between these two, in which *klein uur* would be perceived to be longer than *klein uurtje*, though no evidence apart from my native speaker intuition can be provided. However, for the present discussion, it suffices to say that *klein uur(tje)* is the counterpart of *groot uur*.

(28) *Op* *het* *dak* *van* *de* *fabriek* *Franz* *Falke-Rohen* *in* *Schmallenberg,*
on DEF.N roof from DEF.C factory Franz Falke-Rohen in Schmallenberg

op ***een*** ***dik*** ***uur*** ***van*** *Keulen* *en* *aan* *de* *oever-s* *van* *de*
on INDEF fat hour from Cologne and at DEF.PL shore-PL from DEF.C

Rijn, *wapper-t* *de* *Europese* *vlag* *lustig* *in* *het* *typisch-e*
Rhine wave-PRS.3SG DEF.C European flag cheerful in DEF.N typical-DEF

Sauerland-s-e *landschap.*
Sauerland-ADJZ-DEF landscape

'On the roof of the factory *Franz Falke-Rohen* in Schmallenberg, a good hour (lit. a fat hour) away from Cologne and at the Rhine's shores, the European flag is waving cheerfully in the characteristic landscape of Sauerland.'

(SoNaR)

The reason that I pay so much attention to these particular instances of size metaphors, is that they form a potential problem for a simple one-to-one relation between temporal metaphors and cognitive implications. From a temporal metaphor perspective one would say *klein uur(tje)* and *dik uur* might influence the perception of time in such a way that in an experimental setting the size of a stimulus would influence the estimation of its duration. In other words, based on these expressions, it is expected that smaller stimuli will be perceived to take less time, and bigger (in analogy to *dik* 'fat') stimuli to take more time. However, when taking a closer look at these examples, they appear to occur in a 'distance' context, since they are used metaphorically as spatial quantifiers of distance. So, one could also argue that these particular instances would facilitate the influence of line length rather than figure size on duration estimation in an experimental setting. As said, these particular expressions concern marginal frequencies. On the other hand, they are productive: different temporal quantifiers can be inserted in the spatial quantifier slot, although they occur mostly without a modifying adjective, and thus will not be classified as size metaphors, such as (29):

(29) *Het* *huis* *lig-t* *aan* *een* *boulevard,* *vlak* *bij* *de*
DEF.N house lie-PRS.3SG at INDEF boulevard near by DEF.C

Brussel-s-e *ring* *en* ***op*** ***een*** ***kwartier*** ***van*** *Brussel-centrum.*
Brussels-ADJZ-DEF ring and on INDEF quarter from Brussels -centre.

'The house is located at a boulevard, nearby the ring road of Brussels and a quarter of an hour away from the centre of Brussels.'

(SoNaR)

In short, temporal quantifiers can be productively used as a metaphor for spatial distance. Not all of these instances are also temporal metaphors. However, in some cases a temporal quantifier phrase includes a spatial modifier, turning the temporal quantifier into a duration metaphor, more specifically: a size metaphor (as in example 28). If such a size metaphor quantifier phrase is used as a metaphor for spatial distance, it would be hard to decide only on the basis of linguistic data which metaphor is dominant in the cognitive representation of the situation: the

size metaphor or the distance metaphor. What this illustrates, is that it is not merely difficult to compose an exhaustive list of size metaphors, but also to interpret these size metaphors and the weight they might have in cognitive conceptualizations.

To approach an inclusive overview of size metaphors, I carried out n-gram investigations of different temporal lemmas, such as *tijd* 'time', and *uur* 'hour', preceded by an adjective. From these n-gram investigations, it appeared that Dutch size metaphors include the adjectives *dik* 'fat', *klein* 'small' and marginally *groot* 'big'. A subsequent investigation of n-grams of these adjectives in combination with a noun, revealed that these adjectives are by far not as widely used to form duration metaphors as *lang* and *kort* are. In fact, they are only interpreted in durational sense when they occur with 'temporal nouns' like *uur* 'hour', *maand* 'month', etc. So, although size metaphors exist in Dutch, they are far less common than distance metaphors, and only productive in the form of an attributive adjectives modifying a noun with durational semantics. As such, it is much more straightforward that size metaphors are indeed metaphors than it is with distance metaphors. Adjectives such as *dik, klein* and *groot* always refer to the physical size of a certain entity, and thus belong to the domain of space. When they modify a temporal noun, it is clear that they do not refer to physical size, and can therefore be interpreted in durational sense.

3.3.3. Amount metaphors

A first investigation of amount metaphors in a similar way to Casasanto's methodology reveals 6390 instances of *veel tijd* 'much time' in SoNaR (see table 1). The counterpart of *veel tijd, weinig tijd,* occurs 2354 times in SoNaR. This seems to follow the general tendency of short durations being less frequently expressed with a duration metaphor than long durations. Table 1 also showed that there are more amount metaphors than just *veel tijd* and *weinig tijd*. However, a crucial question that needs to be answered is: are these indeed instances of duration metaphors? Actually, these 'amount metaphors' do not unambiguously fit the working definition of a duration metaphor used in this thesis. Take for example:

(30) *Dan heb je **weinig tijd** voor overpeinz-ing-en.*
then have.PRS.2SG PRO:2SG few time for contemplate-NMLZ-PL

'Then, you will have little time for contemplations'

(SoNaR)

A quick recap: the working definition of a duration metaphor stated that it either had to indicate the time span of a certain event or to describe a duration in general. Example (30) does not indicate that the contemplations take little time, but rather that 'there is' little time for contemplations. In other words, *tijd* in this sense does not indicate a duration or the time span of an event, but rather depicts *tijd* as the resource of which a certain amount is needed for a certain event. Evidence for this conclusion may be found in the fact that the verb *hebben* 'have' is used: time is described as something that can be possessed.

On the other hand, there are instances in which *veel tijd* does refer to duration, as in example (31):

(31) *Het* na-bluss-en *neem-t* ***veel*** ***tijd*** *in beslag* […]
DEF.N after-extinguish-INF take-PRS.3SG much time in occupation

'The extinguishing afterwards absorbs a lot of time.'

(SoNaR)

In example (31), *veel tijd* indicates the time span of a certain event, namely the duration of the extinguishing that takes place after the actual fire is gone. In this example, *neemt veel tijd in beslag* could be replaced by: *duurt lang*.[21] Compare examples (32a) and (32b):

(32) a. […] *ook omdat de reis* ***erg veel tijd in beslag neem-t.***
also because DEF.C journey very much time in occupation take-PRS.3SG
'[…] also because the journey takes a lot of time.'

b. De reis **duur-t** **lang** […]
DEF.C journey last-PRS.3SG long
'The journey takes long […]'

(SoNaR)

Instead of taking the frequency of *veel tijd* as the frequency of an amount metaphor, it might thus be better to take the frequency of the expression: *veel tijd in beslag nemen*. The same goes for the other amount metaphors in table 1: *enige tijd*, *meer tijd*, *wat tijd*. The construction *QUANT tijd in beslag nemen*, can also occur in a different form, for example: *neem QUANT tijd in beslag*, or: *QUANT tijd in beslag neem*, in which *neem* is a lemma that can be inflected in different ways. In all these cases, *QUANT tijd in beslag* is fixed in form as well as word order. When grouping the instances of *tijd in beslag* in SoNaR according to the lemma left from the expression[22], results show that number metaphors are actually quite marginally. In this way, in total, I found 744 instances of number metaphors in SoNaR.

Although this shows that real number metaphors are rather infrequent, it is important to note that any 'quantifier + *tijd*' combination might activate a durational interpretation, even if duration is not the main message it conveys. In other words, the effect that such a combination might have on the perception of duration might not be determined by the frequency of its occurrence with specific durational interpretation, but by the overall frequency of this expression.

3.4. Conclusion

From the previous three sections, it is clear that duration metaphors comprise much more than merely translation equivalents of *long time*, and *much time*. Although many expressions were discussed, and examples showed that classification of metaphors sometimes is difficult, it is possible to say something about preferences in Dutch.

The default expressions to talk about duration in Dutch include 'distance terminology'. Evidence for this conclusion is that the only temporal adverbial available in Dutch to indicate an expanded duration is *lang*. Besides, nouns modified by the attributive adjectives *lang* or *kort*,

[21] Based on my judgement as a native speaker.
[22] Quantifiers are not annotated as such in SoNaR, therefore, I manually selected the quantifiers from the list of words that occur before *tijd in beslag* in SoNaR.

are unambiguously interpreted in a durational sense. Moreover, also nouns that do not specifically belong to the domain of duration, but semantically inherently have durational implications, can form a distance metaphor with *lang* or *kort*. A careful investigation of these expressions in relation to purely spatial expressions including *lang* and *kort*, showed that the metaphorical status of the temporal expressions is debatable. No evidence was found that the spatial use of *lang* and *kort* is the basic use, and that these words are borrowed into the domain of time to form a duration metaphor. Neither comparisons of frequencies of the different expressions as they are found in contemporary Dutch, nor etymological accounts, provided such evidence. In fact, the duration constructions are overall more frequent than the spatial constructions. Even etymologically no evidence was found that the spatial sense is the original use, and that the durational use is metaphoric. So, although a metaphoric nature of the duration expressions could easily be explained by instances where spatial *lang* has implications for duration (as in: *een lange weg* 'a long way'), no evidence for the existence of such a conceptual metaphor was found. Still, this does not take away the fact that space and time are apparently linguistically linked in this respect. It just implicates that maybe it is an equal relationship in present-day Dutch, without one domain being marked as source domain of a construction and the other as target domain.

For size metaphors, the conclusions are much more straightforward. Size metaphors are mainly used within temporal quantifier phrases, and are not very frequent. Amount metaphors occur rather frequently, but arguably not all instances of 'quantifier + *tijd*' belong to the domain of duration metaphors. Although they refer to a certain amount of time, their main goal is not to describe the time span of a certain event or to give a specification of a certain duration. Even though some of the amount metaphors fit the working definition of a duration metaphor, most instances of initially perceived amount metaphors appeared to rather refer to time as a resource.

4. Theory: Experimental implementation of linguistic metaphors

As discussed in chapter 2, Casasanto and Boroditsky (2008) test the effect of distance on duration estimation with a series of six experiments. In a subsequent study, Casasanto (2010) builds on the findings of these experiments with an experiment designed to test the influence of amount on duration estimation (see section 2.1). Both experimental designs are based on linguistic analyses of duration metaphors in different languages. In the previous sections, attention has been paid to these analyses and a description has been provided of Dutch duration metaphors. The present chapter revisits Casasanto and Boroditsky (2008) and Casasanto (2010) in a discussion of their experimental designs for testing the influence of the spatial parameters 'distance' and 'amount' on duration estimations. Reviewing these experimental designs will allow me to construct an experimental design adequate for testing the effect of space on duration estimations by speakers of Dutch. This experiment is discussed in chapter 5.

Chapter 5 merely reports on the execution and the results of the experiment that was carried out within the scope of this thesis. However, besides providing evidence from yet another language, I would also like to make a methodological contribution to the field. Therefore, in the current chapter attention is paid to the similarities and differences between the current experiment and the ones by Casasanto and Boroditsky, defending the choices that I made in designing the experiment. The chapter ends with predictions for Dutch participants, in analogy to general predictions provided by Casasanto and Boroditksy (2008), and Casasanto (2010).

4.1. The stimuli

One of the main differences between the current experiment and the ones carried out by Casasanto and Boroditsky (2008) and Casasanto (2010) is found in the stimulus types. Casasanto and Boroditsky (2008) had one basic stimulus type: the (growing) line. Besides this stimulus type, Casasanto (2010) used one other type, namely the filling tank; "a schematically drawn container of water filling up gradually" (Casasanto 2010:469), the function of which is described in section 2.1. Unfortunately, Casasanto (2010) does not include a picture of what this stimulus looked like (nor are examples of it included in Casasanto 2005), and does not provide descriptive values for its dimensions. This leaves the question open to what extent this picture was 'schematicalized': Did it include some kind of perspective, or would it be interpreted two-dimensionally rather than three-dimensionally? Was the water recognizable as such, or did it not include a simulation of liquidity? These questions might seem rather trivial at first sight, but the more complex the stimulus, the less comparable it would be to the growing lines. On the other hand, the more simple/schematic the filling tank stimulus, the less direct its link to amount metaphors; a very simple drawing of a filling tank might actually just look like a vertically growing rectangle. Which, in turn, is only different from the growing line in terms of its weight (a rectangle could be viewed as a very thick line) and direction (vertical instead of horizontal). In short, Casasanto (2005, 2010) does not provide enough information to reconstruct the filling tank task.

Not only is it difficult to interpret what the filling tank task looked like, it should also be questioned whether it is a suitable stimulus for the question under investigation. The aim of

the filling tank task is to test the effect of amount metaphors on duration estimation. Or, in terms of predictions:

> "[…] speakers of Amount Languages like Greek should show a strong influence of 'fullness' on time estimation, whereas speakers of Distance Languages like English should show a weaker effect."
> (Casasanto 2010:469)

As discussed in section 2.2, and chapter 3, it might be problematic to classify languages as either Amount or Distance Language. Besides that, within what Casasanto (2010) calls amount metaphor, a distinction might be preferable between size and amount metaphors. In this sense, size refers to metaphors including terminology describing physical dimensional properties. It was also discussed that it is possible that the presence of amount metaphors in a language facilitates an effect of 'distinct entity amounts' on duration estimation, not merely 'mass entity amounts'. The filling tank task does not cover this 'distinct entity amount'. In short, this task might need some revision.

In order to meet the three different duration metaphor types that were discussed in section 2.2 and chapter 3, I propose a threefold distinction of stimuli for research on the relation between space and duration:

- lines of different lengths (distance metaphor)
- figures with different sizes (size metaphor)
- different amounts of distinct units (amount metaphor)[23]

The exact specifications of the implementation of these stimulus types in the present investigation are described in section 5.2.1. As far as possible, they match the specifications given by Casasanto and Boroditsky (2008), in order to facilitate comparability of the different studies. The main parallels are the duration specifications and the number of different size values.

Another potential problem in the experiments carried out by Casasanto and Boroditsky (2008), and Casasanto (2010), is the presence of movement, as briefly mentioned in section 2.1. Almost all of the experiments discussed by Casasanto and Boroditsky include yet another component besides distance and duration, namely movement. All experiments but one include a *growing* line (or, in the case of experiment 5, a moving dot, see section 2.1), and the tank in the filling tank task is gradually filling up. Merely experiment 6 includes a stationary line (Casasanto and Boroditsky 2008:587). Casasanto and Boroditsky do not explain why this element is involved in five of their six experiments and in the filling tank task as well. The problem with it is that it results in an extra variable, which they do not include in their analysis: growth rate. The value of this variable is dependent on the values of the other two: duration of the stimulus and final length of the line (or: maximum displacement of the dot). In other words, a short line with a long duration consequently will have a low growing rate. A long line with a short duration will result in a high growing rate (see appendix 1).

[23] As mentioned in section 1.2.1, Xuan et al. (2007) concluded that larger numbers of dots induced longer estimations of duration. However, in that study, amounts of dots were much smaller, and stimulus durations much shorter than in the current experiment.

Since all durations were crossed with all displacements, different duration-displacement combinations could result in similar growing rates. For example, the combinations 200:1000, 500:2500, and 800:4000 (displacement in pixels:duration in milliseconds), all result in a growing rate of 200 pixels per second. So, even though the displacements and duration values are different for these three stimuli, their growing rate is the same. There are not many instances of different stimuli with the exact same growing rate, but sorting the stimuli according to their growing rates (see appendix I), suggests that growing rate might be considered a continuous variable. The increments are not constant throughout the range of growing rates. However, there are enough values between the minimum of 40 px/s and the maximum of 800 px/s, to assume that participants might perceive it as a continuous scale, ranging from low to high growing rates. From there, it is only one step to predict the effect of stimulus growing rate on duration estimation. A logical hypothesis would be that growing rate has a negative effect on duration estimation: the higher the growing rate, the shorter the estimation of duration. In any case, it seems problematic that this variable is present in the experiments of Casasanto and Boroditsky (2008) and Casasanto (2010), but not accounted for in their analyses[24].

Casasanto (2009:131-133) discusses the effect of speed on duration estimations on the basis of another growing lines experiment by Casasanto and Boroditsky. In that experiment, the effect of distance and speed on time estimation could be evaluated separately. Casasanto reports they found a positive relationship between speed and duration estimation, which is unexpected on the basis of the formula: time = distance/velocity. However, Casasanto (2009) does not provide a reference of a publication of this experiment, nor does he discuss the consequences these findings might have for the conclusions of their earlier experiments. In any case, to avoid an interaction of growing rate with the perception of space and duration, the experiment in the present thesis does not include a component of movement. All stimuli are static and remain the same throughout the stimulus presentation. Displacement value is therefore replaced by space value; depending on the stimulus type, this value will refer to length (lines), size (circles), or number (amounts of dots).

4.2. Methodological issues

Besides the stimuli, there are more aspects of the experiments designed by Casasanto and Boroditsky (2008), and Casasanto (2010) that might need some revision. In the lines tasks designed by Casasanto and Boroditsky (2008), all durations were fully crossed with all displacement values, resulting in 81 stimuli. All these stimuli were presented twice to each participant at different time points in the experiment. One time the participant had to respond with a duration estimation, the other time with a space estimation. In total, the experiment included 162 stimuli-respons combinations. Casasanto (2010) is not transparent on this aspect for the two experiments he carried out: the growing lines and the filling tank. He describes that speakers of English show a strong effect of line length, but a weak effect of tank fullness on duration estimation and speakers of Greek show the opposite effects (Casasanto 2010:469). Yet, it is not clear whether the same speakers of English and Greek participated in both tasks or that it were different speakers. Since he calls the two tasks by two different numbers (experiment 8 and experiment 9) (Casasanto 2010:469), it is possible that different people

[24] Though they do account for possible kappa and tau effects (Casasanto & Boroditsky 2008:590-591).

participated in the tasks. This would be in analogy to experiment 1-7 described by Casasanto and Boroditsky (2008), as referred to by Casasanto (2010:462-465).

In the present study, I decided to present all stimuli, of the three different types, to every participant. In my opinion this is a prerequisite for the kind of question that is under investigation. The aim of the experiment, besides testing the existence of a cognitive link between space and duration without language being actively involved, is to find cues for a possible link between duration metaphors and the experience of duration. It is not yet certain that such a linguistically based link does exist, and it is thus possible that differences in effects of different stimulus types can be explained by individual differences between participants. Therefore, it is important that all participants respond to all stimuli, so that a stronger effect of one stimulus type will be visible within participant's responses as well as over the complete data set. Only then, it might suggest a link between language and the perception of space and time.

The consequence of this decision is that there are 243 stimuli that need to be responded to by every participant (9 lines + 9 circles + 9 amounts of dots, × 9 durations). If participants need to view each stimulus twice at different points in the experiment, for different response types (duration estimation and space estimation), this results in 486 stimuli. Since the experiment would become too long if so many stimuli were included, I decided to ask for both duration and space response after each stimulus. So, participants view 243 stimuli in randomized order, and for each stimulus, give a duration as well as a space estimation[25]. In this way, the duration of the experiment is drastically reduced. An additional benefit of this construction is that participants are not biased by the previous time they saw the stimulus when they give the second response for a stimulus.

Casasanto and Boroditsky removed rather a lot of the participants (88 of the in total 304 participants) from the analysis due to incorrect or excessively poor performance (Casasanto 2005:17, 52, Casasanto and Boroditsky 2008:581). Incorrect performance would be for example responding for duration when response for space was asked for. It is logical that such responses were removed. However, removing participants that perform 'excessively poor' from the analysis, is more problematic. How does one determine what excessively poor performance is? Casasanto and Boroditsky do not refer to previous studies for a baseline of what performance accuracy rate could be regarded normal for this type of task. Instead, participants who estimated stimulus durations less than half of their actual durations were removed. The explanation for such bad performance is attributed to impatience with the repetitive task (Casasanto 2005:17, Casasanto and Boroditsky 2010:581). They do not mention which part of the removed participants was excluded on what ground. Since there is no prove that this 'poor performance' is indeed due to impatience, I decided not to exclude participants based on poor performance. Instead, in the statistical analysis, participants are included as random effect, to control for variation between participants.

[25] The response for space in the current experiment differs from the one described by Casasanto and Boroditsky (2008). In their growing line task, participants had to indicate the starting point and end point of the line they saw by mouse clicks at the appropriate positions. However, this is more complex in case of a circle, and virtually impossible in case of amounts of dots. Therefore, participants give their space response in a different way, described in section 5.2.3.

4.3. Predictions

Casasanto (2010) classifies languages as either Amount Languages or Distance Languages, according to the type of metaphors they use for duration. Based on this classification, he predicts certain outcomes of the growing line and filling tank tasks, if there is a deep influence of language on cognition. In order to formulate similar predictions for the performance of the speakers of Dutch in the current experiment, I carried out the corpus investigation of duration metaphors described in chapter 3.

In section 3.3.1. the metaphoric nature of durational interpretation of nouns modified by *lang* or *kort* was questioned. Based on etymologic evidence and a corpus investigation, I concluded that there is no evidence that this indeed concerns duration metaphors with space as source domain. In fact, the only argument for a metaphoric link with space as source domain and duration as target domain is that duration is more abstract than space, which might be a questionable statement as well. For the scope of this thesis, the historical development of the different metaphor type is of minor importance than the present day use of these metaphors. What the investigation in section 3.3.1. did show is that durational sense of *lang/kort* modifying a noun is more prevalent than spatial sense. Although it is clear that *lang* and *kort* can be used in durational as well as spatial contexts, there is no evidence in contemporary Dutch for an asymmetrical link from space to duration in this respect.

Translating this to an experimental setting means that it is not possible to predict on the basis of the linguistic investigation that line length will influence duration estimation, but duration will not influence line length estimation. In fact, the linguistic data suggest that an effect might be found in both ways. So, stimulus duration might influence the estimation of line length as well as stimulus line length might influence the estimation of duration.

Section 3.3.2. discussed the difficulty of *hele tijd* as a duration metaphor. Besides the question whether it should be classified as a size metaphor, or yet another category, it was also discussed that it does not always function as a duration metaphor. In fact, only about a third of the instances of *hele tijd* in SoNaR and CGN refer to duration. Besides, the counterpart of *hele tijd*, *halve tijd*, never refers to duration. For that reason, *hele tijd* cannot lead to a specific stimulus type, since the present experimental design requires that the stimulus space value can be scaled in different orders of magnitude. However, other size metaphors suggest that an influence of circle size on duration estimation might be found. Since this concerns clear metaphors with space as source domain and time as target domain, it is expected that an effect will only be found from circle size to duration estimation and not from duration to size estimation.

Section 3.3.3. argued that amount metaphors in Dutch have the form *QUANT tijd in beslag nemen*, and as such are rather marginal. Similar expressions referring to duration occur with other temporal nouns instead of *tijd*, for example: QUANT *uur in beslag nemen*. Since these other nouns all refer to countable units, these expressions were not considered metaphors, and were not discussed in chapter 3. However, their similarity to the '*QUANT tijd in beslag nemen*' constructions, suggests they might influence the perception of duration in such a way that larger amounts of distinct entities positively affect the estimation of duration. In other words, if a stimulus consisting of a particular amount of dots includes more dots, the duration of this stimulus will be estimated as taking more time than it actually did.

As discussed in chapter 3, it is difficult to classify Dutch as either a Distance, Size or Amount Language, if a strong metaphoric nature of the duration expressions is a prerequisite. Distance expressions, being metaphoric or not, seem to be most prevalent to describe duration. Amount metaphors are also widespread if they are viewed broader than specifically referring to duration, and also include TIME IS A RESOURCE instances. It is very well possible that this latter type of amount metaphors also influences the perception of duration, and that, consequently, a strong effect of amount on duration estimation might be found. Following Casasanto's (2010) line of reasoning, size is least likely to influence estimation of time by speakers of Dutch, since size metaphors are the rarest. Length, on the other hand, is expected to have the greatest effect on duration estimation by speakers of Dutch, since distance expressions are the default, and most frequent, way to refer to subjective experience of duration. Beyond Casasanto's line of reasoning, the metaphoric link between space and time seems to be most prevalent in Dutch size metaphors, more than in distance and amount metaphors, and as such a strong effect of size on duration might be found. In that case, a weaker effect of distance and amount is expected.

5. Estimating duration and space: a psychophysical experiment

5.1. Introduction

This chapter discusses an experiment that investigates the question whether there is a cognitive link between the domains of time and space even when language is not actively involved. And, if so, if there is evidence that this relationship between time and space follows the same patterns as the linguistic relationship between the two domains does. The aim of the experiment is to answer the following research questions:

1. Are speakers of Dutch influenced by spatial parameters of stimulus figures in estimating the duration of these figures?
2. Are speakers of Dutch influenced by duration of stimulus figures in estimating spatial parameters of these figures?
3. With respect to research questions 1 and 2, is there a significant difference in effects between different stimulus types?

The preceding chapters showed that the work of Casasanto and Boroditsky (2008) and the work of Casasanto (2010) discuss many interesting findings that in particular might have consequences for the debate on linguistic relativity. Casasanto (2010:474-475) explicitly claims that his findings support a deep view on language-thought relations, which means that language is believed to also influence mental representation that does not include language (Casasanto 2010:461). Specifically, Casasanto (2010) argues on the basis of various cognitive tasks, that speakers of so-called distance metaphor languages are influenced by one-dimensional spatial displacement (line length) in their estimation of duration stronger than by more-dimensional spatial displacement. On the other hand, speakers of amount metaphor languages are stronger influenced by more-dimensional spatial displacement (a partly or completely filled up container of water) in their estimation of duration. However, as discussed in chapters 2 and 4, these conclusions, in order to be confirmed, are in want of more evidence.

This thesis therefore also describes an investigation of duration metaphors in Dutch (chapter 3) and the way these findings might be implemented in a cognitive experiment to explore language-thought relations in speakers of Dutch (chapter 4). In short, three different duration metaphors have been found in Dutch: distance metaphors, size metaphors and amount metaphors. In analogy to these three different metaphors, three different stimulus types have been designed, respectively lines, circles and amounts of dots. On the basis of frequencies of these metaphors and the work of Casasanto and Boroditsky (2008) and Casasanto (2010), it is expected that merely, or at least predominantly, lines will influence Dutch speakers' perception of time. Judging by the conclusions of these same studies by Casasanto and Boroditsky, it is expected that no influence will be found of stimulus duration on the estimation of spatial features of the stimuli.

5.2. Methodology

5.2.1. Materials

For constructing the stimuli, three different types of figures were used: i) lines, ii) circles and iii) amounts of dots (see figure 2). Two variables were specified for each stimulus: i) spatial parameter value and ii) duration. Spatial parameters are: length for lines, size for circles and

number for dots. Spatial parameter values were set from 20 to 100, with increments of 10, so 9 different values for the spatial parameter were included in the experiment (with values: 20, 30, 40, 50, 60, 70, 80, 90 and 100).

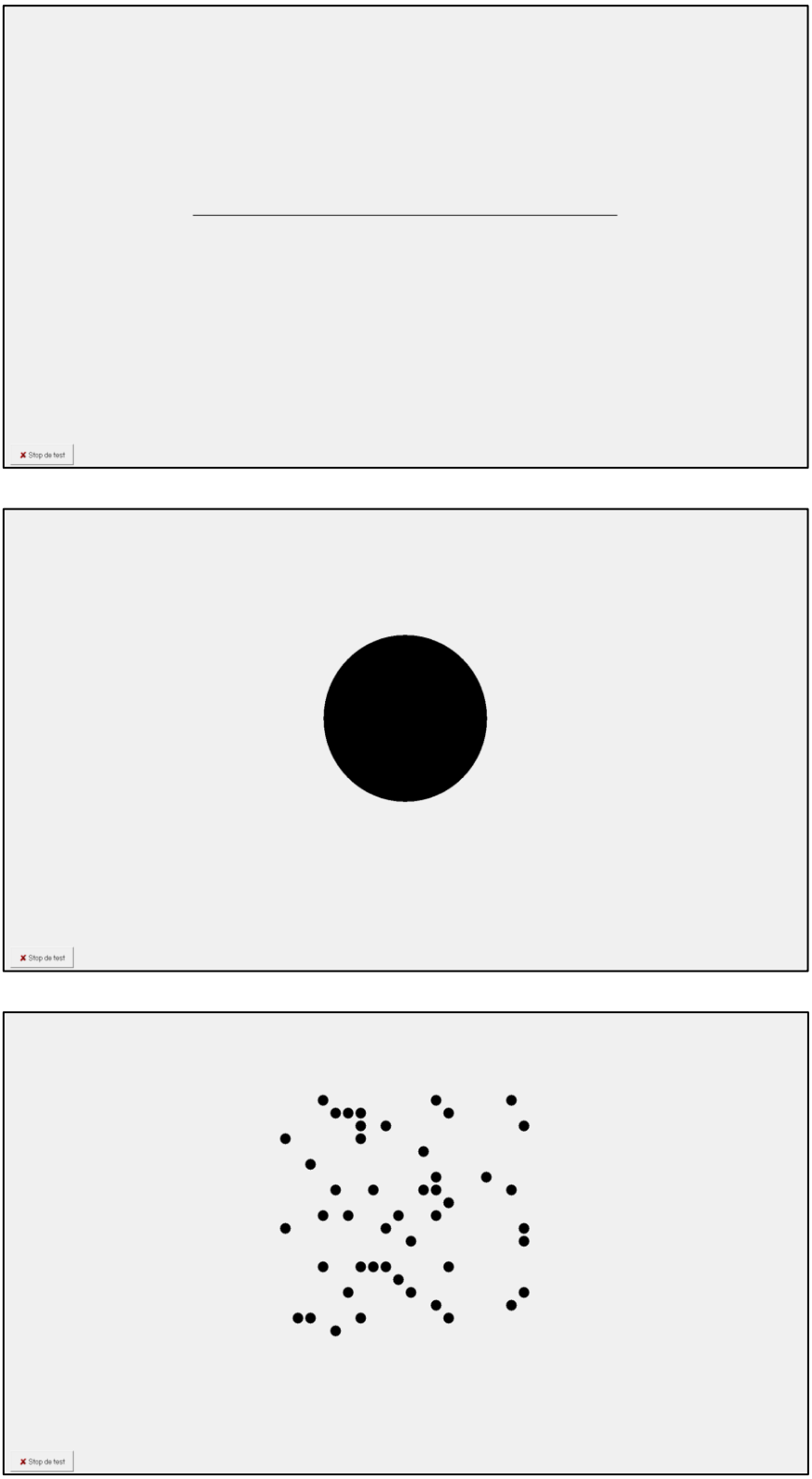

Figure 2. Screenshots of stimulus presentations. Space values from top to bottom: line: 80; circle: 60; dots: 50.

For each stimulus type, the spatial parameter represents a different physical quantity. For lines, the value of the spatial parameter determines the length of the line in pixels. The weight of the lines was set at 3 pixels. For circles, the spatial parameter is size; its value determines the diameter in pixels.[26] For amounts of dots, the spatial parameter is number; its value equals the number of dots[27] that appear on the screen. In the remainder of this thesis spatial parameter value is referred to as 'space value'. The place in which the stimuli appeared was horizontally centred on the screen, slightly above the vertical centre[28] (for an overview of all stimuli see appendix II). Durations were set from 1000 to 5000 milliseconds, with increments of 500 milliseconds; the experiment thus included also 9 different values for duration (1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500 and 5000 milliseconds). The 3 figure types were fully crossed with the 9 durations and 9 spatial parameter values, resulting in 243 stimuli (9 × 9 × 3 = 243).

5.2.2. Participants

20 native speakers of Dutch (8 male and 12 female) took part in this experiment. All of them participated on a voluntary basis; they were not reimbursed for their participation. Participants could quit the experiment at any time. The mean age of the participants was 27 years. The minimum age was set at 10 years as the relevant linguistic constructions are acquired in early childhood.[29] In the end, one 12-year old and one 15-year old participant were involved in the experiment,[30] all other participants were adults. No maximum age was set beforehand, but given the nature of the experiment, no elderly people were recruited, to avoid a bias due to

[26] Because the experiment was designed to function on different monitors, the value of the spatial parameter for lines and circles does not equal the exact amount of pixels. To calculate the amount of pixels, the following formulas were used:

- Line length in pixels equals screen width in pixels divided by 150 times the value of the spatial parameter (line length = screen width / 150 × space value)
- Circle diameter in pixels equals screen height in pixels divided by 150 times the value of the spatial parameter
  (circle diameter = screen height / 150 × space value)

For example, a line with spatial parameter value 40 on a monitor with resolution 1920 × 1080 pixels has an absolute length of 1920 / 150 × 40 = 512 pixels. If on that same monitor, a circle with the same spatial parameter value would be displayed; its diameter would equal 1080 / 150 × 40 = 288 pixels.

[27] The size of individual dots was held constant throughout the experiment. The diameter of the dots in pixels was determined according to the following formula: screen height divided by 32 minus 3 (diameter dot = screen height / 32 − 3). So, on the same monitor as discussed before, a dot would have a diameter of 1080 / 32 – 3 = 31 pixels. Individual dots were randomly assigned a place in a 20 by 20 matrix. In other words, there were 400 (20 × 20) available places, of which at maximum 100 were actually occupied by a dot, giving the impression of a cloud of dots. The length of the sides of this square framework within which dots appeared equals the screen height divided by 32 times 20 (matrix height = matrix width = screen height / 32 × 20).

[28] The exact place was determined according to the following formula: amount of pixels vertically below stimulus = (screen height – stimulus height) / 2. In which stimulus height is set at 3 pixels for the lines, and represents the diameter for the circles and the matrix height for the dots. As a result, the centre of each individual stimulus (regardless stimulus type) is fixed at the same point on the screen when the stimuli are displayed on the same monitor.

[29] As far as I know, no publications on the acquisition of temporal metaphors exist for Dutch, but as a native speaker, I know that the temporal metaphors under consideration are very common and not associated with exceptional linguistic competence. Most speakers are probably even not aware of the metaphorical nature of these expressions. Therefore, I am convinced that every normally developing native Dutch child in the last classes of primary school understands and uses common temporal metaphors.

[30] With consent of parents.

unfamiliarity with computers or unreported vision problems. The eldest participant was 52 years old.

5.2.3. Procedure

Participant were instructed to look at the stimuli and to estimate their duration and spatial parameter by mouse clicks on the appropriate buttons. After starting the program, an introduction appeared informing the participants about the task they had to carry out (see appendix III). The experiment was self-paced; participants had to click a button to go to the next page. After the introduction, participants were asked to fill in their gender, age, native language and other languages (including age of onset of acquisition). Subsequently, they could practice three stimuli before the actual experiment started. After each sixth part of the experiment, participants were informed they could take a break. The experiment lasted approximately 60 minutes. At the end of the experiment, participants were informed about their 'scores': the program calculated the mean absolute deviation between stimulus durations and duration estimations, and between stimulus space values and estimated values. This information was merely provided to give participants some idea of their performance as 'reward' for the time they spent on it.[31] Participants performed the experiment on their own computers[32].

Appendix IV shows the procedure of a stimulus presentation and response. First, an attractor *Let op* 'Attention' appeared in the middle of the screen for 750 milliseconds, followed by an empty screen[33] for another 750 milliseconds. Then, the stimulus was presented according to its specific stimulus duration. After the stimulus presentation, participants had to click the button *start tijd* 'start timing' to start timing their duration estimation. This button changed into *stop* as soon as the timing was started, for which no further visual support was provided. The duration estimation was finished by clicking this 'stop' button. Then, the button disappeared and a horizontal scrollbar appeared at the bottom of the screen. Participants estimated space using this scrollbar. At its appearance, the slider of the scrollbar was at the left end, and a figure (of the same type as the stimulus) with space value 1 was displayed just above the scrollbar. When moving the slider, the figure changed according to the movement: movement to the right resulted in higher space values, movement to the left resulted in lower space values.[34] Appendix III shows different positions of the scrollbar to illustrate how the figure changes according to the movement. The participant moved the slider in such a position that the figure of the screen matched best the figure that was presented as stimulus. When the participant was satisfied with the estimation of the figure, the button *Volgende* 'Next', at the lower right corner, was clicked, and the new stimulus was presented, starting with the attractor. Participants could quit the

[31] In reaction to a pilot in which the participant was disappointed he did not get any information on his performance. People were interested in how accurately they could estimate duration and space.

[32] The experiment was designed as an executable to run on Windows computers. The resolution of Windows is 16 milliseconds.

[33] This empty screen was inserted because in a pilot it appeared that if a stimulus was presented directly after the attractor, it was very difficult not to include the duration of the attractor in the estimation of the stimulus duration.

[34] The amounts of dots represent a special case in this respect. Whenever the slider was moved, the place of individual dots differed. The reason for this complication is that if the position of the dots would be the same in the presentation of the stimulus and the estimation of the number of dots, participants would automatically rely on the figure that the dots had formed in the stimulus presentation.

experiment at any time by clicking the button ‘Stop de test’, in the lower left corner, either or not to finish it later.[35]

5.3. Analysis

5.3.1. Data

A total of 9720 responses (20 participants × 243 duration estimations × 243 space estimations) were collected. Due to two technical problems[36], 3402 data points were excluded from the analysis. The remaining 6318 data points, 3240 for duration estimations and 3078 for space estimations, were analysed; this is 65% of the total of collected data points.

5.3.2. Statistical analysis

Following Casasanto and Boroditsky (2008), linear regression models were built. Data was analysed using R version 3.2.3 (R Core Team 2015). Specifically, I used the packages ‘boot’ (Canty and Riply 2015, Davison and Hinkley 1997) for bootstrap functions, ‘car’ (Fox and Weisberg 2011) for linear regression, ‘lme4’ (Bates et al. 2015) for mixed models, and ‘QuantPsyc’ (Fletcher 2012) for checking assumptions. Graphs were created using IBM SPSS Statistics.

Six different subsets of data were analysed:

1. Duration estimations for all data
2. Space estimations for all data
3. Duration estimations for lines only
4. Space estimations for lines only
5. Duration estimations for circles only
6. Space estimations for circles only

For every subset of data, four linear regression models were run. The first two models were simple models that had stimulus duration value or stimulus space value as a predictor variable. The third model had both stimulus duration value and stimulus space value as predictor variables, while in the fourth model I also included the interaction between stimulus duration value and stimulus space value. Participants were included as a random factor in all four

[35] After restarting the experiment, and filling in a previously used username, the experiment automatically continues at the beginning of the last uncompleted stimulus.

[36] All stimuli of the ‘amount of dots’ type had to be removed from the data (3240 data points), due to a bug in the source code of the experiment. A buffer was programmed into the experiment to prevent a double selection of the same dot place when a fixed number of dots were randomly assigned a place (which would result in a variable shortage of dots in stimulus presentation). During the analysis of the data, a logic error in this specific code was revealed. Due to this error, the chance that this happened was not taken away, but did actually increase. As this is a variable deficit, active in stimulus presentation as well as response presentation, there was no way to control the data for it afterwards.

For lines and circles, all space responses from participant 1 (162 data points) were removed from the data because of a problem with the response scale that was discovered after this participant completed the experiment. In the first version of the experiment, the maximum possible response value for space was set at 100. The space value of stimuli with space value 100 could thus not be estimated bigger than the actual value. For the second version, in which the 19 other participants took part, the maximum space response was set at value 120. This results in different scales for participant 1 versus all other participants. As the scales were not labelled, participants interpreted them relatively and therefore the different scales cannot be compared. For that reason, all space responses of participant 1 were left out of consideration, instead of just the ones with space value 100. Since participant 1 did carry out the exact same task and was confronted with the exact same stimuli and the same time response devices as the other participants, duration estimations of participant 1 are still taken into account.

models. For the subsets of the data that covered both lines and circles (subsets 1 and 2), a fifth model was run, including besides the stimulus duration value and the stimulus space value also stimulus type as a predictor variable. The likelihood ratio test using the anova ( ) function was performed to determine which model fit best the data set. Only the best fitting models are discussed in section 5.4.

5.4. Results

Figure 3 plots duration estimations and space estimations against the stimulus duration and stimulus space value.[37] Figure 3a plots the mean estimated duration against the actual duration of the stimulus, and figure 3b plots the mean estimated space value against the actual space value of the stimulus. In a situation where participants exactly reproduce the values of the stimulus variables, the mean estimations are equal to the number on the horizontal axis. The closer to this value, the better the estimation. Figures 3a and 3b show that, overall, participants estimated both duration and space moderately well. There appears to be a tendency for estimations to be higher than the actual stimulus value for small values, and lower than the actual stimulus value for high values. This applies to both duration and space estimations. The small error bars, indicating 2 Standard Error, suggest that, within the data, there is not much variance. When visually comparing the error bars of figure 3a and 3b, it can be concluded that the data on space estimations show less variation than the duration estimations data. No striking differences between the different stimulus types are visible in these figures, both lines and circles are estimated similarly.

Figure 3c plots the mean estimated duration against the stimulus space value. In a situation where there is virtually no effect of space on duration estimation, it is expected that the mean estimated duration will be 3000 milliseconds for each stimulus space value, since each space value occurred with all 9 durations in the experiment[38]. Figure 3c shows that estimated durations were below 3000 milliseconds for most stimulus space values. This might be partly explained by the fact that in general, long durations were estimated lower than their actual values. However, in figure 3c there appears to be a slight increase in estimated duration over the increments of stimulus space values, at least when duration estimations are compared for the lowest and the highest stimulus space values. This is the case for both stimulus types, although for the space values in the mid-range, estimations differ for lines and circles. A striking difference is seen at space value 50, where lines show a drop, but circles a peak.

[37] In this figure, the lines that connect the data points do not provide extra information, they merely improve the visibility of the data points. As discussed, the experiment included nine values for space and nine durations, no data is available on values between two factors. Therefore, only the values on the same vertical line as a value on the horizontal axis are measured values. Although the line does provide some idea of what a regression line might look like for this data set, it should not be confused with a real regression line.

[38] (1000 + 1500 + 2000 + 2500 + 3000 + 3500 + 4000 + 4500 + 5000) / 9 = 3000

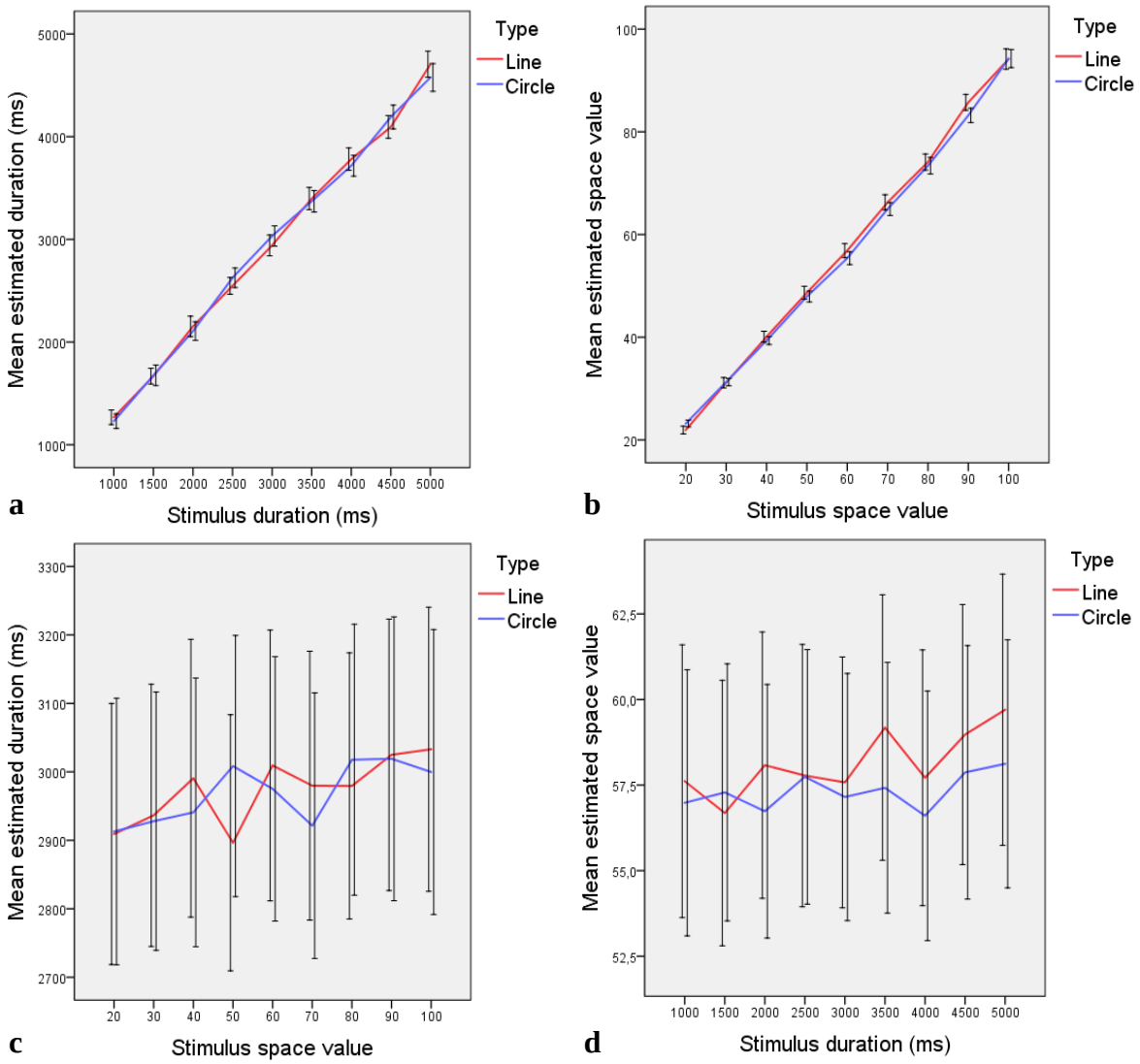

Figure 3. Mean estimations over all participants of duration (left) and space value (right) for the different stimulus types. Error bars indicate +/− 2 Standard Error.

Figure 3d plots the mean estimated space value against the stimulus duration. Similarly to the expected mean for duration estimations, the expected mean for space value estimations can be calculated as well. When there is no effect of duration on estimation of space and people can perfectly reproduce a figure they have seen, the mean estimated space value is expected to be 60, since each duration value occurs with all 9 space values in the experiment[39]. Figure 3d also shows some increase in estimated space value as durations expand, although the effect seems to be bigger for lines than for circles. Overall, estimations are lower than the expected value.

An important note to both figures 3c and 3d is that the vertical scale is very narrow. While the increments for durations were 500 milliseconds, mean estimations deviate at the most about 100 milliseconds from the expected 3000 milliseconds. Likewise, space values increased with 10 step increments, but mean estimations deviated at most about 4 steps from the expected value of 60. The error bars are very big, about 400 milliseconds, suggesting a lot of variance between participants.

[39] (20 + 30 + 40 + 50 + 60 + 70 + 80 + 90 + 100) / 9 = 60

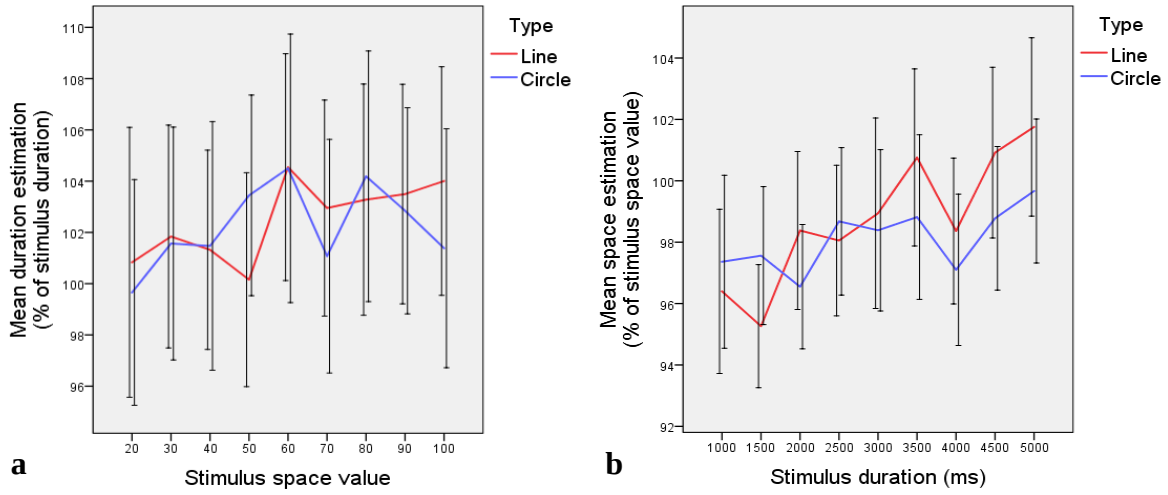

Figure 4. Mean estimations as a percentage of actual stimulus value. Error bars indicate +/− two Standard Error.

In figure 4, estimations are plotted as relative values. Each estimation of a stimulus value was scored as a percentage of the actual stimulus value. Figure 4a plots the mean duration estimation as a percentage of the actual stimulus duration against the stimulus space value. Figure 4b plots the mean space estimation as a percentage of the actual stimulus space value against the stimulus duration. Percentages below 100 indicate that a variable was estimated shorter/smaller than its true value; percentages above 100 indicate that it was estimated longer/bigger than its true value. Similarly to figures 3c and 3d, figures 4a and 4b show a very small range of percentages, with scores ranging from about 95 to 105%, indicating that overall, performance was high.

Figure 4a shows almost all mean scores for duration estimation are above 100%, indicating that on average, stimulus durations are estimated longer than the actual duration rather than shorter. Note that the peak lies at space value 60 for both stimulus types, with a score around 104%. Maybe, stimuli with space value 60, the mean space value, had the greatest effect on duration estimation. However, this could only be confirmed by a statistical analysis in which stimulus space value is treated as a categorical variable, which goes beyond the scope of this thesis. Figure 4b shows that, contrary to the estimations of duration as displayed in figure 4a, estimations of space are generally below 100%. This means that, on average, stimuli were estimated spatially shorter/smaller than they actually were. Especially for lines, the score seems to increase as durations increase, which might indicate a positive effect of stimulus duration on space estimation.

			Estimate	SE	t value
All data					
	Duration estimation				
		Intercept	368.9	85.26	4.33
		Duration	0.8339	0.0082	104.00
		Space	1.309	0.4009	3.26
	Space estimation				
		Intercept	3.2698	0.8302	3.94
		Space	0.8966	0.0055	162.34
		Duration	0.0004	0.0001	3.26
		Type	− 0.8213	0.2852	− 2.88
Lines					
	Duration estimation				
		Intercept	350.20	92.571	3.78
		Duration	0.8378	0.0111	75.67
		Space	1.4534	0.5536	2.63
	Space estimation				
		Intercept	1.8356	1.0172	1.80
		Space	0.9120	0.0080	114.06
		Duration	0.0005	0.0002	3.31
Circles					
	Duration estimation				
		Intercept	387.55	92.199	4.20
		Duration	0.8301	0.0116	71.49
		Space	1.1638	0.5805	2.00
	Space estimation				
		Intercept	4.4552	0.8902	5.0
		Space	0.8812	0.0073	120.3

Table 8. Estimates, Standard Errors and t values for best fitting models. Random effect: Participant. Effects are significant if the absolute t value equals, or is bigger than, 2.

Table 8 shows the results of the statistical analysis, including the estimates, Standard Errors and t values of the best fitting models. It confirms that overall, participant estimated duration and space value moderately well; for each subset of the data, stimulus duration is a significant predictor for duration estimation, and stimulus space value is a significant predictor of space value estimation, with high estimates. For absolute values of effects that are not being discussed, I refer to table 8. In the remainder of this section, I will merely pay attention to the results that directly relate to the research questions described in section 5.1. These questions are concerned with the crosswise effect: Is there an effect of stimulus space value on duration estimation? And, secondly, is there an effect of stimulus duration on space estimation? For both questions a third question was asked in case of a significant effect: Is there a significant difference in effect between the different stimulus types?

The first two models that are described in table 8 account for the complete data set of responses for lines and circles. For both duration estimation and space estimation a significant crosswise effect was found. In other words, the stimulus duration influenced space estimations and the stimulus space value influenced duration estimations. No significant effect of stimulus type was found for duration estimations. This means that lines and circles do not significantly differ in the effect they have on a participant's time perception. Both lines and circles influence time perception in a similar way. The estimate for the effect of stimulus space value on duration estimation is 1.309 (see table 8). This means that for every step on the space scale, the estimation of duration is 1.309 milliseconds longer. As discussed, stimulus space values differ with increments of 10 steps on the space scale, so each higher stimulus space value has an effect of 13.09 milliseconds on the duration estimation. In other words, on the basis of the data, the model predicts that if the duration of two stimuli with adjacent space values and similar duration values is estimated, the duration of the stimulus with the higher space value will be estimated 13.09 milliseconds longer than that of the stimulus with the lower space value.

Since no significant effect of stimulus type was found for duration estimations, lines and circles are not discussed separately in this respect. For space estimations on the other hand, a significant effect of stimulus type was found, indicating that lines and circles do not have the same effect on the perception of space. By comparing models for lines and circles separately, it became clear that this difference is found in the effect of stimulus duration on space estimation. For circles, the best fitting model does not include an effect of stimulus duration on space estimation. For lines, however, a significant effect of duration was found, with an estimate of 0.0005. Remember that the increments of stimulus duration were 500 milliseconds. So, each step on the stimulus duration scale has an effect of 0.25 steps on the estimation of line length.

The effect of stimulus space value on duration estimation, as well as the effect of line duration on the estimation of line length are both small effects. Interestingly, they are rather similar in relative terms. Given that the increments of stimulus duration were 500 milliseconds, an effect of 13.09 milliseconds equals about 2,6% of the difference between two adjacent stimulus durations. Similarly, given that the stimulus space value increments were 10 steps, an effect of 0.25 steps equals 2.5% of the difference between two adjacent stimulus space values.

5.6. Conclusion

With respect to the research questions, the following answers can be provided on the basis of the evidence presented in this chapter:

1. Speakers of Dutch are influenced by spatial parameters of stimulus figures in estimating the duration of these figures. This accounts for both lines and circles.
2. Speakers of Dutch are influenced by duration of stimulus lines when reproducing the length of these lines, but not by duration of stimulus circles when estimating the size of these circles.

Note that all reported crossway effects were very small, especially compared to the influences of stimulus space values on space estimations and stimulus duration on duration estimations. It remains a rather subjective question to what extent these findings support the existence of language-thought relation in non-linguistic mental representations. Indeed, on the basis of the Dutch duration metaphor investigation, it is expected that lines have more influence on time

perception than circles. Still, an effect of circle size on duration estimation was reported, and it did not significantly differ to the effect of line length on duration. On the basis of frequency lists of metaphors it is possible to determine which metaphor type is more prevalent in Dutch, but it is not possible to predict exact effect sizes of space on time perception on the basis of such an analysis. Moreover, the fact that an effect of space on duration estimation (and of duration on spatial line length estimation) was found, is no irrefutable, not even direct, evidence for the existence of deep language-thought relations. It does, however, keeps open the door to this possibility.

Unlike the findings of Casasanto and Boroditsky (2008) and Casasanto (2010), it appears that Dutch speakers are, to some extent, both influenced by space values in duration estimation as well as duration values in space estimations. Not only does this finding contradict the findings of Casasanto and Boroditsky, it also poses a methodological problem for the design of the experiment. Namely, it implies that the actual value of either one of the stimulus variables cannot be correctly perceived without being influenced by the (perceived) value of the other variable. This results in a vicious circle of influence of independent variables on dependent variables. If the duration of a stimulus affects the perceived size of this stimulus, and the size of a stimulus affects the perceived duration of this stimulus, the question rises if there are any true independent variables in the experiment. Maybe, a more truthful description would be that the perceived duration of a stimulus, influences the estimation of its size and that the perceived size of a stimulus influenced the estimation of its duration. In other words, the variables are interdependent. In a subsequent study, attention might also be paid to the contribution of individual predictor values to the overall effects that were found in the present study.

6. Final remarks

At the beginning of this thesis I introduced the question to what extent and in what way linguistic metaphors about time, and specifically referring to duration, are related to the perception of duration. Of particular interest is the question whether, if there is a conceptual link between time and space, this link shows the same asymmetry that is often reported for a linguistic link between time and space. Based on CMT, it is expected that linguistic metaphors with space as source domain and time as target domain can function as predictors for a conceptual link in speakers' perception of these domains.

My study of Dutch duration metaphors revealed that, as expected on the basis of an evaluation of Casasanto's (2010) report on duration metaphors in different languages, these metaphors can be classified in three different groups: distance, size and amount metaphors. At the same time, it became clear that it is sometimes difficult to determine which expressions actually are metaphors, and whether they are specifically duration metaphors, or if they belong to another type of time metaphor. Unequivocally, Dutch most frequently exhibits distance expressions in reference to relative duration, yet these expressions appeared to be the most doubtful cases with respect to metaphoric status. Strikingly, in the psychophysical experiment carried out within the scope of this thesis, it was the 'distance stimulus type' (the line) that resulted in a bidirectional effect between space and time, with a relatively equal size.

Contrary to the reports of Casasanto and Boroditsky (2008), and Casasanto (2010), speakers of a language that prefers 'distance metaphors' do, thus, not necessarily show an asymmetric effect of spatial distance on duration. In that respect, my findings seem to be congruent with the hypothesis posed by ATOM that relations between domains are symmetrical. However, these findings also contradict the theory of Cai and Connell (2015) that the high acuity of perceiving space visually facilitates an effect of space on duration, and that duration only affects space if space is perceived with senses that have lower perceptual acuity. Further research is needed to disentangle these apparent contradictions.

For size metaphors, evidence from my corpus investigation was more straightforward than for distance metaphors. Dutch exhibits size metaphors, which undoubtedly use spatial terminology metaphorically for duration, but they are far less frequent than the distance expressions with *lang* and *kort*. Surprisingly, in the experiment, the circles with different sizes affected the estimation of duration in a way that was not significantly different from the way the lines affected the estimation of duration. Contrary to the conclusion of Casasanto (2010), evidence of Dutch reveals that speakers of a 'distance metaphor language', might thus be equally affected by distance as well as size in their perception of duration. In that respect, the current thesis provides evidence for ATOM rather than for CMT.

Yet, the results of the circle stimuli seem to support CMT with respect to the asymmetrical nature of the link between size and time; stimulus size did significantly affect duration estimations, but stimulus duration did not affect size estimations, unlike the effect found for lines. I can think of two plausible explanations for this. The most likely scenario in my opinion is that the estimation of circle size might have been a very easy task, easier than estimating line length. Since the contrast between the circle and the background was high, due to the circle being filled in black, several participants reported an optic illusion after disappearance of the circle: they could still see it, but in a 'contrasting colour'. This might have

facilitated a more accurate estimation of circle size, and suppressed the effect of duration. Another explanation might be that size metaphors in Dutch are perceived more as metaphors by Dutch speakers than distance metaphors are, a plausible hypothesis regarding the frequency comparisons discussed in chapter 3. The awareness of spatial size as source for durational size might have facilitated an asymmetric effect of space on time for the circles. To rule out the first possibility, in a subsequent study, a different stimulus might be designed to test the perceptual relation between size and duration. An example could be merely including the outline of a circle, without it being filled.

A last critical note towards the presented experiment concerns the way stimulus variables were interpreted in the data analysis of the experiment. Stimulus duration and stimulus space value were both treated as continuous variables, following Casasanto and Boroditsky (2008) and Casasanto (2010). Nonetheless, there are reasons to assume that treating them as categorical variables might be more apt. A continuous scale implies that intercepts between any two adjacent values on the scale are equal. Although the absolute numbers of the different duration and space values of the stimulus point towards a continuous scale, in reality it is more complex. Any effect of stimulus variables on estimations of duration and space predicted by ATOM or CMT, is based on an expected subjective interpretation of stimulus values as either small or big (or short versus long). However, it is not straightforward where participants will perceive the switch between these two extremes. Treating stimulus variables as categorical might provide more insight in this matter. Likewise, an investigation of the way people categorize various stimuli as either of small or big magnitude, might contribute to a better understanding of the data and to the improvement of the experimental design.

Altogether, evidence from Dutch neither confirms nor completely rejects assumptions based on the findings of Casasanto and Boroditsky (2008) and Casasanto (2010). Clearly there is a link between space and duration, in language as well as in perception. But with respect to the specifics of this link, I found different patterns for the estimation of space and duration by Dutch speakers than Bottini and Casasanto (2005) reported for Dutch. Likewise, based on the classification of both languages as distance languages, speakers of English and Dutch are expected to exhibit a similar influence of space on duration. Yet, though the presented experiment was methodologically highly similar to the experiments with which Casasanto and Boroditsky (2008) and Casasanto (2010) tested speakers of English, I found rather different patterns for Dutch. I believe further research is needed before the present findings, both my own and the findings of the reviewed studies, can be used as evidence in favour of the existence of deep language-thought relations between space and time.

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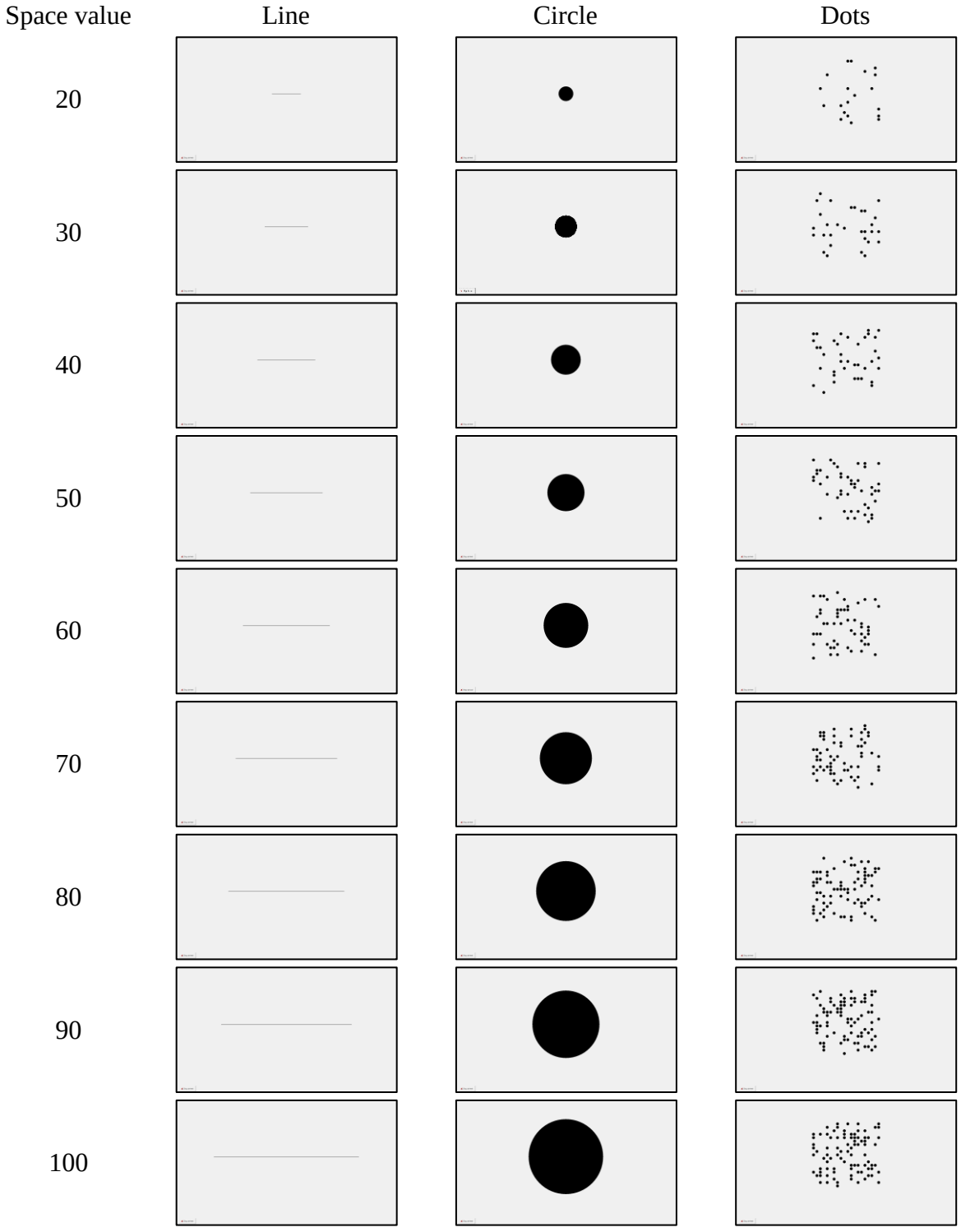
Appendix I: Growing rates

Stimuli displacement:duration combinations from Casasanto and Boroditsky (2008), sorted according to growing rate (smallest to largest). Growing rates are rounded off to pixels per second.

Displacement (pixels)	Duration (milliseconds)	Growing rate (pixels/second)
200	5000	**40**
200	4500	**44**
200	4000	**50**
275	5000	**55**
200	3500	**57**
275	4500	**61**
200	3000	**67**
275	4000	**69**
350	5000	**70**
350	4500	**78**
275	3500	**79**
200	2500	**80**
425	5000	**85**
350	4000	**88**
275	3000	**92**
425	4500	**94**
200	2000	**100**
350	3500	**100**
500	5000	**100**
425	4000	**106**
275	2500	**110**
500	4500	**111**
575	5000	**115**
350	3000	**117**
425	3500	**121**
500	4000	**125**
575	4500	**128**
650	5000	**130**
200	1500	**133**
275	2000	**138**
350	2500	**140**
425	3000	**142**
500	3500	**143**
575	4000	**144**
650	4500	**144**
725	5000	**145**
800	5000	**160**
725	4500	**161**
650	4000	**163**
575	3500	**164**
500	3000	**167**
425	2500	**170**
350	2000	**175**
800	4500	**178**
725	4000	**181**
275	1500	**183**
650	3500	**186**
575	3000	**192**
200	1000	**200**
500	2500	**200**
800	4000	**200**
725	3500	**207**
425	2000	**213**
650	3000	**217**
800	3500	**229**
575	2500	**230**
350	1500	**233**
725	3000	**242**
500	2000	**250**
650	2500	**260**
800	3000	**267**
275	1000	**275**
425	1500	**283**
575	2000	**288**
725	2500	**290**
800	2500	**320**
650	2000	**325**
500	1500	**333**
350	1000	**350**
725	2000	**363**
575	1500	**383**
800	2000	**400**
425	1000	**425**
650	1500	**433**
725	1500	**483**
500	1000	**500**
800	1500	**533**
575	1000	**575**
650	1000	**650**
725	1000	**725**
800	1000	**800**

Appendix II: All stimuli



This table displays minimized screenshots from the experiment of all space values for all three stimulus types. Stimuli of the same type with the same space value (but another duration) were exactly the same throughout the experiment except for the dots. For the amounts of dots, the place of each individual dot differed at random in different instances of the same space value. Thus, pictures of lines and circles represent exact stimuli, but pictures of dots are illustrations of possible stimuli. Borders are added and represent the edge of the monitor, since stimuli covered up the complete screen.

Appendix III: Introduction experiment

Translation:

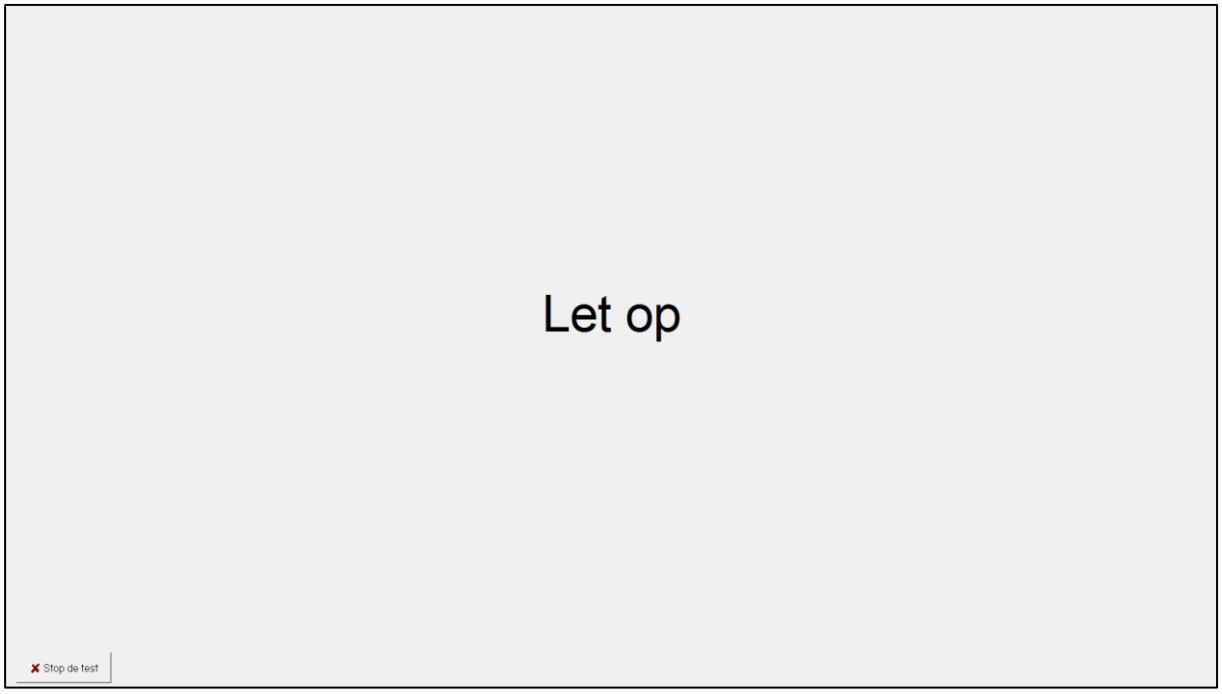
Welcome!

This experiment is an estimation-test. You are going to look at different screens on which for a certain duration a certain figure will be displayed. After each screen, estimate the duration during which you saw the figure. This is done by clicking the button 'start time'. This button changes into a 'stop'- button as soon as the timing is started. To stop the timing, click the 'stop' button. Subsequently, estimate the figure that you saw, by moving the scrollbar at the bottom of the screen in such a way that the figure on the screen matches the figure you saw. Pay attention! The place of the figure/figures on the screen is not relevant! For example, when you saw a particular number of dots, the place of individual dots is not relevant in the estimation, it is about the number. When you click 'Next', your response will be registered. The program will automatically go on to the next screen. Before a new figure is presented, you will see 'Pay attention', so that you will know the experiment is continuing.

The experiment consists of six parts, between these parts, you can take a break, this will be announced. You can at any time decide to quit the experiment by clicking the 'Stop the test' button, it is possible to finish the test at a later moment.

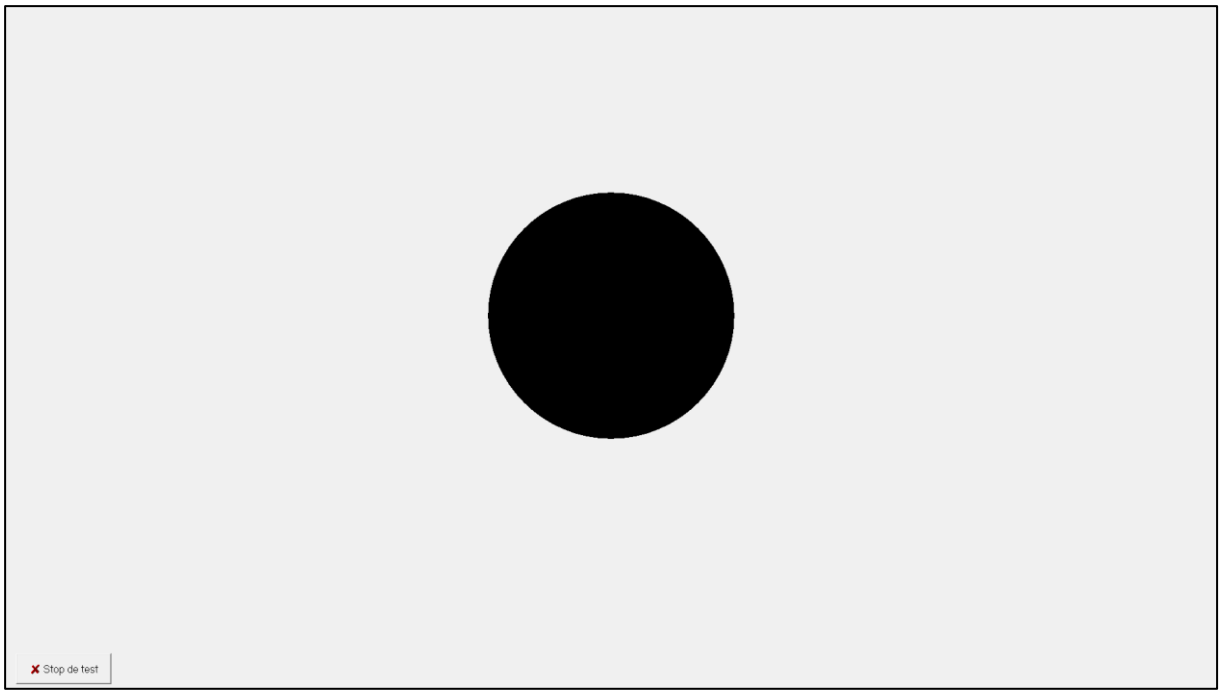
Did you carefully read this information? If so, click 'Next' to start.

Appendix IV: Screenshots of stimulus procedure

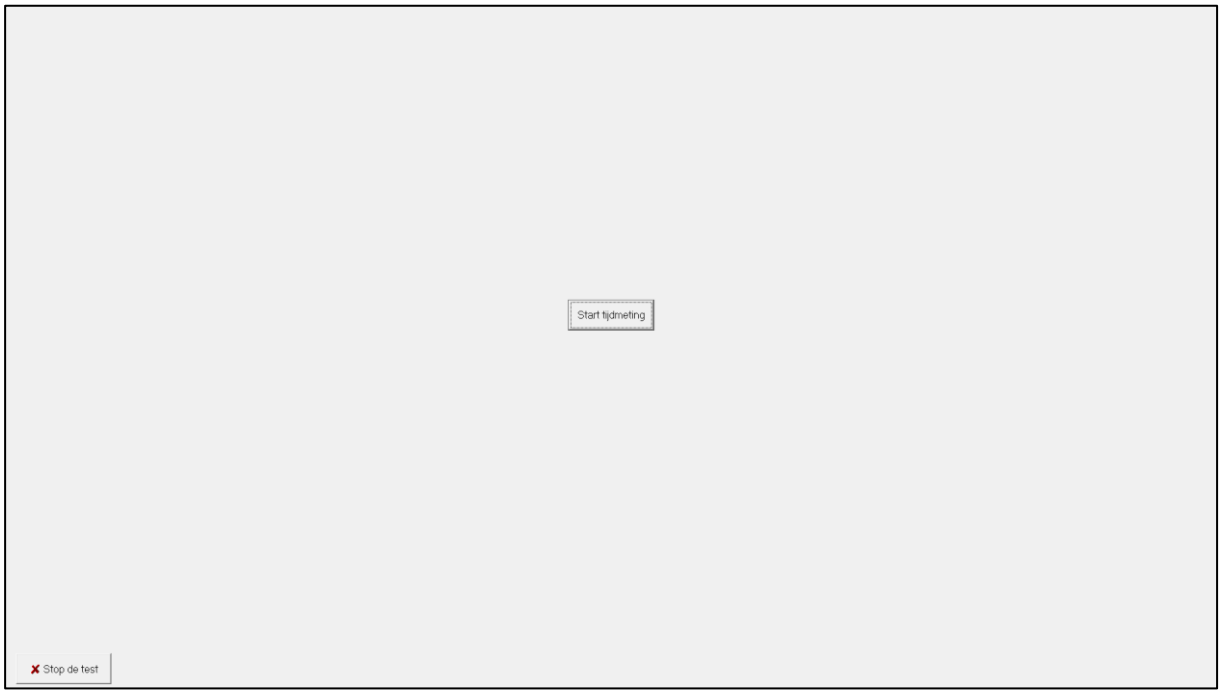


Attractor

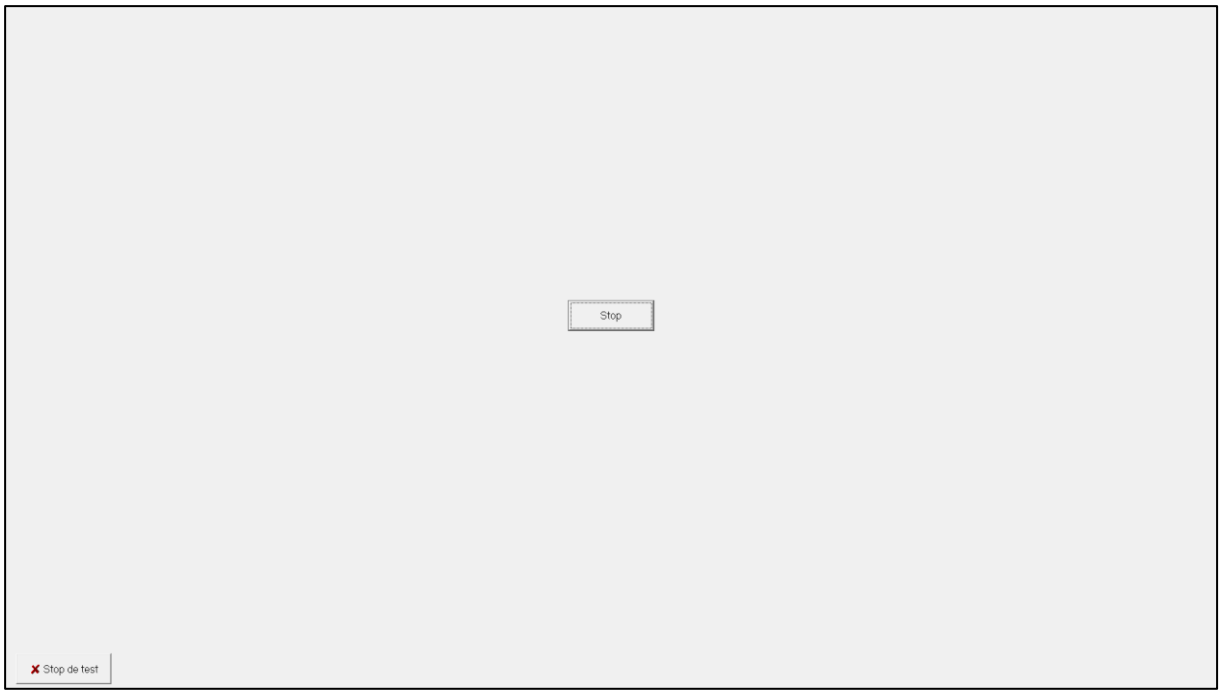
Empty screen



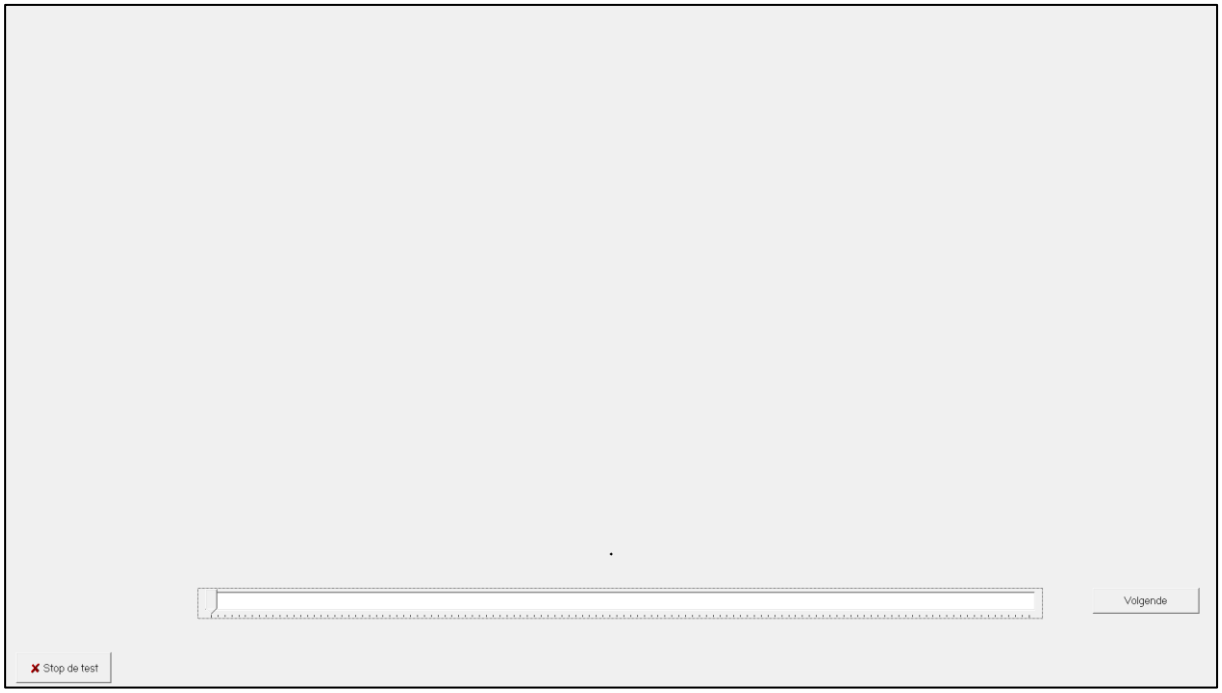
Stimulus presentation



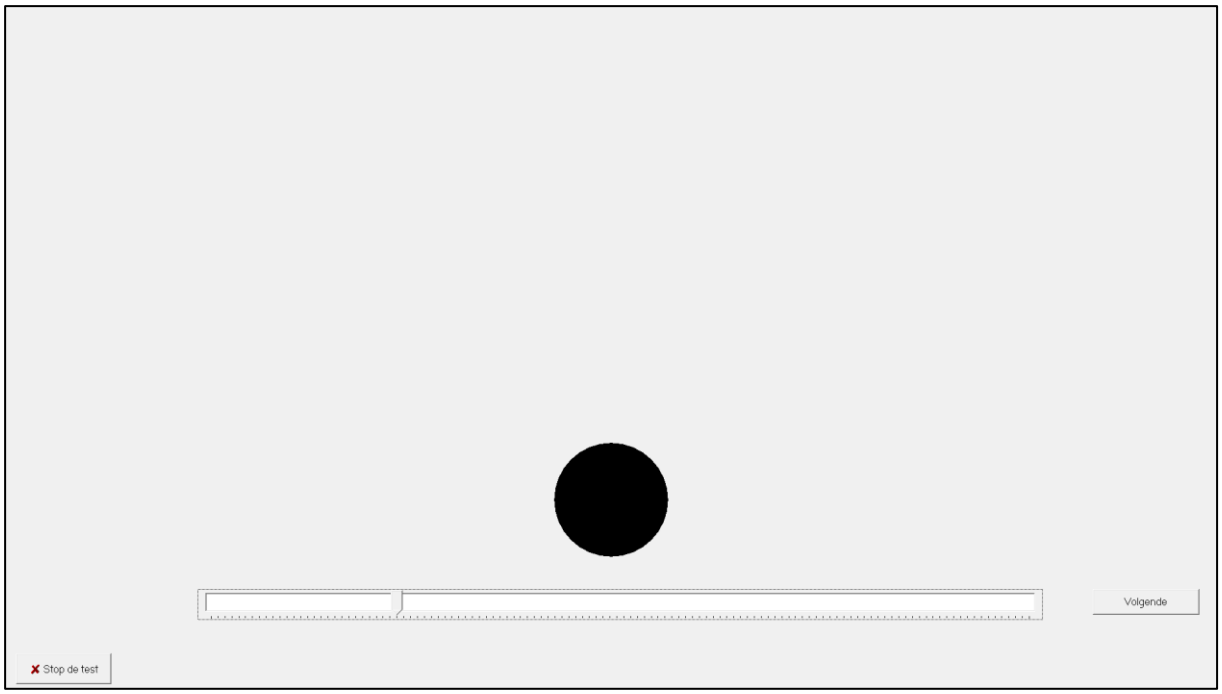
Duration estimation: start



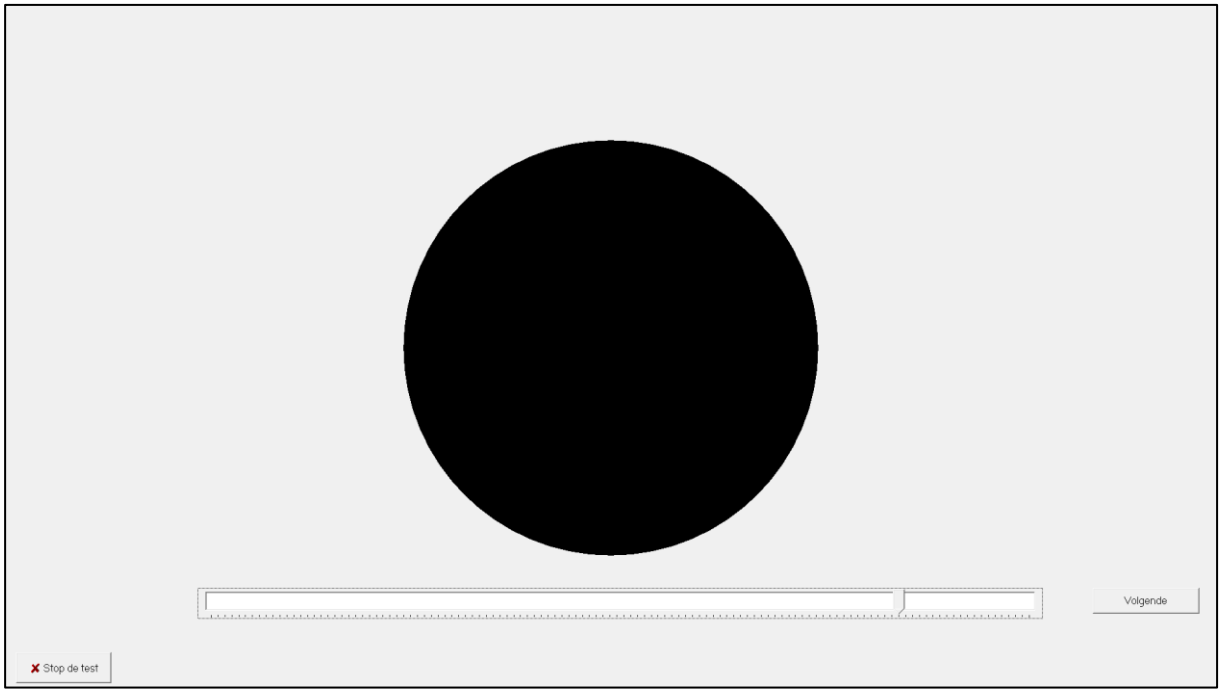
Duration estimation: stop



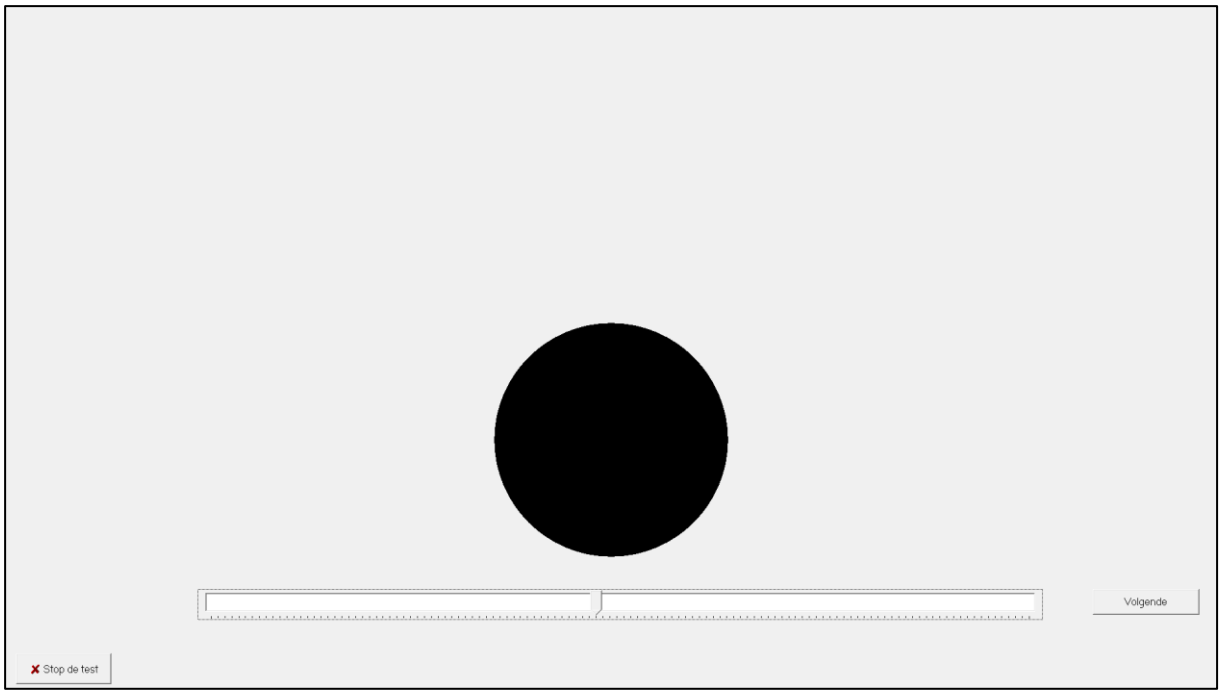
Space estimation: start



Space estimation: slider left



Space estimation: slider right



Space estimation: response