Dimensional spatial relations in adult language acquisition

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0. Introduction

This paper focuses on the way spatial concepts are expressed in the early second language (L2) development of adults acquiring Dutch. In particular, research results are presented on the acquisition of linguistic means for referring to dimensional spatial relations which include the vertical axis (*boven/beneden*, 'above'/'below'), the lateral axis (*links/rechts*, 'left'/'right') and the transversal axis (*voor/achter*, 'in front of'/'behind'). The data come from a longitudinal database on two Moroccan and two Turkish learners who acquired Dutch primarily in social interaction with native speakers. The main objective of this paper is to determine which dimensional concepts are expressed through which linguistic means in initial L2 learner varieties, and how these linguistic means are acquired over time. The Dutch results are compared with the acquisition patterns found in Carroll and Becker (1993) whose study focused on the L2 development of learners of English, French and German. Both our study and the study of Carroll and Becker use the data on spontaneous second language acquisition which were collected within the framework of an international European Science Foundation (ESF) project on adult language acquisition in everyday communication (see Perdue 1984, Feldweg 1991 and Perdue 1993).

1. Establishing reference to dimensional relations

Reference to perceptual space can be established by referring to either a spatial state (location) or a spatial change (motion/direction) (see Klein 1986). In structuring spatial states and spatial changes, languages have different means which allow descriptions of spatial relations at various levels of specificity (see Carroll and Becker 1993). The linguistic means range from a mere denotation of the space at the relatum, without further specification of the exact location, to the use of a system of coordinate axes. Two types of spatial structures have to be distinguished here: topological spaces and dimensional spaces. Topological relationships include an INNER space, an EXTERIOR space, a space at the dividing line between those two spaces, the BOUNDARY space, and a NEIGHBOURING space (see Carroll and Becker 1993 and Extra and Van Hout 1993). Dimensional relationships provide a more elaborate spatial structure which is linked to a viewpoint (Carroll and Becker 1993). This spatial structure consists of three axes

with opposite sides which project from a zero point (origo) along three dimensions, one on the vertical and two on the horizontal plane. These dimensions can be referred to as the vertical axis (top/bottom), the lateral axis (left/right) and the transversal axis (front/back).

Although these axes are determined by properties of the viewpoint and the origo (dimensional relations are therefore often called projective relations), the vertical axis is a rather fixed point of reference since it is derived from the line of gravitational force. However, this axis also corresponds to the head-to-toe axis of the speaker/hearer (Carroll and Becker 1993). The lateral and transversal axes are defined relative to an entity with opposing sides, prototypically the speaker/hearer. The transversal axis is defined by asymmetrical features such as the line of vision or typical line of motion. No such visible asymmetry is found with the lateral axis which is divided into a left and right side by convention.

In this paper, dimensional relations are studied which can be used in referring to location (e.g., *de lift is beneden* 'the elevator is down') and direction (e.g., *hij gaat naar boven* 'he is going up'). The Dutch word classes into which dimensional concepts expressing location and direction are mapped consist of adverbs and prepositions. A taxonomy of the most obvious linguistic devices in Dutch for expressing dimensional relations is given in Table 1. Two types of directional relations have to be distinguished (see Klein 1991): (1) goal-oriented direction, motion towards a given point; and (2) source-oriented direction, motion from a given point. Given the devices in Table 1, one may claim that for expressing location in Dutch, the transversal axis is mainly established by means of prepositions and the vertical and lateral axes by means of adverbs. As Table 1 shows, the basic locative adverbs are simple lexemes in Dutch; directional adverbs/adverbial phrases, however, have a composite structure (e.g., *naar boven* 'up(wards)', *linksaf* 'to the left').

2. Order of development

In their analysis of adult learners of English, French and German Carroll and Becker (1993) focus on the acquisition of linguistic means expressing location. To a lesser extent, devices indicating direction were investigated; they only dealt with dimensional devices as far as locative expressions were concerned. Moreover, only locative dimensional relations expressed by prepositions were studied. In this study we aim at giving a description of the acquisition of dimensional means expressing both location and direction by means of adverbs and prepositions in L2 Dutch.

Table 1. Taxonomy of the main linguistic devices expressing dimensional relations in standard Dutch

location		preposition	adverb
vertical		boven 'above' beneden, onder 'below'	boven 'above' beneden 'below'
lateral		(links van) (rechts van)	links 'left' rechts 'right'
transversal		voor 'in front of' achter 'behind'	voor(–) (e.g., voorin 'in front') achter(–) (e.g., achterop 'behind')
direction		preposition	adverb
goal	vertical		naar boven 'up(wards)' naar beneden 'downwards'
	lateral		naar links, linksaf 'to the left' naar rechts, rechtsaf 'to the right'
	transversal		naar voren, vooruit 'forwards' naar achteren, achteruit 'backwards'
source	vertical		van boven/van beneden
	lateral		van links/van rechts
	transversal		van voren/van achteren

Carroll and Becker (1993) conclude that their adult L2 learners develop devices to express direction before location. In referring to direction, learners encode topological as well as dimensional meanings. In the early stages, the basic system of reference to location is more restricted than reference to direction. In the locative system topological relations emerge and develop before dimensional relations. With respect to topological relations, INNER space is acquired before location at BOUNDARY space. On the basis of their results, Carroll and Becker draw the conclusion that the intake of spatial forms and their grammatical organization is, for the most part, target language (TL) dominated. In referring to direction, for example, L2 learners of French start with forms derived from verbs (Romance languages typically encode direction into the verb stem) and learners of German and Dutch initially use verb particles or prepositions (in Germanic languages the expression of direction is left to 'satellite' particles or verb-external means) (see Talmy 1985 and Becker et al. 1988).

As for locative dimensional relations, a specific order is claimed by Carroll and Becker (1993) for the L2 acquisition of German: verticality is expressed first and linguistic means expressing the lateral axis appear before means indicating the transversal axis. They put forward two arguments to explain this acquisition order. First, the vertical axis is the most stable one (fixed point of reference, gravitational force). Secondly, the use of the lateral and transversal axes implies a shift from an object-based spatial system to a system of variable and changing viewpoints. Using lateral and transversal devices will require more attention on

the learner's part to what holds as front/back or left/right in relation to either speaker or hearer.

The Dutch system of spatial reference is similar to German, which would mean that the L2 Dutch learners have similar patterns of acquisition of spatial devices. In Section 3, we will discuss the informants and the database used. Section 4 discusses the results obtained. First, we present findings on acquiring spatial reference in general (Subsection 4.1) followed by our findings in the domain of dimensional spatial relations (Subsection 4.2). In Section 5, some concluding remarks are made.

3. Informants and database

Key informants in the present study are four adult learners of Dutch: Ergün and Mahmut, two Turkish men, and Fatima and Mohamed, a Moroccan woman and man respectively. At the start of the data collection, the socio-biographical profile of the informants was as follows. They were between 18 and 30 years of age, had legal status, no native target-language spouse and no children of school age. Their level of education was limited, their proficiency in Dutch was very low and no tuition was received. The informants were monolingual and at the time of the first recording had lived in the Netherlands between 7 and 12 months (for more detailed information see Broeder 1991 and Perdue 1993). The informants were followed and recorded in a variety of language activities for approximately two and a half years at monthly intervals. In all, three similar cycles of nine monthly encounters or sessions took place.

4. Results

The findings discussed in 4.1 are drawn from previous studies (Broeder et al. 1985, Schenning 1991, Extra et al. 1992, Extra and Van Hout 1993); the findings discussed relate to cycle 1. The analyses in 4.2 are based on all sessions (9) of all cycles (3). For each informant all 27 sessions were scanned on potentially dimensional linguistic means.

4.1 Previous results. An overview of the main spatial devices used by our four informants for expressing motion, direction and location is given in Table 2. The database used for direction and location consists of the odd sessions (5) of cycle 1 (given the rather limited database of Fatima, all her sessions (9) in cycle 1 were scanned for reference to these concepts). For the distribution of motion verbs, a larger database derived from all nine sessions of cycle 1 was used (all four informants). For direction and location NPs, zero-markings are included in the table

(∅); a zero-marking means that the relatum is mentioned, but that no preposition (or other element) is used to specify or mark the spatial relation.

Table 2. Linguistic devices expressing motion, direction and location in initial L2 learner varieties of Dutch (cycle 1) and their frequencies of occurrence

	Fatima		Mohamed		Ergün		Mahmut	
motion verbs	komen	60	komen	88	komen	120	komen	67
	lopen	20	lopen	12	lopen	12	lopen	7
			gaan	90	gaan	82	gaan	4
direction NPs	∅	9			∅	18	∅	14
(goal)	naar	19	naar	17	naar	1		
	naar-met	6	met	2	(gaan-naar)	(18)		
	met	2	naar...voor	1				
	naar-van	5						
	van	1						
location NPs	∅	8			∅	17	∅	16
(inner space)	van	9	in	9	in	2	in	1
	met	7	bij	4	met	1		

Table 2 shows that all four informants use motion verbs and that they all use forms of the verbs *komen* 'come' and *lopen* 'walk' to express motion events; only Fatima has not acquired the verb of motion *gaan* 'go' yet (see Schenning 1991, Extra et al. 1992, Extra and Van Hout 1993). Extra and Van Hout (1993) found that goal-oriented direction precedes source-oriented direction. A list of the goal-oriented devices found in cycle 1 is given under the heading of direction NPs in Table 2. The table clearly shows that the Moroccan informants often use prepositions; the Turkish informants chiefly use zero-markings, which means that they do not mark at all the directional element on the NP. The Turkish informant Ergün seems to use the preposition *naar* 'towards'/'to' frequently, but he uses it only in combination with the motion verb *gaan* 'go' as a formulaic expression in which the direction marker cannot be interpreted as a spatial preposition (see Extra and Van Hout 1993).

In Table 2, only INNER space NPs have been included as locative topological devices because explicit reference to INNER space emerges before other topological spatial relations in the initial stages of the acquisition process (see Carroll and Becker 1993 and Extra and Van Hout 1993). Verbs of location are almost absent in the initial acquisition process of Dutch as an L2 (see Extra et al. 1992); reference to location is primarily established by means of NPs. In referring to location, the same preference of the Turkish informants for zero-markings as with respect to direction can be observed.

The Moroccan informant Fatima frequently uses the prepositions *van* 'of'/'from' or *met* 'with' in referring to direction (goal) and location (INNER space), although these prepositions cannot have these spatial meanings in Dutch.

She even combines different prepositions into innovative collocations like *naar-met* 'to-with' and *naar-van* 'to-from'. Fatima's (FA) preference for the non-spatial preposition *met* 'with' in a spatial context, in spite of the fact that the input utterance of the native speaker (NS) contains the right target form, can be illustrated by (1a) for reference to location (session 1.9) and by (1b) for reference to direction (session 3.4):

(1) a NS   waar? in Marokko of Nederland? 'where? in Morocco or the NL?'
        FA   nee met Marokko 'no with Morocco'
     b NS   moet je niet naar een dokter? 'should you not go to a doctor?'
        FA   misschien ik ga met dokter 'maybe I go with doctor'

All in all, the Dutch data on spatial reference in cycle 1 corroborate the conclusion of Carroll and Becker (1993) that linguistic means expressing direction (motion verbs and direction NPs) precede means expressing location (location NPs, no locative verbs), of which INNER space is acquired before BOUNDARY space (see Section 2).

However, although they acquire the same TL, the Moroccan informants show another pattern than the Turkish learners in using linguistic devices for referring to the goal-direction concept. The Turkish informants, from the very beginning, use verbal forms for expressing motion/direction and if they use NPs indicating direction these are bare NPs (without a preposition); the Moroccan informants use verbal forms as well as prepositions to refer to the directional component of a motion event. Although Carroll and Becker (1993) conclude that the way direction is expressed depends on the organization of the TL in question, these different patterns show that the TL organization is not the only factor in early L2 acquisition of spatial reference. We will return to the role of the source language in Section 5.

4.2 Reference to dimensional relations. In Table 3, the main potential linguistic devices used by the Turkish and Moroccan learners of Dutch to refer to the three dimensions are presented; the actual spatial use is indicated between brackets.

Table 3 shows that, especially, the form *voor* has been used frequently in a non-spatial context, as for example in temporal expressions (*kwart voor tien* 'a quarter to ten'). The Moroccan informant Fatima has not used *voor* in any spatial meaning at all; she uses alternative linguistic means to refer to both the front and back dimension of the transversal axis (the form *achter* 'behind' does not appear up to cycle 3). This is illustrated by example (2) from session 2.9:

(2)   NS   en dan gaat ie <die kant uit> <gestures backwards>
              'and then goes he <that side from> <gestures backwards>'
        FA   moet <die kant> <gestures forward> niet uh terug met uh
              'must <that side> <gestures forward> not er back with er'

Table 3. Overview of potential linguistic devices expressing dimensional relations (cycle 1-3); actual spatial use is given between brackets

	Fatima		Mohamed		Ergün		Mahmut	
Transversal axis								
voor 'in front of'	126	(–)	345	(29)	80	(22)	136	(98)
achter 'behind'	9	(9)	85	(79)	75	(70)	84	(78)
Vertical axis								
boven 'above'	14	(12)	19	(18)	19	(19)	46	(46)
beneden 'below'	8	(6)	5	(5)	17	(17)	9	(9)
onder 'under'	–	(–)	17	(16)	3	(3)	30	(30)
Lateral axis								
links 'left'	42	(41)	76	(76)	72	(72)	69	(69)
rechts 'right'	16	(16)	66	(63)	89	(88)	95	(90)

The front dimension expressed by means of the NP *die kant* 'that side' and the appropriate gesture by Fatima contrasts with the particle *terug* 'back' which together with the non-spatial preposition *met* 'with' indicates direction backwards.

The most important conclusion to be drawn from Table 3 is that, taken over three cycles, all four informants use linguistic devices to refer to each of the three dimensions (with the exception of *voor* for Fatima). An overview of the sessions in which specific dimensional linguistic devices occur for the first time with a spatial meaning is given in Table 4.

The data in Table 4 on the three dimensions contradict the order found by Carroll and Becker (1993) for L2 German learners. The Dutch informants already refer to the three dimensional axes in cycle 1 and there is no general order of acquisition. Only for Fatima (transversal axis later) and Ergün (lateral axis later) can traces of some order of acquisition be claimed to exist.

The most conspicuous result in Table 4 is the order of acquisition within the dimensions, an aspect not mentioned in Carroll and Becker (1993) at all. It can be inferred from Table 4 that linguistic devices to refer to the back dimension of the transversal axis (*achter* 'behind') are used before devices to refer to the opposite dimension (*voor* 'in front of'). In dimensional devices indicating the vertical axis, the order found is top before bottom. No internal order comes out for the lateral dimension. Some form of markedness may account for the acquisition order of the opposite dimensions of the transversal and vertical axis. Reference to the front and bottom dimensions respectively can be seen as the unmarked option: the front or bottom dimension is automatically intended if no explicit reference is being made to the transversal or vertical axis. This effect may be strengthened by

assuming that the form *voor* is less transparent because it may be used for non-spatial relations. The fact that the lateral axis does not produce an internal acquisition order may be accounted for by the absence of any argument to relate one of the two sides to a markedness or transparency factor.

Table 4. First occurrence of dimensional devices expressing spatial meaning aspects (session number is given between brackets)

		cycle 1		cycle 2		cycle 3	
Fatima	vertical	boven	(1.8)				
		beneden	(1.9)				
	lateral	links	(1.9)			rechts	(3.8)
	transversal					achter	(3.2)
Mohamed	vertical	boven, onder	(1.9)	beneden	(2.9)		
	lateral	links, rechts	(1.6)				
	transversal	achter	(1.3)				
		voor	(1.6)				
Ergün	vertical	boven	(1.2)	onder	(2.7)		
				beneden	(2.8)		
	lateral			links, rechts	(2.7)		
	transversal	achter	(1.2)	voor	(2.9)		
Mahmut	vertical	boven	(1.2)				
		beneden	(1.7)				
		onder	(1.9)				
	lateral	links, rechts	(1.8)				
	transversal	achter, voor	(1.3)				

We have to be careful, however, in drawing the conclusion that no specific order of acquisition exists between the three axes. The data presented are rather global and it is possible that such a global approach has blurred underlying patterns of acquisition. Further aspects of the data have to be taken into account. An important factor may be the type of word class a spatial element belongs to.

In Table 5, the spatially used dimensional devices are split up according to their word class. Three categories have been distinguished: (1) prepositional groups; (2) adverbs; and (3) a 'rest' category of forms for which the word class could not be determined unambiguously. In Dutch, reference to the vertical and lateral dimensional axes is mainly established by adverbs. For expressing the transversal axis, the following distinction must be made: prepositions in case of location and adverbs in case of direction. Table 5 shows that, for all informants, the category of adverbs dominates in referring to the vertical and lateral axes. In marking the transversal axis, the Moroccan informants use PPs as well as adverbs whereas the Turkish informants predominantly rely on the category of adverbs.

This corresponds with our earlier findings that the Turkish informants rarely use prepositions in establishing spatial relations (see Subsection 4.1).

Table 5. Word class categories of the dimensional devices (cycle 1-3)

	Fatima			*Mohamed*			*Ergün*			*Mahmut*		
	PP	adv	rest	PP	adv	rest	PP	adv	rest	PP	adv	rest
Transversal												
voor	–	–	–	11	15	3	5	16	1	6	81	11
achter	4	4	1	48	31	–	4	54	12	3	65	10
Vertical												
boven	–	11	1	–	17	1	–	17	2	–	42	4
beneden	–	6	–	–	5	–	–	16	1	–	9	–
onder	–	–	–	14	2	–	1	2	–	1	16	13
Lateral												
links	–	41	–	–	73	3	–	70	2	–	63	6
rechts	–	15	1	–	56	7	–	83	5	–	79	11

Even if only the PP occurrences in Table 5 were taken into account in the analysis, the dimensional order of acquisition is still not the one found by Carroll and Becker (1993). In addition, the results in Table 5 make clear that the study of dimensional spatial relations should not be confined to prepositional phrases.

A second aspect to be investigated in more detail is the location-direction distinction. Table 6 gives an overview of the various forms used by the learners in referring to locative and directional relations expressing the transversal axis. Table 6 shows that locative dimensional means appear before directional dimensional means. All informants start with expressing locative transversal relations by means of the unmarked forms *voor* 'in front of' and *achter* 'behind'. In later stages of the acquisition process, references to transversal directions show up; the informants use both locative and directional forms to refer to directional relations of the transversal axis. Finally, Table 6 shows that, in contrast to the Turkish informants, the Moroccan informants never use complex adverbs when expressing location (e.g., *voorin* 'in front').

A third aspect we investigated in more detail is the expression of so-called sub-spaces. English has a number of devices to refer to the three dimensional axes which have a motivated form-function relation which facilitates the acquisition process (see Johnston and Slobin 1979). It has a transparent system of dimensional reference based on inherent parts of the INNER space of the relatum (e.g., at the top/bottom/front/back of). Spaces beyond the outer boundary of the relatum do not have this transparency with the consequence that means expressing EXTERIOR spaces (over/above/below) appear later in the acquisition process (see Carroll and Becker 1993).

Table 6. Locative and directional forms expressing the transversal axis (cycle 1-3) (session number is given between brackets)

	Fatima		Mohamed		Ergün		Mahmut	
voor 'in front of'								
location	–		voor	(1.6)	voor	(2.9)	voor	(1.3)
					vooraan	(3.9)	voorin	(1.6)
direction	–		voor	(1.6)	voor	(3.9)	voor	(1.6)
			naar voor	(2.9)			vooruit	(1.9)
			voort	(3.6)			voor	(2.9)
achter 'behind'								
location	achter	(3.2)	achter	(1.3)	achter	(1.2)	achter	(1.3)
					achteren	(1.3)	achterin	(1.9)
					achterop	(1.9)		
					achteraan	(2.3)		
					achterin	(2.4)		
direction	achter	(3.9)	achter	(1.9)	naar achter	(3.9)	achter	(1.6)
	achter-met	(3.9)	achteruit	(1.9)	achteraan	(3.9)	achteraan	(3.9)
			naar achter	(2.9)			achteruit	(3.9)

In Dutch and German, linguistic devices to express inner locative dimensional relations are composed in a less transparent way; similar forms are used to denote divisions for INNER and EXTERIOR space (*boven op het huis* 'on top of the house' versus *boven het huis* 'above the house'). Nevertheless, it is possible that learners of Dutch start with expressing inner sub-spaces. It turns out, however, that reference to inner sub-spaces is very rare in the Dutch data. It is practically absent in the Turkish data; although rather late in the acquisition process (first occurrence is in session 2.9), the Moroccan informants do sometimes mark sub-spaces. In example (3), which comes from Mohamed (session 3.5), the preposition *in* 'in' plus relatum specifies the sub-space defined by the adverb *achter* 'behind'.

(3)   achter in de auto 'in the back of the car'

5. Conclusions and discussion

The Dutch data on the acquisition of spatial reference corroborate the conclusion of Carroll and Becker (1993) that in adult language acquisition linguistic means expressing direction precede means expressing topological location of which INNER space is acquired before BOUNDARY space. This pattern can be seen as rather universal, in the sense that it has been observed in a variety of source and target languages combinations.

The acquisition of linguistic means to refer to spatial dimensional relations has a pattern in L2 Dutch that contradicts the developmental order put forward by

Carroll and Becker (1993). First of all, it makes no sense to apply the order of direction before location to dimensional relations. Reference to dimensional direction is more complex in Dutch, and, consequently, all learners start with location in the dimensional spatial domain. The order of acquisition formulated by Carroll an Becker (1993) goes from vertical to lateral to transversal. No evidence is found in the Dutch data for this order. On the contrary, the data indicate the absence of any order. Given the fact that we deal with cognitive mature language learners, we do not see by which argument it can be predicted that learners should have specific preferences for starting with one of the three dimensional axes involved. Moreover, linguistic means of one dimension can hardly be overgeneralized to express other dimensions. Although Dutch is less transparent than, for example, English in linguistic devices expressing dimensional relations, forms of all three axes are present early in the process of acquisition; more specific forms, like for example specifications of inner sub-spaces, appear later in the acquisition process. It is important to note that this early occurrence can only be found when not only prepositional phrases are taken into account but also adverbs. The development of dimensional relations seems to be quite independent of the development of topological relations. If any order pattern is present in the Dutch data, it is an order of acquisition within the dimensions distinguished ('behind' before 'in front of', 'top' before 'bottom').

Another question is at what point have our learners fully mastered all semantic and pragmatic details of the dimensional linguistic means. For instance, in the appropriate use of the transversal elements *voor* 'in front of' and *achter* 'behind', inherent properties of the object referred to and the viewpoint play a decisive role. This acquisitional aspect will have to be investigated in more detail. Given the complexity of the projective properties of the transversal dimensional linguistic means in Dutch, it is fairly plausible that the acquisition of these means will be completed only rather late.

Although Carroll and Becker (1993) only attribute a modest role to the source language (SL) in the order of L2 acquisition of spatial reference, the Moroccan informants show a different distribution pattern than the Turkish informants. Acquiring the same target language (TL), Dutch, the Moroccan informants have a strong preference for using prepositions in referring to location and direction whereas the Turkish learners use zero-markings (bare NPs) or, to a greater extent, make use of adverbs. Furthermore, the Moroccan informants specify sub-spaces defined by adverbs by means of a preposition plus relatum whereas the marking of sub-spaces is almost absent in the language use of the Turkish informants. These differences can be explained by the fact that both Moroccan-Arabic and Dutch make use of obligatory morphemes of direction or location preposed to the NP; in Turkish, direction or location NPs are never marked by prepositions (see Extra and Van Hout 1993). Instead, three different case suffixes are used for expressing different spatial orientations (see Lewis 1975 and Bastuji 1976). For more specific spatial orientations, a special class of postpositional phrases is

available in Turkish. The frequent non-use of prepositions by the Turkish informants can be taken as indicative of SL influence (see Extra and Van Hout 1993). Consequently, whereas prepositions used by the Moroccan informants are followed by a relatum, the Turkish informants to a lesser extent express the relatum when referring to spatial relations. This seems to imply that Turkish learners have to look for ways of expression beyond the strict utterance level to indicate the relatum. This means that we have to study in more detail the way discourse is organized in adult language acquisition of spatial relations.

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