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Spatial inflection and memory for direction in Acazulco Otomí

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Abstract

Many languages have developed a specialized tool for coding spatial background aspects of events: *associated motion* morphology (Guillaume 2016). This sparsely investigated verb inflection allows speakers to specify that the situation described by a verb takes place against the background of a motion event, as in ‘sing (while coming)’. Associated-motion systems typically include deictic information, and when verb inflection requires distinctions between motion in different directions, a *thinking-for-speaking* account (Slobin 2003) would predict cognitive consequences in the shape of heightened memory for direction. To evaluate this hypothesis, we compare encoding of and memory for direction in an endangered Otopamean language, Acazulco Otomí (Mexico). First, we examine diversity and frequency in the use of associated-motion inflection in pilgrim narratives. Then, we investigate the potential cognitive correlates with a psycholinguistic recognition-memory experiment measuring change-detection performance. Linguistic encoding of background direction was found to support memory for direction, but the sample size was small, and the experiment further indicated that both the associated-motion inflection and its corresponding attention patterns are in a process of dissolution. This echoes findings in Arrernte (Wilkins 2006) and Mojeño Trinitario (Rose 2015), and we discuss why associated motion might be an especially vulnerable category in language-endangerment contexts.

1. Introduction

While crosslinguistic variation in many aspects of spatial language has been extensively investigated (Levinson and Wilkins 2006), a phenomenon that has only recently come to attention is a special type of spatial verb morphology: associated motion. Associated motion morphemes specify that the main event designated by the verb is accompanied by a spatially oriented motion event, as in (1), where the associated motion prefix *ar-* signals that the foreground event of throwing candy takes place against a translocative background event of moving in another direction than towards the deictic centre.

(1) Acazolco Otomí (Mexico)¹

ar-’éhpi

3.REAL.IPFV.TRL-throw

‘He is throwing (while going).’

In recent years, it has become clear that associated motion systems are not crosslinguistically rare, but can be found in languages all over the world, with particularly high density in the Amazon and in Australia (Guillaume 2016; Wilkins 2006). These systems typically categorize deictic contrasts (coming vs. going) and often specify the temporal relationship between the main event and the motion event. While crosslinguistic work on associated motion is still sparse, it is evident that what languages with this spatial inflection share is a pervasive tendency to present motion information as relevant background for other events, and this makes the systems interesting from a psycholinguistic point of view.

Psycholinguistic experiments in semantic typology have found effects of linguistic coding of space on speakers’ conceptualization of space also in nonverbal tasks. A particularly well-established example is the marked difference in nonverbal orientation strategies between speech communities that preferredly use cardinal axes (north-south-east-west) and those that use the human body (left-right) as anchor when communicating about small-scale location, as in *The fox is west of the hare* vs. *The fox is left of the hare* (Pederson et al. 1998). The *thinking for speaking* account explains such effects by pointing to the fact that humans spend much of their lives communicating, and since both speech production and comprehension take place at high speed, it is practical always to have conceptualized situations in ways that match the expression requirements in one’s language beforehand (Slobin 1996).

Until now, no psycholinguistic experiments have assessed the possible influence of associated motion morphology on cognition, but the expectation would be that such marking would stimulate speakers to routinize attention to spatial aspects of situations. If one’s language requires one to remember spatial aspects of an event to inflect a verb correctly, whether or not those spatial aspects are crucial to the event, it will be useful for speakers to develop cognitive strategies for paying attention to such aspects of events and for storing them for easy retrieval.

Because associated motion morphology involves such subtle and pervasive reference to space, it presents us with a privileged opportunity to study the role of spatial language in human cognition. Our main question is whether linguistic requirements to express spatial information influences speakers’ attention to and memory for spatial aspects of events, and to address this question, we study Acazolco Otomí, an Otopamean language spoken in Mexico. Spatial verb inflection is widespread in the Otopamean family (Hernández-Green 2013), but this language family has hitherto been overlooked in surveys of associated motion. In this paper, we target spatial verb morphology in Acazolco Otomí from two angles. First, we present a study of spontaneous production of associated motion prefixes in pilgrim narratives to assess how extensively and

¹ All Otomí utterances used for illustration in the examples in the introduction section are taken from the data sets in Studies 1 and 2, where speakers were either narrating journeys or describing video clips. The transcription is based on the practical orthography developed for Acazolco Otomí (see Hernández-Green 2015). Glossing follows Leipzig Glossing Rules, with the following additional glosses: CSL: cislocative, ENCL: boundary-marking enclitic, NV: not visible, REAL: realis, REG: registration of oblique argument or adjunct, TRL: translocative.

flexibly speakers use them in naturalistic contexts. Second, we investigate the potential cognitive correlates of this type of grammaticalized reference to space in a psycholinguistic experiment examining tendencies to detect subtle changes in direction in speakers with varying mastery of spatial verb morphology.

The structure of the paper is as follows: We first sketch out crosslinguistic characteristics of systems marking associated motion (1.1) and then specify which cognitive effects a *thinking for speaking* account would predict for them (1.2). In Section 2, we introduce Acazulco Otomí and its geographic and cultural context, and we sum up previous descriptions of associated motion in the language. Study 1 (Section 3) examines frequency and diversity in Acazulco Otomí speakers' use of spatial verb morphology in pilgrim narratives and considers its relationship to shared walking practices. Study 2 (Section 4) investigates by means of a psycholinguistic recognition-memory experiment whether use of associated motion morphology supports Acazulco Otomí speakers' memory for spatial background aspects of events. Finally, Section 5 sums up the findings and discusses what light they shed on linguistic influence on spatial cognition, especially in the context of language endangerment.

1.1 Grammaticalized reference to spatial background: associated motion

Crosslinguistically, languages differ not only in the types of distinctions honoured and the formal strategies for expression of space, but also in the requirements for treating situations as spatial in the first place. As seen above, one especially pervasive role for spatial notions to play in the grammar of a language is as spatial verb inflection, as in (1) above and (2) below. In languages where information about motion, direction and location is expressed as bound affixes on the verb, speakers systematically have to make decisions about these spatial characteristics of events.

(2) Cavineña (Bolivia)

senda-ju *ba-diru-kware* *beta* *dati*
path-LOC see-**while.going.back**-PST two tortoise.ABS

'I saw two tortoises in the path while I was going back.' (Guillaume 2000)

The term *Associated Motion* was introduced by Koch (1984) to categorize verb morphology in the Australian language Kaytej, and similar categories have since been identified in languages spoken all over the world, with especially high concentrations in Australia and Amazonian South America, but also in North America, Mesoamerica, Africa, Asia and Papua New Guinea (Guillaume 2016)². Guillaume (2016), who presents the most comprehensive crosslinguistic comparison to date of marking of associated motion (abbreviated as AM), offers the following working definition: "An AM marker is a grammatical morpheme that is associated with the verb and that has among its

² As suggested by a reviewer, the higher concentration of AM marking languages found in some areas may partly depend on stronger traditions for investigating and reporting AM in these areas. While this may certainly be part of the story, Guillaume's survey of South American languages shows that AM is a highly diffusible phenomenon with tendencies to spread between neighbouring languages, across language families (2016, 127). This result makes it likely that AM marking does indeed occur more frequently in certain areas, and that higher concentration in the Amazon and Australia is not just an artefact of specific research traditions. Of course, this does not preclude that other areas with widespread AM marking exist without having been reported.

possible functions the coding of translational motion” (2016, 92). In his sample of 66 South American languages, 44 languages (67%) presented AM markers, and on the level of language families, the proportion was equally impressive: AM markers were identified in 23 families out of 36 (64%).

Grammaticalized reference to background motion can thus not be classified as a rare phenomenon, and though by no means universal, it appears to have evolved in languages all over the world. Nevertheless, this type of grammar has been vastly underdescribed, and attempts to generalize over crosslinguistic findings have only recently begun. Indeed, authors working on the subject stress that “the typology of this category is under construction” (Rose 2015, 117) and “must be taken as work in progress aiming to conceptualize and account for an emerging field of investigation” (Guillaume 2016, 84).

One of the uncertainties pertaining to this category regards its relationship to marking of direction. As seen in examples (1) and (2) above, the markers in Acazulco Otomí and Cavineña do not only indicate associated motion, but also specify a path for this motion (ex. 1: going in any other direction than towards the deictic centre; ex. 2: returning to a place that is different from the deictic centre). Thus, they are not just motion markers, but simultaneously direction markers. Wilkins explicitly includes this direction component in his characterization of AM markers in Arrernte, which are “used to indicate that the verb-stem action happens against the background of a motion event with a specific orientation in space” (2006, 47). This direction component is left out of Guillaume’s (2016) working definition (above), which focuses exclusively on motion and thus accepts markers such as the set in Mojeño Trinitario (Rose 2015), which encodes associated motion with no information about direction. Both Rose (2015) and Guillaume (2016) emphasize the importance of distinguishing between directionals (which only indicate direction, not motion) and AM markers (which always indicate motion and may or may not indicate direction).

Rose suggests that behaviour with *motion verbs* can be used as a criterion for distinguishing between directionals and AM markers: directionals are primarily restricted to attaching to motion verbs, while AM markers are restricted from occurring with motion verbs (2015, 120). For some languages, such a motion-verb based criterion would work, but for others, it would not. In Arrernte, for instance, the rich set of 15 AM morphemes occurs freely with oriented motion verbs and manner-of-motion verbs and is only restricted from four deictic motion verb roots (Wilkins 2006, 41–45). How exactly the relationship between associated motion and directionals is best characterized, and whether it makes sense to draw a sharp line between them, are thus still open questions in the nascent field of associated motion studies.

When direction is coded, deictic distinctions between motion to and from the deictic centre are typically marked, but other non-deictic path information, e.g. vertical motion or point crossing, can also be conveyed. Further distinctions frequently found in AM systems are timing (prior/concurrent/subsequent motion) and shape (straight/reversive path of motion). AM systems differ as to types and amount of distinctions, but share the feature of offering speakers handy conventional tools for supplying highly precise spatial background information for events.

1.2 Thinking for speaking: grammar and cognition

Since speakers of languages with AM systematically have to make decisions about path and motion, they are likely to develop attentional routines for monitoring and remembering these dimensions of experiences. This type of effect of grammar on attention patterns is what Slobin proposes in his *thinking for speaking* account: “those event components that must be attended to in thinking for speaking must also be mentally stored for future speaking” (2003, 176). Slobin (2003) gives evidence of this effect by pointing to differential attention to manner vs. path of motion in speakers of languages where information about either manner or path predominately is coded in the main verb, and he points out two linguistic factors that reinforce attention to a specific domain: habituality and codability.

A semantic domain is seen as habitually encoded when it is encoded in grammatical constructions or obligatory lexical selections. This is the case for path and motion in languages with associated motion, as AM morphology is not restricted to communication about events with motion or path as a central point. So, a speaker of English would usually present a crying situation without direction information, but in Warumungu, a speaker would be expected to make a decision, as in (3).

(3) Warumungu (Australia)

amanya-arnpa kiwari kaki-rrapan
that.same-still child cry-**hither.PRS**

‘That same child is coming crying.’ (Simpson 2004, 298)

It is of course always possible for an English speaker to be explicit about direction also for events such as crying (e.g. *She cried on her way home/north*), but this would not be the habitual choice. Since the spatial domain is so habitually encoded in languages with associated motion, a thinking for speaking account would predict particularly stable sensitivity to spatial distinctions for speakers of these languages.

As for the second factor, codability, AM languages also score high. A domain is “codable” in Slobin’s sense if it is easy to express it, i.e. if it is coded in expressions that are “short, and/or high frequency, and generally part of a small set of options in a paradigm or small set of items” (2003, 161). Such codability is exactly what characterizes expression of space in these languages, where speakers express motion and direction by choosing single morphemes from closed paradigmatic sets of high-frequent items. And again, the high degree of codability of direction and motion would lead us to expect speakers of AM languages to pay special attention to these dimensions of events and to exhibit better memory for them than speakers of other languages would.

1.3 Research questions and hypotheses

In the present paper, we examine the intriguing and sparsely described phenomenon of spatial verb inflection from a psycholinguistic perspective, presenting two studies on Acazolco Otomí, an endangered language from the Otopamean language family (Mexico), where associated motion systems are widespread.

In Study 1, we explore which situations Acazolco Otomí speakers find it relevant to mark associated motion for and establish how systematically the inflection is used. We analyse AM morphology in narratives about pilgrimages, a central collective activity in traditional Otomí culture.

In Study 2, we turn to the relationship between language and cognition, extending central questions in the semantic typology of spatial language to spatial verb inflection. Following research in the *thinking for speaking* tradition, we hypothesize that use of AM morphology supports memory for direction. To evaluate this hypothesis of an influence from spatial grammar on spatial cognition, we conduct a psycholinguistic change-detection experiment with subjects with different levels of fluency in Otomí.

As a background for the two studies, Section 2 introduces spatial verb morphology in Acazolco Otomí after a brief presentation of the language and the community where it is spoken, San Jerónimo Acazolco.

2. Acazolco Otomí and San Jerónimo Acazolco

Acazolco Otomí (endonym: yühú) is an Otomanguean language of the Otopamean branch, and it is exclusively spoken in a single Mexican village, San Jerónimo Acazolco (endonym: Ndöngü, in daily speech and the rest of this paper: Acazolco). The number of fluent speakers has been estimated to between 100 and 200 out of a population of around 5,000 (Pharao Hansen et al. 2016), and the language is severely to critically endangered according to the UNESCO criteria, as only the great-grandparent generation, and some speakers from the grandparent generation are fluent in the language.

Acazolco Otomí is a head-marking language with split-subject alignment and complex verbal morphology, with an array of grammatical categories marked on the verb and expressed with different allomorphs in four inflectional verb classes (Hernández-Green 2015). There is no case marking, and word order is flexible with VSO order considered basic (Hernández-Green 2015). Sentence formation is highly flexible, with different strategies for allowing numerals, kinship terms, other nouns, adjectives and adverbs to function as predicates in clauses with non-verbal predication (Hernández-Green 2015).

The Frame of Reference favoured in location predications is geomorphic, with speakers employing axes in the environment as anchor when locating entities relative to each other. The most frequently used environmental axes are the *'a rígwani–'a ríthót'i* axis ('uphill'–'downhill'), which corresponds to an east-west axis, and the crossing *'a xǒntho–'a mbotǔđi* axis ('at mountain'–'where pines stand'), with Acazolco's holy protector mountain located north of the village, and the areas with pine trees south of the village (Boeg Thomsen and Pharao Hansen 2015). The geomorphic Frame of Reference and the associated motion inflection conspire to require speakers of Acazolco Otomí to pay careful attention to position in the surrounding landscape.

Acazolco is situated at an altitude of 2760 metres on an incline bordering a mountain range and a lacustrine plain in the Trans-Mexican volcanic belt. North and east of the village lie the rocky and pine-clad mountains of the Sierra de las Cruces, and to the south and the west, the village overlooks Valle de Toluca with its lakes, swamps, cornfields, small hills and extinct volcanoes. Traditionally, interaction with the surrounding landscape was central for the people of Acazolco, as their primary

subsistence patterns (cultivation of corn and agave, pastoralism, fishing, gathering of mushrooms and herbs and firewood collection) all depended on it. The traditional form of travelling to other communities was on foot. A small group of muleteers travelled for commercial purposes, crossing a mountain range to go Mexico City in the east or descending south into the lowlands with tropical climate, 1100 metres below. While only a small subset of the population participated in these trade journeys, collective ritual walking practices united the whole community in annual multi-day pilgrimages to sanctuaries far away, most importantly to Chalma (elevation: 1650 metres) in the hot lowlands. While the introduction of cars in the middle of the 20th century put an end to all travel on foot for practical purposes such as commerce, the ritual walking practices are very much alive, with all age groups participating in both pilgrimages and processions.



Figure 1: Pilgrimage from Acazulco to Chalma 2013.

2.1 Associated motion in Acazulco Otomí

Spatial verb inflection systems are widespread in the Otopamean family, but the specific categories they present differ. Often, the systems contrast translocative and cislocative motion, but others mark AM without direction, and some include location (Hernández-Green 2013). The system of AM marking in Acazulco Otomí has been described by Hernández-Green (2015), who characterizes it as a system with a primary distinction between cislocative motion (towards the deictic centre) and translocative motion (in any other direction). This distinction is marked in portmanteau prefixes that fuse aspect, mood, person and associated motion, as in (4), where the prefix *ba-* fuses person (3rd person), mood (realis), aspect (imperfective) and associated motion (cislocative), and in (5), where the prefix *ar-* fuses person (3rd person), mood (realis), aspect (imperfective) and associated motion (translocative). Example (6) presents the same verb unmarked for associated motion; here the prefix *ra-* only encodes person (3rd person), mood (realis) and aspect (imperfective).

(4) *ba-’yǒ*

3.REAL.IPFV.CSL-walk
 ‘They are walking (coming).’

(5) *ar-’yo*

yu
 3.REAL.IPFV.TRL-walk DEF.PL.DIST
 ‘They are walking (going).’

(6) *ra-’yǒ*

yu *nzédi*
 3.REAL.IPFV-walk DEF.PL.DIST man
 ‘The men are walking.’

Semantic features

Playing together with verb telicity, the perfective and imperfective markers of associated motion present different temporal relations between the foreground action designated by the lexeme that the AM markers attach to and the associated motion event (Hernández-Green 2015). For atelic verbs, imperfective AM morphemes mark *concurrent motion* of the continuous co-extensive type (cf. Guillaume 2016, 116f), as in (8). For telic verbs, imperfective marking again indicates concurrent motion, but this time with the main event occurring multiple times in course of the motion event, as in (9), where a group of people are iteratively throwing seed offerings on a bonfire while passing it.

- (8) *kha gár-tí* *k'ú* *hme*
and 2.REAL.IPFV.TRL-carry DEF.PL.NV tortilla
'And you carry your tortillas (going).'

- (9) *ar-pónti* *ar-'út'i* *'a tsibi ya*
3.REAL.IPFV.TRL-throw.down 3.REAL.IPFV.TRL-throw.into LOC fire DEF.PL.PROX
'They throw (them) down, they throw (them) into the fire (going).'

Turning to perfective marking, the translocative morphemes consistently indicate prior motion, with the event designated by the lexeme occurring *after* a change of place, as in (10), where a group of pilgrims eat after having travelled from Acazulco to another village:

- (10) *'a Ndetshe hén gín-tsíhme=ga='mbe* *k'u=a*
LOC Santiago again 1.IRR.PFV.TRL-eat=1=PL.EXCL there=ENCL
'In Santiago, we'll eat again there (after going).'

The corresponding perfective cislocative morphemes are unspecified for temporal relation between the events: motion can be either prior (“go and do”) or posterior (“do and go”) to the main event designated by the lexeme. Further, Hernández-Green (2015) describes that this specific subset of perfective cislocative prefixes can even be used with a derived locative sense where they do not indicate associated motion at all, but signal that an event occurs far from the deictic centre (“extralocative”). This is the case in (11), where the cislocative prefix *du-* cannot be interpreted as marking motion towards the deictic centre, since the buying event is both preceded and followed by motion away from the deictic centre.

- (11) *'ndá du-tan* *k'ú-i* *nts'ihme*
each 3.IRR.PFV.CSL-buy DEF.PL.NV-3PL.POSS food
'Each one will buy their own food (far from here).'

This special extralocative use of the cislocative inflection is most typical for obtainment predicates, such as *tai*, ‘buy’, which, according to Hernández-Green (2013; 2015, 386ff), are likely to have played a driving role in a process of semantic extension.

Here, it is worth noting that in the larger Otopamean family, spatial verb inflection is not restricted to associated *motion*, but includes categories of location (Hernández-Green 2013). Many Otomí languages have a dedicated extralocative category marking events taking place away from the deictic centre, and Sierra Otomí presents even more fine-grained location distinctions, with verbal prefixes contrasting level, i.e. events that occur at higher or lower altitude relative to the deictic centre (Voigtlander and Echevoyen 1979). In Acazolco Otomí, Hernández-Green (2015) suggests that vestiges of the same locational level inflection may be found in elicited examples, but only for verbal prefixes fusing indexation of 3rd-person subjects *and* registration of a locative oblique argument or adjunct (Hernández-Green 2015, 456f).

Formal characteristics: applicability

The markers in Acazolco Otomí have broad applicability, as they can be used for inflecting not only non-motion verbs (such as *tsihme*, ‘eat’, in (10) above), but also motion verbs (such as *’yǒ*, ‘walk’, in (4–5) above) and non-verbal predicates. Use with non-motion verbs is typically treated as a diagnostic of associated motion because it demonstrates that the morpheme can add unique information about motion not conveyed by the verb (Guillaume 2016, 102). The fact that AM markers in Acazolco Otomí attach to a range of non-motion verbs establishes their status as AM markers. This status is underlined by their ability to attach to non-verbal predicates, as when the numeral *hyú*, ‘three’, is inflected with cislocative imperfective *ba-*, yielding the inflected form *ba-hyú*, ‘they come three toward us’ (Hernández-Green 2015). Here, the cislocative marker adds not only motion, but action itself. This wide-ranging capacity to add motion information to all sorts of situations across word-class boundaries marks the morphemes in Acazolco Otomí as AM markers par excellence. When the AM markers attach to motion verbs, as in (4–5) above, motion itself is already coded in the lexical stem, and the AM markers specify the direction of this motion.

Formal characteristics: fusion

This high degree of fusion between associated motion, aspect, person and mood is interesting in two ways. First, diachronically, it points to a long-lasting tendency at previous language stages for speakers to deem information about associated motion relevant enough to provide it habitually together with information about subject, information status and temporal contour of situations, with recurring co-occurrences presumably leading to fusion over time. Second, synchronically, it means that when speakers produce the obligatory verbal TAM and person-marking prefix, they have to make active decisions about absence/presence and type of motion with direction, as the AM marker is not a separate morpheme that can be left out.

3. Study 1: Associated motion in narratives

In Study 1, we lay the foundations for the psycholinguistic experiment in Study 2 by exploring how Acazolco Otomí speakers use AM morphology in naturalistic contexts. We examine applicability and frequency of use to qualify our predictions for any potential influence from linguistic marking of associated motion on speakers’ attention and memory. Further, checking how marking in Acazolco Otomí patterns with other AM systems will make it easier to assess to what degree findings from the psycholinguistic experiment might be generalized to other languages. To this end,

we analyse frequency and diversity in Acazolco Otomí speakers' spontaneous use of AM prefixes in pilgrim narratives, with a particular eye to their behaviour with motion vs. non-motion verbs.

3.1 Method

Three narratives were collected from three female speakers (aged 67–80 years) who had grown up as monolingual Otomí speakers, but learned Spanish in school and now speak Spanish in most everyday contexts, with interaction in Otomí usually restricted to conversations with same-age friends and relatives. They all count as fluent Otomí speakers in the eyes of the community. We requested each speaker to describe a multi-day pilgrimage to the sanctuary Chalma in the lowlands, as this would allow us to compare verb inflection for the same events with direction to and from the village and gauge the range of activities for which speakers consider AM marking relevant when talking about a set of common activities that form the backbone of the community's public life. Finally, as the journeys span large elevation differences of about 1300 m, they provide us with privileged contexts for checking for traces of elevation inflection, i.e. the prefixes distinguishing between events taking place at higher versus lower altitude that Hernández-Green (2015) found remnants of.

The pilgrimage dataset comprises 312 clauses from three narratives of differing length: 42, 84 and 186 clauses. Two clauses without TAM prefixes were left out of the analysis. For the remaining 310 clauses, we coded presence/absence and type of AM marking in the verb prefix, predicate, predicate type (motion vs. non-motion), place and direction (hither vs. thither relative to the deictic centre) for the situation described as well as discourse status (storyline event: situations occurring during the specific journey described vs. background information: place descriptions, information about general circumstances).

3.2 Results

Out of the 310 clauses, almost half of them (149) presented AM inflection, whereas 161 did not. In 129 of the 149 clauses with AM marking, the prefixes were used in their core AM sense, conveying motion with direction, while 20 others presented extralocative use. Thus, as also found by Hernández-Green (2015), speakers would sometimes use cislocative prefixes in a derived locative sense to mark events taking place far from the deictic centre (e.g. while staying in Chalma, neither coming nor going). We focus here on the 129 occurrences where AM marking indicates motion with direction. The AM prefixes were used with high flexibility to encode associated motion and direction for a range of diverse situations: they occurred with 42 different predicates, presenting fusions between the translocative and cislocative with imperfective and perfective aspect, both moods (realis, irrealis) and all three persons (1st, 2nd, 3rd).

Non-motion predicates

In 46 of the clauses, non-motion predicates were inflected with AM prefixes coding an associated motion event with direction. With imperfective aspect, the AM markers mark that the situations described by the predicates they attach to take place while the agent is moving, either towards the deictic centre (cislocative) or in any other direction (translocative), as in (12):

- (12) *dár-khu's=k'a='mbe* *k'á-m* *línterna*
1.REAL.IPFV.TRL-hold.up=1=PL.EXCL DEF.SG-1POSS lantern
 ‘We hold up our lanterns (while going).’

With perfective aspect, the AM markers code non-concurrent motion. Translocative perfective prefixes always signal prior motion, i.e. that the situation described by the predicate takes place *after* the agent has moved in another direction than towards the deictic centre, as in (13), where the travellers go to bed on their outward journey, having gone to another village. For cislocative perfective prefixes, the associated non-concurrent motion events can be interpreted as either prior or subsequent. In (14), describing a stay in a village on the homebound journey, the cislocative marking specifies that the event of getting up takes motion in a direction towards the deictic centre as its background, but the prefix does not specify whether this motion event takes place before or after getting up.

- (13) *gín-'òh=ka='mbe* *k'u=a* *òra gín-ndǎns=k'a='mbe=a*
1.IRR.PFV.TRL-lie.down=1=PL.EXCL there=ENCL now **1.IRR.PFV.TRL**-get.up=1=PL.EXCL=ENCL
 ‘We'll lie down there (having gone there), now we'll get up (having gone there).’

- (14) *òra dú-ndǎnts'i=a*
 now **1.REAL.PFV.CSL**-get.up=ENCL
 ‘Now I get up (having come/before coming).’

All in all, 19 different non-motion predicates are inflected with AM prefixes, including two nonverbal predicates, the adverbs *mp'ét'o* (‘before’) and *mp'épha* (‘after’). The fourteen others are: *'e* (‘herd’), *'énä* (‘say’), *'eni* (‘herd’), *hě* (‘be late’), *kúi* (‘take out’), *mpǎnt'i* (‘wrap’), *nkóni* (‘rest’), *nú* (‘see’), *nzéngwa* (‘greet’), *pó r kwé* (‘get tired’), *tai* (‘buy’), *tsí* (‘ingest’), *tsihme* (‘eat’), *tú* (‘carry’).

Motion verbs

The AM prefixes are also highly frequent with motion verbs (83 occurrences), for which AM markers can only add information about the *direction* of motion, as motion is already coded in the verb itself, as in (15) and (16).

- (15) *gár-'yo=ga='mbé* *'a xǒntho*
1.IRR.IPFV.TRL=walk=1=PL.EXCL LOC mountain
 ‘We walk in the mountains (going).’

- (16) *'a xǒntho ba-pǒx=a* *ba-'yǒ*
 LOC mountain **3.REAL.IPFV.CSL**-ascend=ENCL **3.REAL.IPFV.CSL**-walk
 ‘They ascend the mountain (coming), they walk (coming).’

Motion verbs inflected with AM prefixes include verbs with orientation (e.g. *kǒi*, ‘descend’), manner (e.g. *něi*, ‘dance’) and deictic information (e.g. *'ěhě*, ‘come’), and, all in all, 23 different

Finally, 17 clauses present preparatory events in Acazolco or at the destination, Chalma, where the pilgrims stay a handful of days. These two places appear to be stable enough locations not to warrant AM inflection marking them as part of the journey.

For the remaining 71 clauses describing event-line events en route, but without AM marking, there are no obvious features distinguishing them from the 129 clauses marked with AM. At present, AM inflection thus appears to be highly frequent, but not obligatory in Acazolco Otomí descriptions of situations with associated motion events.

3.3 Discussion

Study 1 shows that AM inflection is a pervasive phenomenon when Acazolco Otomí speakers communicate about journeys and the events taking place on the way. The prefixes are used with high frequency and have broad applicability, being used with a wide range of motion verbs and non-motion verbs. Thus, for activities such as eating, going to bed and getting up, speakers carefully specify whether they take place while going away from or coming back to Acazolco, interpreting these situations as subparts of an overall motion event. With motion verbs, the verbs themselves designate motion, and the AM prefixes double this information while adding specification of direction.

As expected from the description in Hernández-Green (2015), the associated motion system in Acazolco Otomí thus differs from the ones in the two Bolivian languages Mojeño Trinitario (Rose 2015) and Cavineña (Guillaume 2000), where there are separate sets of morphemes for AM markers (not used with motion verbs) and directionals (only used with motion verbs). Instead, the Acazolco Otomí system patterns with the ones found in the two Australian languages Arrernte (Wilkins 2006) and Warumungu (Simpson 2004), where the same AM markers attach to both types of verbs, as described by Simpson: “For activity verbs such as ‘cry’ in Warumungu the associated path affix introduces both motion and orientation. For motion verbs the affix introduces orientation (to or away from the speaker)” (2004, 297).

Simpson describes the Warumungu markers in a study of associated path constructions in Australian languages, investigating the ethnosyntactic hypothesis that syntactic constructions may develop in culture-specific ways to serve culture-specific communicative needs based in the particular concerns and practices of a speech community (2004, 287–288). The basic rationale is that when people recurrently engage in the same shared activities, they will talk about them frequently, and these routine conversational patterns may conventionalize into grammar. Simpson’s example case is the emergence of associated path constructions in Warlpiri, and her analysis provides an interesting point of comparison for the associated motion system in Acazolco Otomí, as she proposes a causal motivation in the fundamental shared practice of travelling in traditional nomadic Warlpiri culture. Like the Warlpiris, the Acazolco Otomí community has a long cultural history of spending time travelling together, with processions and multiday pilgrimages forming a focal part of community life. Therefore, a host of shared activities (singing, praying, eating, sleeping, bathing etc.) have travelling as recurring backdrop. Such collective walking practices are highly common in other Otomí communities as well (see e.g. Galinier 2004; Oliver Vega et al. 2004), and similarly, AM inflection is a shared phenomenon for Otomí languages in general, with systems of varying complexity (Hernández-Green 2013). We may thus hypothesize that also for the

Otomís, collective walking practices have strengthened the relevance of providing linguistic background information about motion with direction and – diachronically – supported the emergence of this inflection.

4. Study 2: Recognition memory experiment

Study 1 evidenced a pervasive use of associated motion morphology in journey narratives. If habitual linguistic marking shapes speakers' attention and memory patterns, as proposed by the *thinking for speaking* theory, then speakers of Acazulco Otomí would be hypothesized to pay more attention to directional aspects of events than speakers of languages without grammaticalized reference to direction. Further, as linguistic encoding supposedly supports memory, speakers are expected to demonstrate better recall of direction if they have verbalized directional aspects of events. Study 2 was designed to evaluate this hypothesis of a linguistic influence on memory by means of a psycholinguistic experiment measuring recognition memory in speakers with varying fluency in Acazulco Otomí. The main question was whether grammatical linguistic encoding of direction supports memory for direction. Linguistic encoding of direction was operationalized as use of AM morphemes when describing video clips depicting events taking place while moving (e.g. throwing candy while *going* or drinking juice while coming *up*). Memory for direction was operationalized as the ability to detect changes in video clips where the actions taking place while moving (e.g. throwing candy, drinking juice) remained the same, but where the direction of the simultaneous motion had been altered (e.g. throwing candy while *coming* or drinking juice while coming *down*).

4.1 Method

To assess the potential influence of linguistic encoding of associated motion on memory, we developed a recognition-memory experiment, inspired by a video experiment devised by Malt et al. (2003), who evaluated dependencies between linguistic encoding of motion events and ability to recognize variation in manner and path in a subsequent memory task. The clue of our new experiment was to let participants watch and describe a series of short films in a first (presentation) phase and then present them with a series of identical versus slightly altered films in a second (recognition) phase, asking them to identify which films they had seen during the presentation phase. The altered target clips presented the same actions and actors as the original clips (e.g. eating, drinking, carrying various objects), but varied in direction of the accompanying motion. We examined whether encoding spatial information with verbal prefixes in the presentation phase predicted ability to detect subtle changes in spatial features in the recognition phase, when a series of background variables was controlled, and in particular, we asked whether any potential effect of AM marking was specific for changes on the deictic hither-thither axis.

To evaluate whether Acazulco Otomí speakers benefit from path encoding, we needed a basis of comparison, i.e. scenes described *without* AM prefixes. To obtain such variation in descriptions, we took advantage of the extensive bilingualism characterizing Acazulco, where all speakers of the oldest generation are bilingual in Otomí and Spanish, but where the balance between the two languages differs widely between subjects. Some speakers use Otomí every day for a variety of conversational purposes, whereas others hardly ever use their maternal language and only do so in

restricted routine contexts such as traditional greetings. The speakers' other language, Spanish, does *not* present them with a grammatical category marking motion and path. Bilingualism in Acazulco thus allowed us to test subjects who live in the same geographical surroundings and participate in the same cultural routine practices, but who differ in degree of fluency in Otomí's spatial inflection and could thus be expected to exhibit wide variation in use of AM markers.

4.1.1 Stimuli

The stimuli consisted of two sets of videos: one set of 23 videos for the presentation phase and 27 videos for the recognition phase. 10 videos were presented in exactly the same versions in the recognition phase ("Repeat"), 13 videos were presented in slightly altered versions ("Altered"), and 4 videos ("New") were only seen in the recognition phase, not in the presentation phase. Each participant thus saw 40 unique video clips: 10 Repeat clips (seen twice, once in each test phase), 13 + 13 Altered clips (one version seen in each test phase) and 4 New clips (only seen in the recognition phase).

These 40 video clips consisted in a mixture of authentic and constructed recordings. 17 of the clips were authentic recordings of everyday scenes in the village (e.g. a peasant working in a field, mules carrying cornstalks) and of traditional ritual practices during pilgrimages, processions and village celebrations (e.g. singing, carrying saints, bathing and dancing). We utilized the Acazulquian propensity for carrying out different activities while walking and travelling to record the same events with the same participants twice with contrasting spatial features. To these, we added 23 clips constructed for the experiment with combinations of ourselves and a field colleague engaging in everyday activities in the village (e.g. eating bread, carrying candles).

To distract attention from the experimental contrasts, the 40 clips varied in action type, number (single, pair, group) and identity of agents (community members, ourselves, local animals). The pairs of Altered clips only varied on spatial dimensions.

The clips varied in length from 6 to 25 seconds, and the statistical model checked that differences in length did not influence performance.

Target items: Altered

Since our main question was whether use of AM morphology predicts memory for direction, operationalized as the ability to detect subtle spatial alterations of video clips, the 13 pairs of Altered clips are the ones of experimental interest. These pairs presented spatial manipulations of four different types, contrasting either deictic coming-going motion (4 pairs), crossing right-left motion (4 pairs), vertical up-down motion (4 pairs) or high-low level (3 pairs) between the two phases⁴.

As for the deictic contrast, scenes presenting hither motion (coming) are scenes where the agents move toward the camera, giving the impression that they approach the deictic centre, the place where the participant and the experimenter are talking, and they contrast with scenes

⁴ The high-low contrast is *not* a direction contrast, but a *location* contrast. This last contrast was included to test a secondary question: whether participants would include information about vertical level in the TAM prefix, inflecting predicates according to whether events took place at higher or lower altitude relative to the deictic centre, cf. Section 2.1.1 above).



Figure 2: Stills from an Altered pair contrasting coming-going motion.

Control items: Repeat and New

The Repeat and New clips had two functions:

1) In the test phase, they presented speakers with clear-cut examples of seen and unseen scenes, ascertaining that all speakers had the chance to experience the test questions as meaningful. If we had not included Repeat videos, a speaker who always noted the spatial changes would have had to answer no for all test questions, and if we had not included New videos, a speaker who never noted the spatial changes, would have had to answer yes for all test questions. Both patterns would presumably be so pragmatically weird as to make speakers question what the task was about and try to second-guess our purpose, which would undermine our aim of examining differences in routine attention and memory.

2) In the analysis phase, the Repeat and New clips acted as control items, allowing us to check that participants understood the task and were paying attention. Since the correct answers for these control clips had opposite polarity, they provided us with a basis of comparison for subjects' answers on the (Altered) target trials. If a subject e.g. failed all the Altered trials, it could either be because she was only attending to the unaltered foreground actions (i.e. the expected response for subjects not fluent in spatial inflection) or because she was giving mechanical positive answers. If the latter was the case, we could detect this by checking whether she also gave positive answers to the New items, and we did indeed exclude a participant who gave invariant positive answers. On the other hand, if a subject passed all the Altered trials, it could either be because she was indeed attending to the altered spatial features (i.e. the expected response for subjects fluent in spatial inflection) or because she was giving mechanical negative answers. If the latter was the case, we

presenting thither motion (going), where the agents move away from the camera (Figure 2). The crossing pairs contrasted movement from left to right vs. right to left on the screen, while the vertical up-down and high-low contrasts depended on absolute altitude.

Eleven of the pairs only presented one spatial contrast, but one pair combined a contrast in crossing and vertical direction (carrying a saint down a street, crossing the screen from left to right vs. up the same street, crossing from right to left) and one pair combined a contrast in vertical direction with an altitude contrast (carrying saints up from a low part of the village vs. down from a high part of the village). It was checked in the statistical model that the number of contrasts, 1 vs. 2, did not influence performance.

could detect this by checking whether she also gave negative answers to the Repeat items. One subject failed 6 of 10 control Repeat trials and was excluded from the analysis.

None of the participants we included in our analysis produced more than one single error on the 14 control trials. For the two participants we did exclude from the analysis, failure to pass control questions substantiated observations from the test phase that these participants either did not understand the task, were unable to perform it or did not pay attention.

Presentation order

For each of the two phases, a randomized order was generated, which was then modified to avoid any blocks with the same actors, same contrasts or of either Altered, Repeat or New clips. All participants saw videos in the same fixed order.

4.1.2 Procedure

Participants were tested individually, and for each subject, the experiment consisted in two parts, a presentation phase and a recognition phase. During the presentation phase, the task was to describe the 23 clips verbally, and for each clip, participants were prompted to do so with a question in Otomí: *Tébe' k'a xithóha?* ('What happened?'). During the recognition phase, the task for participants was to assess whether they had seen each of the 27 Repeat, Altered and New clips during the presentation phase. For each clip, the test question in Otomí was *Xkinú na mp'et'o?* ('Have you seen it before?'), and participants were instructed to say *'öhö* (yes) if they had seen the clip before and *hí'nä* (no) if they had not. The clips were presented in PowerPoint, and participants saw each clip once during each phase. To make the task harder with the aim of increasing variation, a break was inserted between the two phases. During this retention interval, all participants took part in the same distractor activity: watching photos of local plants and naming them in Otomí.

4.1.3 Participants

Six female speakers of Otomí participated in the study. We aimed for more, but speaker disease and ritual duties got in the way. The speakers were selected on the expectation of having varying degrees of fluency in Otomí, with some using the language fluently on a daily basis, others rarely.

In this already small sample, we had to discard the data from two of our six participants. In one case, the responses were unusable because the participant's daughter joined the session for phase 2, and kept interfering with her mother's answers. In the other case, the participant gave unvarying "yes" responses to all videos in the recognition phase, including the control videos, apparently due to a combination of poor eyesight and task fatigue. Finally, we had to exclude data from the last third of one of the included speakers' recognition data. In phase 1 and in the first two thirds of phase 2, she paid close attention to the stimuli and gave varied answers, e.g. correctly identifying the control videos with new scenes as unseen, but after the first 18 clips in phase 2, she exclaimed "We've seen them all", and from then on she stopped paying attention and gave quick yes responses to all videos, including a control video.

The four speakers included in the analysis ranged in age between 74 and 81 years, and they had all grown up as monolingual Otomí speakers and learned Spanish in school.

4.1.4 Scoring

For the linguistic responses in the description phase, each utterance was coded for presence, type and conventionality of AM markers. Only utterances describing what was going on in the clip were included in the analysis, i.e. if a clip inspired talk about memories of other experiences, these utterances were excluded. Cislocative prefixes used for movement towards the camera and translocative prefixes used for movement in any other direction were coded as conventional, whereas translocative prefixes used for movement towards the camera and cislocative prefixes used for movement in any other direction were coded as unconventional.

Since many scenes were described with more than a single utterance, responses were summarized for each scene in a second step. For each scene per participant, two measures were derived: 1) the number of utterances, 2) the number of conventional AM markers minus the number of unconventional AM markers. As a scene would sometimes be incongruently described with *both* a conventional AM marker *and* its semantic opposite, the second calculation was made to take into account that any potential memory support from categorizing a scene with a specific marker assumedly would be cancelled out by having the scene incongruently categorized (as e.g. in ex. 22–23 below). Use of conventional AM morphology for a scene was entered as a binary (with/without) factor in the mixed models analysing subjects' recognition-memory responses, with >0 scores counting as “with” and ≤0 scores counting as “without”.

Responses were also coded for presence of verbal inflection for level (high vs. low), but as level markers turned out to be completely absent, any further analysis of this inflection was dropped.

In the recognition phase, participants' responses to the test questions (“Have you seen it before?”) were scored as correct or incorrect. For the 17 Altered and New clips, the following responses were scored as correct: *hí'nä* (‘no’), *híxtinúga* (‘I haven't seen it’), *híndranúga/híndranúwi* (‘I/we didn't see it’) and head shakes. For the 10 Repeat clips, the responses *'öhö* (‘yes’), *xtinúga/xtinúwi* (‘I/we have already seen it’) and nods were scored as correct. For all clips, lack of response counted as incorrect.

4.2 Results

We present the results in two subsections. First, we give an overview of linguistic responses in the description phase (4.2.1). Then, we present the change-detection results from the recognition phase and analyse how they relate to responses in the description phase (4.2.2).

4.2.1 Linguistic descriptions

All in all, the four speakers used 260 utterances to describe the 23 scenes. They produced AM marking in 91 of those utterances, exhibiting four distinct patterns of use.

Consistent use

One speaker (age: 78) used AM prefixes in 47% of her utterances (49 out of 105) and consistently distinguished between motion towards the speaker (cislocative) and motion in all other directions (translocative). No motion event was described without AM prefixes; the 53% utterances without them described either static scenes or static background aspects of the motion scenes. The AM prefixes were used in a highly varied manner with both perfective and imperfective aspect, and in

both 2nd and 3rd person. AM inflection was used with a range of motion and non-motion verbs, e.g.: *ardi-xàdi* ('they pray, going'), *ar- 'éhpi* ('he is throwing it, going'), *ba-zó'nde* ('he is late, coming'). This speaker also evidenced the impressive applicability of AM morphology in Acazolco Otomí, freely using it with both numerals (18–19) and what is usually characterized as adverbs (20–21). Without the AM prefixes, *yóho* simply means 'two', *mp'ét'o* 'last' and *khwádi* 'much/many' (see Hernández-Green 2015 for a discussion of criteria for word-class membership in Acazolco Otomí).

(18) *ba-yóho*
3.REAL.IPFV.CSL-two
'Two are coming.'

(19) *ar-yóho*
3.REAL.IPFV.TRL-two
'Two are going.'

(20) *kha ba-mp'ét'o nt'a*
and 3.REAL.IPFV.CSL-last one
'And one comes last.'

(21) *ta ba-khwádi*
INT 3.REAL.IPFV.CSL-many
'So many are coming.'

Less stable use

One speaker (age: 74) retains much of the traditional system, but without stable use. She uses both translocative and cislocative morphemes, in both perfective and imperfective aspect, producing these morphemes with a variety of motion and non-motion verbs, and even with a numeral (*ar-yóho*: 'two are going'). Further, she uses the AM inflection frequently, in 38% of her utterances (28 out of 74), but she does not consistently differentiate between deictic motion hither and thither, as cislocative morphemes are occasionally used for thither motion, and vice versa. This is especially striking when she describes the same scene with opposite direction morphology as in (22–23).

(22) *ar-thé nŷ-r kómida*
3.REAL.IPFV.TRL-hold.in.hand DEF.SG.DIST-3SG.POSS food
'They are carrying their food thither.'

(23) *măx du-pó'ts' r kómida na ra-khá*
maybe 3.IRR.PFV.CSL-move.up 3SG.POSS food DEF.SG.PROX 3.REAL.IPFV-exist
yŷ ngü
DEF.PL.DIST house
'Maybe they are carrying their food hither up to where the houses are.'

Reduced use

One speaker (age: 81) hardly ever used AM prefixes, producing them only in 2 out of 40 utterances (5%) when describing the motion-rich videos. In both cases, she used the same 3rd person cislocative imperfective morpheme (*ba-*) to describe hither motion.

Reduction and reanalysis

This same 3rd person imperfective cislocative morpheme (*ba-*) was also the only prefix used by the last speaker (age: 77), but this speaker used the morpheme much more often, in 29% of her utterances (12 out of 41). However, she did not use it in the conventional way to convey differences in deictic motion, but produced it indiscriminately for describing hither and thither motion (6 instances of each). Since the morpheme was thus not used for conveying *direction* information, it might have been used exclusively to indicate *motion* in itself. Nevertheless, all the three verbs that this speaker used *ba-* for were motion verbs (*'ěhě*: 'come', *'yǒ*: 'walk', *pǎ*: 'go'), so the prefix could not add motion information not already signalled by the verb stem itself. The speaker may thus have reanalysed the cislocative morpheme as a non-informative, but obligatory marker for motion verbs.

Having established substantial variation in use of AM morphology, we now turn to the recognition phase to see whether differences in scene description explain differences in change-detection performance.

Before leaving the linguistic descriptions, it should be mentioned that we found no evidence of a linguistic *level* distinction, i.e. no difference between prefixes used for events taking place at high and low elevations.

4.2.2 Change detection

The linguistic results from the description phase serve as our basis for interpreting the results from the recognition phase, where we turn to the possible cognitive correlates of AM inflection. Our dependent variable is detection of changes in spatial features in scenes with unchanged foreground actions. The analysis was performed on 48 speaker responses to the question "Have you seen this before?" for the Altered video clips⁵. Overall, the speakers successfully detected changes about two thirds of the times (33 out of 48) and failed to detect changes in the last third (15 out of 48).

The question whether encoding deictic information in spatial verb morphology influenced speakers' ability to retain this information and use it as a basis for detecting changes in direction was evaluated with a logistic regression model. This linear mixed-effects regression model was built in the statistical environment R (version 3.1.1, R Development Core Team 2014), using the lme4 package, and it was fitted to the dependent variable Change Detection, which was treated as a binary variable with the levels pass and fail. The model examines whether use of AM morphology for a scene in the presentation phase predicts detection of change in direction or level for the corresponding scene in the recognition phase. Since the video pairs differed on various parameters (hither-thither, right-left, up-down, high-low), and we only expected an influence from deictic associated motion morphology on detection of the deictic hither-thither changes, it was crucial to

⁵ The number is 48, not 52, because the last 9 data points (hereof 4 Altered clips) had to be discarded for one participant (cf. Section 4.1.3 above).

examine whether the influence of spatial marking was restricted to videos with this exact change type. The model therefore tested the factors Deictic Direction, Crossing Direction, Vertical Direction and Level (all binary factors with the levels Changed/Unchanged) as main effects and in interaction with spatial morphology. Speaker and Item were included as random variables, and the model further allowed us to control a series of potential confounds. Most importantly, the speakers gave a different amount of descriptions in the presentation phase. Talking more about a scene would arguably make the scene more memorable to the speaker, independent of use of spatial morphology, so it was important to check whether a potential effect of spatial marking would be independent of amount of description of the scene. To check this, the model tested the co-variate Utterances per Scene. To ascertain that irrelevant features of the stimuli or presentation order did not influence results unduly, the factors Scene Participant (levels: One, Pair, Group, Animal, Inanimate) and Scene Authenticity (levels: Authentic, Constructed) and the co-variables Scene Length, Number of Contrasts, Presentation Number and Recognition Number were tested. Variables were added to the model one at a time, using the principle of forward selection, and discarded from the model if they did not contribute significantly to explaining variance in Change Detection. To be cautious, *control* variables were kept if they approached significance. The final model can be seen in Table 2.

Random effects				
Groups	Name	Variance	Std. Dev.	
Subject	(Intercept)	0.7707	0.8779	
Item	(Intercept)	0.3853	0.6207	
Number of observations: 48, Subjects: 4; Items: 13				
Fixed effects				
	Estimate	Std. Error	z Value	Pr(> z)
(Intercept)	0.2857	1.1907	0.240	0.8104
Deictic Direction	-3.3607	1.4319	-2.347	0.0189 *
AM Prefix	-2.5166	1.3269	-1.897	0.0579 .
Deictic Direction × AM Prefix	4.6722	2.1317	2.192	0.0284 *
Utterances per Scene	0.9050	0.5181	1.747	0.0807 .
Significance codes: ‘*’ .05				

Table 2. Summary of the linear mixed-effects regression model fitted to Change Detection for the predictors Deictic Direction, Spatial Prefix and Utterances per Scene and including random intercept for Subject and Item.

The model presents a clear and interpretable result, with only the two hypothesis-driving predictors contributing significantly to explaining variance in Change Detection, and one control variable emerging as marginally significant. As hypothesized, a scene with altered spatial features was more likely to be recognized as changed if the speaker had previously encoded information about motion and direction using an AM prefix, but – crucially – this influence *only* held for scenes with hither-thither changes, as seen in the interaction between Deictic Direction and AM Prefix ($p = 0.0284$ *). No relationships emerged between spatial verb morphology and scenes with changes in level (high-low) or directions on the crossing axis (right-left) or vertically (up-down).

None of the control variables Scene Participant, Scene Authenticity, Scene Length, Number of Contrasts, Presentation Number or Recognition Number contributed to explaining change-detection success, but Utterances per Scene did emerge as a marginally significant predictor ($p = 0.0807$). It is thus not implausible that producing more utterances when describing a scene facilitates recall, but what is important here is that use of AM prefixes has an *independent* (and indeed stronger) influence on ability to detect spatial changes that cannot be explained away by general differences in linguistic description.

It should be noted that while having 4 predictors for 48 observations falls within the “10–20 observations per parameter” rule of thumb for regression modelling (Balling and Hvelplund 2015, 173), it does fall in the lower end. Further, the number of participants (4) is much below what is usually considered the minimum for a psycholinguistic experiment (10, cf. Balling and Hvelplund 2015), so while the relationships evidenced by the model hold for the actual participant group, we must be more cautious than in a standard psycholinguistic experiment about generalizing to the rest of the population.

4.3 Discussion

In Study 2, we investigated the hypothesis that linguistic encoding of deictic direction in AM morphology supports memory for direction of motion. Speakers’ performance on our change-detection task supported this hypothesis, but it should be kept in mind that this result depends on the responses of only four participants.

The description phase evidenced large variability in speakers’ tendency to use AM prefixes for verb inflection when describing scenes with associated motion events. One speaker used the prefixes consistently to distinguish between coming and going motion, one used these prefixes very rarely, one used the cislocative to cover all motion, and one used both the cislocative and the translocative, but sometimes mixing them up. Results from the recognition phase demonstrated that such differences in describing scenes linguistically have cognitive correlates. If a speaker had used conventional AM morphology to encode coming or going direction for a scene in the presentation phase, she was significantly more likely to detect changes in deictic direction in the recognition phase. Importantly, this effect was only seen for the specific pairs for which use of cislocative vs. translocative was hypothesized to have an effect, i.e. the ones presenting deictic contrasts, not for pairs with crossing (right-left), vertical (up-down) or level (high-low) contrasts.

But where exactly in the process from viewing a scene to detecting a change in an altered scene does this influence from language on cognition play its role? Here, our experiment cannot give us precise information. Slobin suggests the usefulness of considering three timeframes when assessing the influence from speaking on thinking: experience time, speaking time and testing time (2003, 179f). We have talked about linguistic encoding supporting attention to *and* memory for motion with direction, but since both are needed for successful change detection, we cannot tell whether failure to detect a change in direction depends on failure to pay attention to direction when viewing and describing the scene or on failure to store directional information in memory. Thus, we cannot clarify whether the requirements for providing direction information when inflecting verbs made the more proficient speakers scan the scenes routinely for direction and thus pay more attention to direction, or whether all speakers always noticed the same spatial features of the scenes when

viewing them, but were more likely to forget them again in the cases where they did not verbalize them.

5. General discussion

In recent years, it has become clear that many languages all over the world present speakers with a practical conventional tool for supplying background information about motion and direction in the shape of associated motion verb morphology. In this paper, we investigated the potential cognitive correlates of speaking a language with AM inflection through two related studies on the severely endangered Otopamean language Acazulco Otomí, spoken in the Mexican high sierra.

Study 1 examined use of cislocative and translocative prefixes in naturalistic contexts, narratives about pilgrimages that traditionally play a central role in the community. Use of AM morphology was pervasive in descriptions of events on the journey, such as eating, sleeping, getting up and walking. We suggest that the community-shared practices of ritual walking may have played a role in sustaining the AM inflection in Acazulco Otomí since it is in these contexts that a range of different activities are carried out against the backdrop of motion in contrasting directions, i.e. situations that it is useful to communicate about using AM morphology.

In Study 2, we conducted a psycholinguistic experiment to evaluate the *thinking for speaking* hypothesis that linguistic encoding of associated motion shapes speakers' attention to and memory for direction. The results supported this hypothesis by showing that changes in direction were more likely to be detected if speakers had previously encoded direction with an AM prefix.

5.1 Influence from language on cognition

The present results support and extend the conclusions from previous psycholinguistic experiments demonstrating effects of different types of spatial language on different types of spatial cognition (e.g. Pederson et al. (1998) on orientation, Bowerman and Choi (2003) on topological relations). For motion events, Talmy (2000) pointed out crosslinguistic differences in lexicalization patterns, with some languages (such as English) typically coding path information in satellites (e.g. *go in/up/down*), others conflating motion and path information in the main verb as in Spanish: *entrar* ('enter'), *subir* ('ascend'), *bajar* ('descend'). Slobin (2003) summed up results from various tasks indicating cognitive effects of satellite- vs. verb-framing of motion events (as in English vs. Spanish) on attention to path and manner, and he explains these results with reference to the different requirements for habitual attention these lexicalization patterns present speakers with. Since satellites can be left out of a clause, whereas the main verb cannot, information coded in the main verb is something speakers have to make online decisions about more frequently, and path should thus be more salient to Spanish speakers than to English speakers (and vice versa for manner).

Here, it is worth noting that, whereas our subjects differed in proficiency in Otomí, they were *all* fluent in Spanish and should thus be expected to pay close attention to direction. In this light, it might be surprising that we were able to discern any differences at all in subjects' memory for direction. However, when we find an effect of AM use, it is likely because AM inflection in Acazulco Otomí requires even more habitual attention to path than verb-framing in Spanish does. Verb-framing only requires speakers to attend to path when talking about motion events, i.e.

situations where motion is discursively primary, whereas AM inflection requires speakers to attend to path also when speaking about other events that only include motion as background (as in *they sang (coming this way)*), thus most likely encouraging more routinized attention.

5.2 Endangered morphology, changed attention?

The study also gives us a rare snapshot of the variability characterizing *both* language and cognition in a transition phase where an endangered language is yielding to a dominant language. The psycholinguistic experiment did not only expose three different types of loss of the cislocative-translocative distinction in Acazulco Otomí (scarce use/reanalysis/inconsistent use), but it also pointed out the cognitive consequences of this linguistic loss. The results suggest that what the speech community is in the process of losing in its shift to Spanish is not only its indigenous lexicon and grammar, but also corresponding collectively shared patterns of attending to spatial background aspects of events, patterns previously underpinned by Acazulco Otomí's AM inflection.

Though we did not set out to examine directly whether AM marking is in a *more* progressed stage of attrition than other parts of the grammar in Acazulco Otomí, it is our impression that it is. Apart from the deviant use of AM morphemes, the three less proficient speakers generally spoke in grammatically well-formed sentences, and one of them otherwise appeared highly fluent, speaking at high speed with a nuanced lexicon and varied grammar in conversation and other elicitation tasks. IF it is the case that AM morphology really is more vulnerable to loss than other parts of the language, we speculate that three factors may conspire to make it so.

First, Spanish has no grammatical category of associated motion. Thus, the second language that Acazulco Otomí speakers use most does not sustain routine attention to the same distinctions in background motion. If speakers fall out of the habit of paying attention to background motion and encoding it automatically for later recall because they have less linguistic use for such attention when speaking Spanish, they may not have the same quick access to relevant spatial information as previously when speaking Otomí either.

Second, as *grammatical* morphemes, the AM markers are discursively secondary (Boye and Harder 2012). Experiments show that such morphemes attract less conscious attention than lexical items (Christensen 2015; Vinther et al. 2015), and speakers are thus less likely to be aware whether they are using them or not, which means that these background morphemes can be expected to be more at risk of disappearing unnoticed than lexical strategies for space marking.

Finally, if language-internal factors are already making AM marking vulnerable to loss, changes in the community's material life may intensify this development. Over the last 50 years, motorized transport (cars and buses) has generally replaced previous practices of travelling on foot, and it may be speculated that this transition makes it less pertinent for Acazulco Otomí speakers to provide information about motion with direction. In previous times, when travelling from one community to another on foot took a day or two, the journey itself with its long duration, different bodily experiences of ascending and descending and the psychological contrast between moving further and further away from versus returning to the secure home of the village may have been more salient to speakers than today when the same distance is covered by car in a couple of hours. While such a change in shared practical routines could certainly not be expected to have an immediate impact on a *stable* linguistic system (cf. Simpson (2004) on the timescale of

developments in ethnosyntax), it is more likely to exert an influence in a situation where the linguistic system in itself is unstable.

If this is the case, then associated motion may not only be an underdescribed phenomenon in the languages of the world, but also one that is more endangered than the languages it occurs in – as the factors proposed above would be likely to be in play also for other languages with associated motion. Preliminary support for viewing associated motion as an especially vulnerable category can be found in observations of attrition in Mojeño Trinitario (Bolivia, Rose 2015, 148f) and Arrernte (Australia), where Wilkins observes that younger speakers only use a subset of the older speakers' AM forms, using this subset with unconventional new senses (2006, 51).

5.3 Future work

Only in recent years has it become clear that languages all over the world have developed grammatical systems for marking associated motion, and compared to other types of spatial language, this inflection is still a sparsely investigated phenomenon. There are several open questions about crosslinguistic tendencies in the types of contrasts marked by these systems and about relationships between three types of spatial verb inflection: associated motion, location and direction. The present study has taken a first step towards examining the cognitive consequences of speaking a language with AM inflection, but given the low number of speakers completing the experiment, we cannot state our results with the same degree of certainty as in a standard psycholinguistic experiment, and the findings need replication in languages that allow larger sample sizes. Further, with larger subject groups, it would be especially interesting to conduct group comparisons and include a further condition *without* explicit language to see whether fluent speakers of languages with associated motion attend more to direction when they are simply monitoring a scene without producing a verbal description.

However, the time window we have for making such experiments may be short, with many AM systems being as endangered as the one in Acazulco Otomí. Indeed, more than half of the languages with AM systems in Guillaume's (2016) survey of associated motion in South American languages are classified by the Ethnologue as either "Threatened", "Shifting", "Moribund" or "Nearly extinct" (Simons and Fennig 2017). Thus, the endangerment of underdescribed spatial verb inflection systems and the challenges we face when aiming to examine these systems experimentally before they disappear altogether illustrate clearly what Pérez Báez (this issue) pinpoints when she states that Linguistics as a science is in the process of losing its own sources of data for making generalizations about the human language faculty. Therefore, even though we may have to live with more uncertainty pertaining to the results from psycholinguistic experiments in endangered languages with small sample sizes than we would prefer, such experiments are important prerequisites for crosslinguistically valid generalizations about human communication systems and their relationships with human cognition.

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