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The interaction between telicity and agentivity: Experimental evidence from intransitive verbs in German and Chinese

**Abstract:** Telicity and agentivity are semantic factors that split intransitive verbs into (at least two) different classes. Clear-cut unergative verbs, which select the auxiliary HAVE, are assumed to be atelic and agent-selecting; unequivocally unaccusative verbs, which select the auxiliary BE, are analyzed as telic and patient-selecting. Thus, agentivity and telicity are assumed to be inversely correlated in split intransitivity. We will present semantic and experimental evidence from German and Mandarin Chinese that casts doubts on this widely held assumption. The focus of our experimental investigation lies on variation with respect to agentivity (specifically motion control, manipulated via animacy), telicity (tested via a locative vs. goal adverbial), and BE/HAVE-selection with semantically flexible intransitive verbs of motion. Our experimental methods are acceptability ratings for German and Chinese (Experiments 1 and 2) and event-related potential (ERP) measures for German (Experiment 3). Our findings contradict the abovementioned assumption that agentivity and telicity are generally inversely correlated and suggest that for the verbs under study, agentivity and telicity harmonize with each other. Furthermore, the ERP measures reveal that the impact of the interaction under discussion is more pronounced on the verb lexeme than on the auxiliary. We also found differences between Chinese and German that relate to the influence of telicity on BE/HAVE-selection. They seem to confirm the claim in previous research that the weight of the telicity factor locomotion (or internal motion) is cross-linguistically variable.

Keywords: Auxiliary selection; Agentivity; Animacy; Telicity; Motion verbs; Event-related brain potentials

## 1. Introduction

As in many other languages, German intransitive verbs are split into unaccusatives such as *entkommen* 'escape' and unergatives such as *reden* 'talk'. Clear-cut unaccusative verbs are telic since they denote a change of location or state of their participant (e.g. Zifonun et al., 1997; Primus, 2011). These properties are generally taken to characterize the patient (or theme) role (e.g. Dowty, 1991; Zaenen, 1993; Pan, 1996; Ackerman and Moore, 1999; McFadden, 2007). In contrast,

\* Corresponding author. *E-mail addresses:* tim.graf@uni-koeln.de (T. Graf), markus.philipp@uni-koeln.de (M. Philipp), xux0@smail.uni-koeln.de (X. Xu), franziska.kretzschmar@uni-koeln.de (F. Kretzschmar), primus@uni-koeln.de (B. Primus). clear-cut unergative verbs are atelic and they are assumed to select an agent role (e.g. Dowty, 1979, 1991; Zaenen, 1993; McFadden, 2007). Thus, telicity and agentivity are taken to be inversely correlated in split intransitivity. The different verb types show a different behavior in a range of phenomena (cp. Grewendorf, 1989 for a comprehensive overview of German). The examples in (1) and (2) from Keller and Sorace (2003:65, 71) illustrate differential auxiliary selection:

	Germ	nan					
(1)	Der	Gefanger	ne ist / *hat	schnell	entkommen.	unaccusat	tive ver
	the	prisoner	be-/have-3	sg quickly	escaped <sup>1</sup>		
	'The	prisoner e	scaped quick	kly.'			
(2)	Die	Lehrerin	*ist / hat	dauernd	geredet.	unergative	verb
	the	teacher	be-/have-3sg	continuous	ly talked		

'The teacher talked continuously.'

As shown in (1), the auxiliary *sein* (BE in the following) is acceptable, while *haben* (HAVE) is unacceptable with unaccusatives. In contrast, BE is unacceptable, while HAVE is acceptable with unergatives, as shown in (2).

An influential pertinent line of research on the distinction between unaccusative and unergative verbs (e.g. Sorace, 2000; Keller and Sorace, 2003; Aranovich, 2007; Legendre, 2007) assumes that this distinction is gradient and that gradience can be captured by the Auxiliary Selection Hierarchy shown in (3). Each position along the hierarchy is illustrated by a German verb that was experimentally tested by Keller and Sorace (2003).

## (3) The Auxiliary Selection Hierarchy (ASH, Keller and Sorace, 2003:60)

Change of location (*entkommen* 'escape') Change of state (*verschwinden* 'disappear') Continuation of state (*aushalten* 'endure') Existence of state, positional (*schweben* 'hover') Uncontrolled process, reaction (*schwanken* 'wobble') Uncontrolled process, emission (*klappern* 'rattle') Controlled process, motional (*schwimmen* 'swim') Controlled process, non-motional (*reden* 'talk')



Agentivity, HAVE

The ASH allows to distinguish core verbs at the unaccusative extreme and the unergative extreme, i.e. change of location verbs and controlled process (non-motional) verbs respectively, from intermediate verbs between the two extremes (Keller and Sorace, 2003:76). Core unaccusative verbs denote telic change and categorically select BE as an auxiliary in perfect tenses. Core unergative verbs denote agentive activity and categorically require HAVE (Keller and Sorace, 2003:60).<sup>2</sup> The criterion for agentivity is that the participant is in control of the event expressed by the predicate (see the lower part of the ASH in (3) above). Since only animates can fulfill this criterion, control is tested by varying the animacy of the participant. Intermediate verbs are claimed to incorporate telicity and agentivity to lesser degrees and to show more variable BE/HAVE-selection.

Motion verbs including *rollen* 'roll' and *fliegen* 'fly', which are flexible with respect to telicity, agentivity and auxiliary selection in German, might be considered to form an additional intermediate class on the ASH and were tested in our experiments (see section 3). Their flexible behavior is illustrated in (4)–(6):

#### German

- (4) a. Der Pilot flog zwei Stunden lang über der Stadt. atelic reading 'The pilot flew above the town for two hours.'
  b. Die Staubwolke flog in zwei Stunden ins Tal. telic reading
  - b. Die Staubwolke flog in zwei Stunden ins Tal.
     the dust cloud flew into the valley in two hours.'

<sup>&</sup>lt;sup>1</sup> Abbreviations used in the glosses: 3sg- third person singular, BE/HAVE – correspondent of the auxiliary *be* and *have* respectively, cL – nominal classifier, RVC – resultative verb complement, PROG – progressive, GEN – genitive, possessive.

<sup>&</sup>lt;sup>2</sup> Keller and Sorace (2003:60) do not explicitly state that core unaccusatives are non-agentive in German. Sorace (2004:265) makes a stronger general statement: "Core verbs (those at the extremes of the hierarchy) are inherently specified for telicity and agentivity, respectively."

(5)	a. b.	Die Staubwolke flog über der Stadt. 'The dust cloud flew above the town.' Der Pilot flog über der Stadt. 'The pilot flew above the town.'	theme reading agent reading
(6)	a.	Der Pilot ist über der Stadt geflogen.	BE
	b.	Der Pilot hat über der Stadt geflogen.	HAVE

'The pilot has flown above the town.'

Variation in terms of telicity is shown in (4). The verb *fliegen* 'fly' is interpreted in German as an atelic activity in the context of the locative adverbial *über der Stadt* 'above the town' (see (4a)) and as a telic accomplishment in the context of the goal adverbial *ins Tal* 'into the valley' (see (4b)). These readings are supported by the appropriate temporal modifiers *for two hours* for atelic events vs. *in two hours* for telic events (cp. e.g. Vendler, 1967; Dowty, 1979). Flexibility in terms of agentivity, specifically control, and animacy is illustrated in (5). In the context of an inanimate subject, as in (5a), the clause is interpreted as a process involving a non-volitional mover, categorized as a theme in most approaches; in the context of an animate subject, as in (5b), the clause is preferably interpreted as a motion controlled by an agent. Flexible auxiliary selection is shown in (6). While the auxiliary BE, as in (6a), is preferred with this class of verbs in the perfect tense, HAVE, as in (6b), is also marginally acceptable.

The main claim of Keller and Sorace (2003:75) is that core verbs exhibit categorical judgments for auxiliary selection, while intermediate verbs elicit gradient preferences. Converging support for this claim stems from experiments using acceptability judgments (Keller and Sorace, 2003, Experiment 1), eye-tracking (Bard et al., 2010) and event-related brain potentials (Roehm et al., 2012).

So the interaction between telicity and agentivity in auxiliary selection was not the primary research focus of Keller and Sorace (2003). As a consequence, animacy and telicity were not manipulated in a fully crossed design. What they tested in Experiment 2 was the interaction between agentivity, i.e. animacy, and auxiliary selection for continuation of state verbs (e.g. *aushalten* 'endure') and for verbs expressing existence of positional state (e.g. *stehen* 'stand, stay'). Their results indicate "that animacy does not have an effect on auxiliary selection for these two verb classes" in German (2003:96). However, we do not consider these results as conclusive since the set of verbs tested with animate subjects in Experiment 1 and with inanimate subjects in Experiment 2 was not identical for verbs denoting continuation of state.

There are also studies investigating the interaction between agentivity and telicity for auxiliary selection in other languages. One example is the acceptability study of Laws (2010) for Italian, which aimed at refining the verb subclassification of the ASH-framework. Regarding the impact of agentivity, only non-core verbs expressing a continuation of state (or condition) were tested with animate and inanimate subjects. The three verbs tested with inanimates (*è/ha durato / persistito / rimasto* 'BE/HAVE-3se lasted / persisted / remained') combine successfully with both *essere* (BE) and *avere* (HAVE), whereas the two verbs tested with animates (*è/ha rimasto / sopravvissuto* 'BE/HAVE-3se remained / survived') combine more exclusively with *essere* (Laws, 2010, Fn3). This challenges the assumption of a negative correlation between agentivity and BE-selection in the ASH-approach. Keller and Sorace (2003:88) assume that non-core verbs prefer BE with non-agentive subjects and HAVE with agentive ones. The fact that animates combine more exclusively with BE with the non-core verbs tested by Laws (2010) in Italian contradicts this prediction. However, the data are too limited to legitimate a firm conclusion.

Turning to Mandarin Chinese, several studies investigate the two aspectual markers *le* and *zhe* in the context of auxiliary selection in West European languages within the ASH-framework (Liu, 2007; Laws and Yuan, 2010 and the L2-acquistion study of Shan and Yuan, 2007). These studies focus on *le/zhe*-selection in the locative inversion construction with the general aim to evaluate the applicability of the ASH-framework to Chinese. According to these studies, the marker *le* is categorically selected for verbs at the unaccusative end, i.e. change of location verbs, as shown in (7).

(7) Chinese (Liu, 2007:188)
 Duimian lai -le/\*-zhe yiliang che opposite-side come -LE/-zHE one-cL car 'From the opposite side came a car.'

The marker *zhe* is categorically selected for verbs closer to the unergative extreme including uncontrolled processes, as shown in (8), and a few controlled processes that allow for locative inversion.

 (8) Chinese (Liu, 2007:192)
 Waitou chui \*-le/-zhe xie weifeng outside blow -LE/-ZHE some breeze 'Outside is blowing some breeze.'

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In the ASH-framework, *le* is comparable to BE and *zhe* to HAVE. In order to facilitate cross-linguistic comparison, we will use BE for *le* and HAVE for *zhe* whenever suitable in the following.

Beyond their presence in the locative inversion, the aspect markers *le* and *zhe* are used in many different constructions in Chinese. Following Smith (1997) and Xiao and McEnery (2004) we distinguish between viewpoint aspect, such as perfective and imperfective, and situation aspect, which includes the distinction between telic events (e.g. accomplishments) and atelic ones (e.g. activities). The latter refers to the intrinsic aspectual properties of situations while the former refers to the speaker's choice of a perspective from which a situation is presented. The two are independent yet interacting components of aspect (Xiao and McEnery, 2004:10). The markers *le* and *zhe* belong to the viewpoint aspect<sup>3</sup> system. In the literature on aspect in Chinese, most scholars agree that *le* signals perfectivity and that it exhibits a strong preference for telic situations (e.g. Smith, 1997:263f.; Xiao and McEnery, 2004:100f.). By contrast, *zhe* is generally assumed to indicate imperfectivity (more specifically durativity) and to strongly disfavor telic situations, e.g. accomplishments and achievements (e.g. Smith, 1997:271f.; Klein et al., 2000:763; Xiao and McEnery, 2004:188f.). This basic analysis of *le* and *zhe* suffices for our purposes (see Xiao and McEnery, 2004 for a more nuanced functional analysis of their use in different constructions). The examples in (9) and (10) illustrate the above-mentioned preferential use of *le* and *zhe* in intransitive sentences with a preverbal subject, as this word order was used in our Experiment 2 (see section 3.2):

- (9) Chinese (Smith, 1997:288) Mali zou-qu-le xuexiao Mali walk-RVC-LE school 'Mali walked to school.'
- (10) Chinese (Smith, 1997:273) Ta zai chuang shang tang-zhe he at bed on lie-zhe 'He is lying on the bed'.

Let us return to *le* and *zhe* in the locative inversion in the ASH-framework. Intermediate verbs expressing a continuation of existence or state, as in (11)–(12), show flexible *le/zhe*-selection, and this is where agentivity (via animacy) comes into play (Liu, 2007; Laws and Yuan, 2010). With an animate subject, both *le* (BE) and *zhe* (HAVE) can be used with this verb type, as shown in (11):

 (11) Chinese (Liu, 2007:190)
 Menkou zuo-le/-zhe yige jingwei doorway sit-Le/-zHE one-cL guard 'At the doorway sits a guard.'

With an inanimate subject, the same verb can only be accompanied by zhe (HAVE), as shown in (12):

 (12) Chinese (Liu, 2007:190) Menkou zuo \*-le/-zhe yi dui shishi doorway sit -Le/-zHE one pair stone-lion 'At the doorway sits a pair of stone lions.'

Similarly to the animacy-related result for Italian in Laws (2010) mentioned above, the distribution illustrated in (11) and (12) for Chinese is a challenge to the assumption of the ASH-approach that animates prefer HAVE and disprefer BE, while inanimates prefer BE and disprefer HAVE.

Summing up, empirical findings from two different constructions in typologically different languages, i.e. auxiliary selection in perfect tenses in Italian and aspectual markers in the locative inversion in Chinese, cast doubts on the assumption that telicity and agentivity are opposing forces for BE and HAVE. As for German, Keller and Sorace (2003) assume that, at least for some verb classes, auxiliary selection is not sensitive to agentivity. These findings, which were not in the center of attention in the studies mentioned above, have prompted us to look deeper into the interaction between agentivity and telicity from a general semantic perspective (section 2) and on a broader experimental basis (section 3).

<sup>&</sup>lt;sup>3</sup> In this section and in our Experiment 2, postverbal *le* is at issue, which is sometimes dissociated from sentence-final *le* (Xiao and McEnery, 2004:93; Li and Thompson, 1981:296).

## 2. The interaction between agentivity and telicity from a semantic perspective

The ASH-approach differs from alternative lines of research on unaccusativity by laying its focus on the distinction between core and intermediate verbs and by explaining the gradient and inconsistent behavior of intermediate verbs ('unaccusativity mismatches') in terms of semantic gradience with respect to telicity and agentivity. The inverse agentivity-telicity correlation, which is the topic of the present paper, is inherited from other approaches to unaccusativity, as mentioned in the introduction.<sup>4</sup>

One influential alternative framework that also captures gradience is Dowty's proto-role approach (Dowty, 1991). In contrast to the ASH-approach, which uses a one-dimensional gradient agentivity concept, Dowty (1991) assumes a multi-dimensional notion so that gradience is an epiphenomenal result of aggregating semantic components of agentivity. The relevant components (entailments in Dowty's view) fall into two categories: proto-agent vs. protopatient. Proto-agent entailments include volitional involvement in (i.e. control of) the event or state, causing an event or change of state in another participant, and autonomous movement. Proto-patient entailments include the telicityrelated notions of change of state and incremental theme (1991:567f., 607). The participant bearing the role of incremental theme is successively affected by the event but does not necessarily undergo a change of state, e.g. memorize a poem. Regarding unaccusativity, Dowty (1991:606f.) follows other approaches by assuming an inverse correlation between agentivity and telicity: agentive atelic verbs are claimed to be definitely unergative and nonagentive telic verbs definitely unaccusative. As an interesting side remark, Dowty explicitly allows for the possibility that agentivity and telicity are ranked differently in different languages (1991:607f.). This option is data-driven and limited to some verb classes in German in Keller and Sorace's (2003) ASH-approach. As mentioned above, the results of Experiment 2 lead Keller and Sorace to hypothesize that agentivity is not relevant for auxiliary selection with certain verb classes in German. This brief overview of two influential frameworks, the ASH- and the proto-role approach, shows that their assumption of an inverse correlation between telicity and agentivity is in line with the research on unaccusativity mentioned in the introduction.

A different picture emerges from psycholinguistic research, specifically from language evolution and language acquisition studies. Simplifying matters for expository purposes, we classify these studies as core cognition research in the following. Many experimental studies and meta-analyses of such studies concur in the claim that goal-directed behavior characterizes – among other properties such as autonomous, i.e. self-propelled, movement – animates as agents. For Rakison and Poulin-Dubois (2001), for example, a purpose of action (goal-directed vs. aimless) is one of the seven characteristic properties related to physical or psychological causality that distinguish animates from inanimates already in infant cognition. This is similar to Spelke and Kinzler's view: our evolutionarily ancient implicit knowledge ("core knowledge") about agentivity includes the insight that the intentional actions of agents are directed to goals (2007:90). Similarly, Carey's assumption is that explaining agents' actions in terms of their goals is part of our core cognition (2009, chap. 5). A goal toward which a participant acts is also one of the characteristic properties of intentional action as argued for by Tomasello and colleagues (cp. Tomasello et al., 2005; Carpenter et al., 2005). In this view, having an explicit goal, such as moving toward a goal, aligns animate agents harmonically with telic events and inanimate participants with atelic events, i.e. aimless motion.

It is obvious from the preceding paragraphs that the pertinent research leads to different predictions for our investigation of BE/HAVE-selection with semantically flexible motion verbs. Regarding the impact of agentivity, i.e. control, on BE/HAVE-selection, there are two opposing assumptions. Some approaches do not include agentivity or animacy as a driving force for the data under consideration (e.g. Zifonun et al., 1997:1862f.; Engelberg, 2000:55f.; Duden, 2009:464f.; Eisenberg, 2013:99f. for German and Smith, 1997; Klein et al., 2000; Xiao and McEnery, 2004 for Chinese). Telicity is assumed to be the only decisive factor, even though it is characterized and called differently in the above-mentioned works. This treatment is appropriate if agentivity plays no palpable, experimentally testable role for BE/HAVE. The corresponding prediction is formulated in (13a). (13b) captures the uncontested impact of telicity on BE/HAVE-selection.

- (13) a. Be/HaveAg: Agentivity, i.e. animacy, plays no role for BE/HAVE-selection.
- (13) b. Be/HaveTel: Telic contexts favor BE, atelic contexts favor HAVE.

<sup>&</sup>lt;sup>4</sup> Approaches to a multi-dimensional transitivity concept following Hopper and Thompson (1980) take agentivity and telicity to contribute in conjunction to enhanced transitivity. However, this kind of approach cannot account for auxiliary selection (cp. Shannon, 1989). HAVE is mandatory for transitive verbs with subject and direct object, at least in German. So one would expect that HAVE is also preferred with one-place verbs of high semantic transitivity. Yet atelic processes, for instance, which are of lower transitivity than telic ones, favor HAVE, while the semantically more transitive telic events favor BE.

In contrast to (13a), ASH-approaches suggest that agentivity interacts with telicity in determining BE/HAVE-selection.<sup>5</sup> The specifics of this interaction are determined by the assumption that agentivity and telicity are inversely correlated. The semantic role of an animate entity undergoing a definite change of location is assumed to have inconsistent role properties. As an animate argument of a motion verb, it is preferentially interpreted as an agent in control of the event, by going through a definite change of location it is a patient. An inanimate entity undergoing a definite change of state is assumed to be a less prototypical patient than an inanimate entity undergoing a definite change of state. This line of research leads to the prediction of an inverse correlation between animacy and telicity formulated in (14a). In ASH-approaches, the inverse correlation is assumed to influence the interaction between animacy and BE/HAVE-selection. Since telic contexts favor BE (see (13b)) and inanimates (see (14a)), BE is preferred with inanimates (see (14a)), HAVE is preferred with animates (see (14b)).

- (14) a. TelAgInverse: Inanimates in the telic (locative) condition and animates in the atelic (goal) condition are preferred against animates in the telic (goal) condition and inanimates in the atelic (locative) condition.
  - b. Be/HaveAgInverse: BE is preferred for inanimates against animates; HAVE is preferred for animates against inanimates.

The predictions that we derive from core cognition research are opposite. Animate agents are harmonically aligned with telic events and inanimate participants with atelic events. An inanimate entity involved in a definite (goal-oriented) change of location is assumed to have inconsistent role properties. As an inanimate entity it is preferentially interpreted as a patient, its goal-oriented behavior would qualify it as an agent. An animate referent moving aimlessly is assumed to be a non-prototypical agent lacking the property of goal-directedness. Consequently, this line of research leads us to assume the predictions in (15a, b):

- (15) a. TelAgHarmonic: Animates in the telic (goal) condition and inanimates in the atelic (locative) condition are preferred against animates in the atelic (locative) condition and inanimates in the telic (goal) condition.
  - b. Be/HaveAgHarmonic: BE is preferred for animates against inanimates; HAVE is preferred for inanimates against animates.

In order to test these predictions, which are linked to previous research on BE/HAVE-selection in German and Chinese, as mentioned in section 1, we designed and carried out three experiments that we will present in the following.

## 3. Experimental evidence from German and Chinese

We conducted an acceptability rating study for German (Experiment 1) and for Chinese (Experiment 2) as well as an event-related potentials (ERP) study for German (Experiment 3) manipulating the factors ANIMACY, TELICITY and BE/HAVE systematically for flexible motion verbs.

## 3.1. Behavioral data in German: Experiment 1

## 3.1.1. Participants

One hundred students from the University of Cologne participated on a voluntary basis in the acceptability rating study. Data of five participants were excluded from the analysis because they reported multilingual or non-native German background. Ninety-five participants entered the final analysis (mean age 21.4 years, age range: 18–34 years, sixty-nine women).

#### 3.1.2. Material and design

In order to investigate the interplay of agentivity and telicity for auxiliary selection in a fully crossed design, these factors have to be manipulated independently. A manipulation of telicity is not possible for verbs denoting a continuation of state (e.g. *stay, remain*) that were tested for animacy-driven BE/HAVE-selection in previous studies, as mentioned in the

<sup>&</sup>lt;sup>5</sup> Keller and Sorace (2003) take a more nuanced point of view. The ASH embodies both telicity and agentivity but Keller and Sorace attribute a smaller weight to agentivity in auxiliary selection (2003:61, 88). They even envisage the possibility that for some languages and some verb classes, i.e. verbs expressing change of location (2003:88), continuation of existence and continuation of positional state (2003:96) in German, auxiliary selection is not sensitive to agentivity.

introduction. Instead, we tested verbs denoting a motion process that allow for the three-way variation under discussion. The structure of a test item and the combined set of manipulations is shown in (16):

(16) Stimulus structure for Experiments 1 and 3: Dass der Inlineskater / die Radkappe letzten Mittwoch auf dem Feldweg / zur Ampel that the inline skater / the wheel cap last Wednesday on the farm road / to the traffic light

gerollt ist / hat, verwunderte den Verkehrspolizisten. rolled BE/HAVE-3sg amazed the traffic policeman.

'That the inline skater / the wheel cap rolled on the farm road / to the traffic light last Wednesday amazed the traffic policeman.'

TELICITY is varied by using a goal or locative adverbial specifying a telic or atelic reading (cf. also (4a, b) above). Agentivity, i.e. control, is manipulated via the factor ANIMACY. Finally, BE/HAVE is alternated by using *sein* BE or *haben* HAVE. All verbs used in Experiment 1 are flexible with respect to these factors. The type and amount of verbs in German that fulfill all requirements is rather limited. Six verbs denoting motion processes that are intransitive, i.e. lack a second nominal argument, or have a predominant intransitive reading in German are suitable for our purposes. The verbs are *fliegen* 'fly', *rollen* 'roll', *schweben* 'float, hover', *schlingern* 'swerve, lurch', *schwimmen* 'swim, float', and *wirbeln* 'swirl, whirl'.

Let us discuss the putative position of the verbs tested in our study along the ASH. Two of our verbs were also tested by Keller and Sorace (2003). These are *schwimmen* 'swim, float' and *schweben* 'float, hover'. Keller and Sorace classify the first verb as a controlled motional process and place this verb class next to the unergative extreme on the ASH; the second verb is analyzed as a continuation of positional state and allotted an intermediate ASH-position (see (3) above). Both analyses are questionable. The preferred reading of *schweben* is 'float', since this verb is inherently locomotional in the terminology of Randall et al. (2004). By this we mean that in the normal course of events *schweben* denotes an unspecified change in the position of motion verbs on the telicity scale, this component enhances their telicity and hence their preference for BE, even in atelic contexts. As to *schwimmen*, it can be used with both animate and inanimate subjects in German (as opposed to *swim* in English). Hence, the event expressed by *schwimmen* is not necessarily under the control of an animate agent. This distinguishes this verb from other verbs Keller and Sorace classified as controlled motion processes (e.g. *wandern* 'hike', *schlurfen* 'shuffle', *rennen* 'run', *tanzen* 'dance' and *hüpfen* 'hop').<sup>6</sup> In sum, the verbs tested in our study can be ranked on the ASH in an intermediate position that is closer to the unaccusative extreme than to the unergative one. For intermediate verbs, Keller and Sorace (2003:88) assume an impact of agentivity in some languages.

#### 3.1.3. Data acquisition and analysis

For each of the six verbs tested in Experiment 1 we created two lexical sets of subject noun phrases (NPs) and adverbial prepositional phrases (PPs) to compensate for the few suitable motion verbs. This leads to twelve experimental items in each of the eight conditions, due to a fully crossed  $2 \times 2 \times 2$  design with the factors ANIMACY (animate vs. inanimate), TELICITY (telic vs. atelic) and BE/HAVE (BE vs. HAVE). This resulted in a total of 96 experimental tokens. The main clause was identical for each instance of a set.

We also constructed twelve fillers with the same structure. We chose six intransitive verbs that are only acceptable with HAVE (e.g. *arbeiten* 'work') and six verbs only acceptable with BE (e.g. *entkommen* 'escape'). We constructed each filler with both auxiliaries, which resulted in twenty-four fillers, where twelve are deemed unacceptable.

In a pilot study we tested the material in a complete within-participant design. BE vs. HAVE is the experimental manipulation that leads to the most pronounced differences in acceptability judgments, since, as described in greater detail above, BE is strongly preferred over HAVE with the motions verbs under investigation. In order to prevent BE vs. HAVE becoming the only decision criterion for the participants, we decided to present this factor between-participants for the current study.

We split the experimental items evenly over eight lists in a Latin-Square design, so that every list contained every value and value combination for ANIMACY and TELICITY. Four lists contained only the auxiliary BE, while the other four contained only HAVE. To the twelve experimental items per list we added twelve fillers (six acceptable and six unacceptable, depending on the auxiliary). The lists were then pseudo-randomized.

Each participant was presented with one of the eight lists as a paper-and-pencil questionnaire. The participants were asked to judge the items on a bipolar four-point scale regarding linguistic acceptability ("sprachliche Akzeptabilität").

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<sup>&</sup>lt;sup>6</sup> The position of controlled motion processes close to the unergative extreme is questionable, as shown by Randall et al. (2004) and Legendre (2007).

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Fig. 1. Rating scale for Experiment 1.



Fig. 2. Model formula of the regression model for Experiment 1.



Fig. 3. Bars represents the mean rating for every condition (higher values showing greater acceptability than lower ones). Error bars show the standard error.

In the task instruction, we specified only the endpoints of the scale: the positive endpoint A was characterized as applicable only for sentences where all phrasings are fully acceptable (converted into 4 for the analysis); the negative endpoint D (converted into 1 for the analysis) was described as applicable only for sentences which include phrasings that are fully unacceptable. The intermediate points were not described. Besides A–D we also used happy and unhappy emoticons to clarify the scale for each item, as shown in Fig. 1.

To account for the scale of measurement of our dependent variable we decided to fit a multi-level cumulative logit regression model (ordered logistic regression) (cf. Agresti, 2002) using the ordinal package (Christensen, 2015) with R (version 3.3.1, R Core Team, 2016). This kind of regression analysis models the probability of an item getting judged with a specific mark. We included the factors ANIMACY, TELICITY and BE/HAVE and all their interactions as predictors. All predictors were sum-coded.

We represented the design of our study in the random effect structure of the model by including by-participant random intercept and slopes for ANIMACY and TELICITY and their interaction and by-item random intercept and slopes for all three predictors and their interactions. The model formula is shown in Fig. 2.

To determine the statistical significance we used Wald's z-test on the regression coefficients.

## 3.1.4. Results

The average rating for each condition is shown in Fig. 3 and the descriptives are reported in Table 1.

HAVE received significantly lower ratings than BE (see BE/HAVE in Table 2). We found a two-way interaction between TELICITY and BE/HAVE reflecting better ratings for HAVE in the atelic (locative) condition than in the telic one, while for

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Mean ratings (higher values showing greater acceptability than lower o	ones) and standard dev	viations for each cor	ndition.
Table 1			

BE/HAVE	TELICITY	ANIMACY	Mean rating	Standard deviation
BE (sein)	Atelic	Animate	2.69	0.93
BE (sein)	Telic	Animate	3.17	0.86
BE (sein)	Atelic	Inanimate	2.59	0.96
BE (sein)	Telic	Inanimate	3.12	0.91
HAVE (haben)	Atelic	Animate	2.19	0.96
HAVE (haben)	Telic	Animate	1.52	0.63
HAVE (haben)	Atelic	Inanimate	2.46	1.02
HAVE (haben)	Telic	Inanimate	1.42	0.63

Table 2	
Parameter estimates for the fixed effects and the threshold coefficients <sup>a</sup>	<sup>a</sup> of the regression model for Experiment 1

Fixed effect	Estimate	Standard error	z-Value	<i>p</i> -Value
TELICITY	0.364	0.124	2.942	.003
ANIMACY	0.179	0.164	0.714	.475
BE/HAVE	1.548	0.300	5.165	<.001
TELICITY $\times$ ANIMACY	-0.038	0.130	-0.289	.772
TELICITY $\times$ BE/HAVE	-1.094	0.140	-7.793	<.001
ANIMACY $\times$ BE/HAVE	0.044	0.107	0.414	.679
$TELICITY \times ANIMACY \times BE/HAVE$	0.157	0.096	1.647	.099

Thresholds coefficien	its		
Threshold	Estimate	Standard error	z-value
1 2	-2.0424	0.212	-9.656
2 3	0.3792	0.199	1.910
3 4	2.7747	0.222	12.480

<sup>a</sup> Although the thresholds are an integral part of the model, they are not of primary interest for interpretation (Agresti, 2002:280f). They could be compared to the intercepts of a logistic regression model for each rating level compared to the preceding rating level. The fixed effects, regardless of the thresholds, represent the overall results independently of the response levels. They can be interpreted as fixed effects of logistic regression models in general.

BE the telic (goal) condition is rated better than the atelic one (see TELICITY  $\times$  BE/HAVE in Table 2). The accompanying main effect of TELICITY (see Table 2) seems to arise rather from the stronger disadvantage for the telic condition with HAVE than for the atelic condition with BE, thereby yielding overall lower ratings for the telic condition than for the atelic one. The three-way interaction shows no statistically significant effect (see TELICITY  $\times$  ANIMACY  $\times$  BE/HAVE in Table 2). However, there is a numerical trend indicating that inanimates in the atelic condition with HAVE are rated better than animates (see the descriptives in Table 1). The full model output is reported in Table 2.

#### 3.1.5. Discussion

As expected from our semantic analysis of the tested motion verbs, auxiliary selection for these verbs is strongly biased in favor of BE, as assumed in the literature (e.g. Randall et al., 2004; Legendre, 2007). As mentioned above in section 3.1.2, these verbs can be classified as telic to some extent in German. The reason is that they are inherently locomotional, even in atelic contexts. Auxiliary selection is modulated by TELICITY as follows: HAVE in the atelic (locative) condition is rated better than in the telic (goal) condition, while for BE the telic (goal) condition is judged more acceptable than the atelic one. This impact of TELICITY on auxiliary selection is in line with the uncontested assumption in previous research that (a)telicity influences BE vs. HAVE (see BeHaveTel in (13b) above).

Our results pertaining to language comprehension are supported by initial findings from language production. We conducted a pilot corpus study using the using the Mannheim German Reference Corpus (Institut für Deutsche Sprache, 2012) for the six verbs used in Experiments 1 and 3. Our pilot study, which considered 287 tokens, points in the same direction as the above-mentioned results for Experiment 1. HAVE is attested for each verb (29 tokens), but it is used more rarely (10.10% of attestations across all six verbs) and it only occurs in atelic contexts. BE is selected much more frequently (258 tokens) than HAVE (89.90% across all six verbs) and it is used for each verb in both telic and atelic contexts.

Regarding the impact of agentivity (tested via animacy), neither the two-way interactions (ANIMACY by TELICITY and ANIMACY by BE/HAVE) nor the three-way interaction ANIMACY, TELICITY and BE/HAVE are statistically significant. We will offer a tentative explanation for this result by comparing German and Chinese in section 4. In German, we have only found a numerical trend that is nevertheless worth mentioning: in the atelic (locative) condition with HAVE, inanimates are rated somewhat better than animates. Interpreted cautiously, this numerical trend challenges the prediction Be/HaveAg in (13a) above, which categorically excludes agentivity as a factor for BE/HAVE selection. Furthermore, it casts some doubt on the assumption of an inverse correlation between agentivity and BE/HAVE. Recall that Be/HaveAgInverse in (14b) above predicts that HAVE is preferred for animates against inanimates. The numerical trend points into the opposite direction toward Be/HaveAgHarmonic in (15b).

#### 3.2. Behavioral data in Chinese: Experiment 2

In order to test our predictions for Mandarin Chinese, we conducted an acceptability rating study.

## 3.2.1. Participants

Fifty-two students from Cologne participated on a voluntary basis in the acceptability rating study (mean age 26.1 years, age range: 20–34 years, twenty-four women). All participants reported a monolingual Mandarin Chinese background and were included in the final analysis.

#### 3.2.2. Material and design

Experiment 2 used a material that was comparable to that in Experiment 1 for German. In Chinese, we tested five verb roots denoting motion: *hua* 'slide', *fei* 'fly', *fu* 'float (vertically)', *piao* 'float (horizontally)', *zhuan* 'roll, rotate'. They are flexible with respect to agentivity, telicity and *le* (BE) vs. *zhe* (HAVE). In order to investigate the interplay of agentivity and telicity for *le/zhe* in a fully crossed design, these factors were manipulated independently. A foregoing main clause introduces the referent of the animate or inanimate subject in the target sentence. This makes the definite preverbal subject more plausible. The structure of a test item and the combined set of manipulations is shown in (17a)–(17d):

t

(17)telic animate a. 助威 观众 正在 为 一位 溜冰选手 guan-zhong zheng-zai wei yi-wei liu-bing-xuan-shou zhu-wei for audience PROG one-cL skating-athlete cheer 'The audience is cheering for a skating athlete.' 那位 选手 滑到 了/着 终点线 na-wei xuan-shou hua-dao -le/-zhe zhong-dian-xian slide-RVC BE/HAVE finish line that-cL athlete 'The athlete has slid/is sliding<sup>7</sup> to the finish line.' telic inanimate b. 小学生 正在 观察 一滴 露珠 xiao-xue-sheng zheng-zai guan-cha yi-di lu-zhu pupil PROG observe one-cL dewdrop 'The pupil is observing a dewdrop.' 那滴 露珠 滑到 了/着 叶子 的 边缘 lu-zhu hua-dao -le/-zhe ye-zi de bian-yuan na-di that-cl dewdrop slide-RVC BE/HAVE leaf GEN edae 'The dewdrop has slid/is sliding to the edge of the leaf.' C. atelic, animate 观众 正在 为 --- 位 溜冰选手 助威 quan-zhong zheng-zai wei yi-wei liu-bing-xuan-shou zhu-wei audience PROG for one-cL skating-athlete cheer 'The audience is cheering for a skating athlete.' 那位 选手 在 赛道 上 滑 了/着 na-wei xuan-shou zai sai-dao shang hua -le/-zhe that-cL athlete in track on slide BE/HAVE 'The athlete has slid/is sliding on the track.' d. atelic inanimate 小学生 露珠 正在 观察 一滴 lu-zhu xiao-xue-sheng zheng-zai guan-cha yi-di pupil observe one-cL dewdrop PROG 'The pupil is observing a dewdrop.' 那滴 露珠 在 叶子 上 滑 了/着 na-di lu-zhu zai ye-zi shang hua -le/-zhe that-cL dewdrop in leaf on slide BE/HAVE 'The dewdrop has slid/is sliding on the leaf.'

<sup>&</sup>lt;sup>7</sup> We translate *le* with the perfect tense and *zhe* with the progressive for illustrative purposes only, without claiming that this is an exact rendering of their semantic contribution in Chinese.

In the subject-verb construction tested in Experiment 2, agentivity was manipulated via animacy, as shown in (17a, c) vs. (17b, d). In addition, a telic reading was obtained by attaching the resultative verb complement (RVC) 到 *dao* to the root of the motion verb (cp. Smith, 1997:282; Xiao and McEnery, 2004:72), as shown in (17a, b). An atelic reading was obtained by adding the locative preposition 在 *zai* 'in, at' (cp. Xiao and McEnery, 2004:205f.).

Our test items have a preverbal subject position due to the following limitations of the locative inversion construction, discussed by Liu (2007) and Laws and Yuan (2010) and illustrated in (7)–(8) and (11)–(12) above. First, most motion verbs cannot be used with a human agent in the locative inversion (e.g. Liu, 2007; Laws and Yuan, 2010). This means that ANIMACY cannot be manipulated. See (18):

(18) Example from Liu (2007:193)

\*Chili you-zhe yige nian qing ren pool-in swim-zhe one-cL young man 'In the pool is swimming a young man.'

Second, the locative phrase in the locative inversion cannot be further specified for a telic goal reading or an atelic location reading because it normally occurs without a preposition (Liu, 2007:182). This means that TELICITY cannot be manipulated. In sum, the interaction between ANIMACY, TELICITY and BE/HAVE cannot be tested in a fully crossed design with the locative construction. Due to these limitations and to the fact that the locative inversion is not the only construction with a variable *le/zhe*-selection, we tested sentences with preverbal subjects. As mentioned in section 1, the basic perfective function of *le* and its strong preference for telic events as well as the basic imperfective (durative) function of *zhe* and its strong dispreference for telic events hold for different types of constructions including the preverbal subject clause type tested by us.

#### 3.2.3. Data acquisition and analysis

For each of the five verbs tested in Experiment 2 we created two lexical sets of subject NPs and PPs to compensate for the few suitable motion verbs. This leads to ten experimental items in eight conditions, due to a fully crossed  $2 \times 2 \times 2$  design with the factors ANIMACY, TELICITY and BE/HAVE. This resulted in a total of 80 experimental tokens.

We also constructed thirty-two fillers, where sixteen are deemed unacceptable, half of them due to syntactic reasons, half due to implausibility. The other sixteen fillers have the same structure as the stimuli. They include four change of location verbs (e.g. *lai* 'come') and four controlled non-motion verbs (e.g. *deng* 'wait'), which were presented in both the telic + *le* condition and the atelic + *zhe* condition. The change of location verbs in the atelic + *zhe* condition and the controlled non-motion are deemed unacceptable.

We split the experimental items evenly over four lists following a Latin-Square design. Every list contained every value combination for ANIMACY and TELICITY and BE/HAVE. To the twenty experimental items per list we added the set of thirty-two fillers described above. The lists were then pseudo-randomized.

Each participant was presented with one of the four lists as a paper-and-pencil questionnaire. The participants were asked to judge the items on a bipolar four-point scale regarding their linguistic adequacy. In the task instruction, we specified that fully adequate sentences should be marked with A (converted into 4 for the analysis); sentences including rather adequate phrasings should be marked with B (converted into 3 for the analysis); sentences including rather inadequate phrasings should be marked with C (converted into 2 for the analysis); finally, sentences including some fully inadequate phrasing should be marked with D (converted into 1 for the analysis). We used letters to clarify the scale for each item and the endpoints of the scale, namely A and D, were labeled with the above-mentioned description, as shown in Fig. 4.

As in Experiment 1, we fitted a multi-level cumulative logit regression model. We included the factors ANIMACY, TELICITY and BE/HAVE and all their interactions as predictors. All predictors were sum-coded. We represented the design of our study in the random effect structure of the model by including by-participant and by-item random intercepts and slopes for ANIMACY, TELICITY and BE/HAVE and their interactions. The model formula is shown in Fig. 5.

#### 3.2.4. Results

The average rating for each condition is shown in Fig. 6 and the descriptives are reported in Table 3.

We found a TELICITY by ANIMACY interaction reflecting that in the telic condition, animate subjects are rated better than inanimate ones, while in the atelic condition, inanimate subjects are rated better than animate ones

A 我认为这个句子非常	В	С	D 我认为某些表述非常不
恰当			恰当
'I regard this sentence			'I regard some phrasings
as fully adequate'			as fully inadequate'

Fig. 4. Rating scale for Experiment 2.

Fig. 5. Model formula of regression model for Experiment 2.



Fig. 6. Bars represents the mean rating for every condition (higher values showing greater acceptability than lower ones). Error bars show the standard error.

Table 3

Mean ratings (higher values showing greater acceptability than lower ones) and standard deviations for each condition.

BE/HAVE	TELICITY	ANIMACY	Mean rating	Standard deviation
BE (le)	Atelic	Animate	2.24	0.91
BE (le)	Telic	Animate	3.64	0.67
BE (le)	Atelic	Inanimate	2.32	0.93
BE (le)	Telic	Inanimate	3.45	0.83
HAVE (zhe)	Atelic	Animate	3.38	0.87
HAVE (zhe)	Telic	Animate	2.13	1.04
HAVE (zhe)	Atelic	Inanimate	3.58	0.72
HAVE (zhe)	Telic	Inanimate	2.03	1.04

#### Table 4

Parameter estimates for the fixed effects and the threshold coefficients of the regression model for Experiment 2.

Fixed effects					
Effect		Estimate	Standard error	z-Value	<i>p</i> -Value
TELICITY		0.133	0.221	0.599	.549
ANIMACY		-0.030	0.223	-0.136	.892
BE/HAVE		0.274	0.212	1.292	.196
$TELICITY \times ANIMACY$		-0.382	0.128	-2.995	.003
$TELICITY \times BE/HAVE$		-2.198	0.243	-9.031	<.001
$ANIMACY \times BE/HAVE$		0.231	0.109	2.124	.034
$TELICITY \times ANIMACY$	$\times$ BE/HAVE	-0.004	0.140	-0.300	.099
Thresholds coefficients					
Threshold	Estimate		Standard error		z-Value
1 2	-3.544		0.347		-10.225
2 3	-1.071		0.324		-3.301
3 4	1.086		0.320		3.393

(see TELICITY × ANIMACY in Table 4). The TELICITY by BE/HAVE interaction shows that telic conditions are rated better with BE (*le*), while atelic conditions are rated better with HAVE (*zhe*) (see TELICITY × BE/HAVE in Table 4). Finally, animates are rated better with BE (*le*), while inanimates are rated better with HAVE (*zhe*) as reflected by the significant ANIMACY by BE/HAVE interaction (see ANIMACY × BE/HAVE in Table 4). We found no main effects for any of the predictors. The full model output is reported in Table 4.

#### 3.2.5. Discussion

There is no overall preference for BE (*le*) or HAVE (*zhe*) with the tested motion verbs in Chinese. By contrast, in German, there is an overall preference for the tested motion verbs to select BE. We will discuss this difference in section 4. Returning to Chinese, telic conditions are rated better with BE (*le*), while atelic conditions are judged more acceptable with HAVE (*zhe*). This result is in line with the correlations assumed in the literature (e.g. Smith, 1997:271f.; Klein et al., 2000:763; Xiao and McEnery, 2004:188f.) and the findings in German. It supports the uncontested assumption in previous research that (a)telicity influences BE vs. HAVE (see BeHaveTeI in (13b) above).

Regarding the ANIMACY by BE/HAVE interaction, animates are rated better with BE (*le*), while inanimates are rated better with HAVE (*zhe*). This result contradicts the prediction Be/HaveAg in (13a) above, which categorically excludes agentivity as a factor for BE/HAVE selection. It supports the hypothesis Be/HaveAgHarmonic in (15b) above and challenges Be/HaveAgInverse in (14b). This firm experimental result pertaining to motion verbs consolidates the observations about continuation of state verbs in the locative inversion made by Liu (2007) and Laws and Yuan (2010) reported in section 1 of this paper. The result of Experiment 1 for German and of Experiment 2 for Chinese point into the same direction. Recall the numerical trend we reported for German indicating that in the atelic conditions with HAVE, inanimates are rated better than animates.

#### 3.3. The event-related potentials study for German: Experiment 3

Despite their merits, acceptability ratings evaluate test sentences as a whole and thus are unsuitable to tease apart the influence of ANIMACY and TELICITY on the verb lexeme from the impact of these factors on BE/HAVE-selection. The time-sensitive ERP data to be presented below are more informative in this respect.

Event-related potentials are electrical voltage fluctuations that reflect the brain's spontaneous neural activity which arises in response to a cognitive or sensory event. Comparisons between two minimally differing conditions reveal processing differences indexed by polarity (negative- or positive-going voltage change), latency (in millisecond resolution), the amplitude of the signal (i.e. the magnitude of the response), and topography (maximum activity relative to electrode position). Together with functional considerations (i.e. conditions under which an effect occurs), polarity, latency, and topography are jointly used to classify so-called ERP components, that is, particular ERP deflections that are ascribed a certain functional significance. The amplitude of ERP deflections, by contrast, is typically viewed as a measure of effect size. ERP component nomenclature is often based on polarity and peak latency, i.e. time from stimulus onset to peak of the difference between a critical and a control condition. Thus, for example, N400 denotes a negativity with a peak latency of around 400 ms and P300 a positivity with a peak latency of around 300 ms. The ERP method is able to reflect the discrete time course dynamics of language processing relative to the onset of a stimulus and is particularly well-suited to tease apart the incremental processing of the different constituents of the clause. For our current research aim, which is the interplay between agentivity and telicity, teasing apart processing of the verb lexeme and processes related to the auxiliary promises to be particularly rewarding.

The ERP data that we present below were elicited within a more comprehensive experiment investigating the contribution of inferences triggered by the verb's co-constituents to the interpretation of semantic roles and event structure and to explore how these inferences are assembled step-by-step with respect to each other and with the verb's meaning (Philipp et al., submitted for publication). The relevant variables for this research question were ANIMACY and TELICITY, i.e. a locative or goal phrase, as shown in (16) above (repeated in (19) below for convenience). The manipulation of the auxiliary BE vs. HAVE was not directly relevant for the main issue in Philipp et al. (submitted for publication) but was suitable to draw participants' task-related attention away from the relevant variables. Parts of section 3 in the present paper including the description of the participants, the material, the design and of the data acquisition and analysis follow Philipp et al. (submitted for publication). The results of Philipp et al. (submitted for publication) regarding the processing of the verbal participle will be discussed below (section 3.3.5.2) since they are pertinent to the topic of the present paper.

In section 2, we introduced the general predictions for our studies. At this point, we would like to specify them in terms of expected ERP modulations. The first prediction stated in (13b) above captures the uncontested fact that telic contexts favor BE and atelic contexts HAVE. In our ERP experiment, participants were first presented a stimulus sentence (see section 3.3.3 for details) and then asked to judge the acceptability of this sentence (binary choice YES/NO). The auxiliary was the last piece of information that enabled an acceptability decision. The results of this acceptability rating show that the interaction TELICITY × AUXILIARY has the highest influence on acceptability (see Philipp et al., submitted for publication for details). Previous ERP literature on sentence processing suggests that binary-choice acceptability tasks are strongly associated with a particular ERP component well-known as P3b. The P3b is a member of the P300 family of ERP components that is considered to be task-sensitive and critically linked to detection or decision processes (e.g. Nieuwenhuis et al., 2005; Sassenhagen et al., 2014). In language (e.g. Molinaro and Carreiras, 2010; Vespignani et al., 2010; Bornkessel-Schlesewsky and Schumacher, 2016), the P3b has been related to predictable task-related events, such as the expected antonym in sentences like *The opposite of black is white* (Roehm et al., 2007). The P3b

peaks earlier for the detection of a preferred (i.e. predicted) constellation and later for a dispreferred (i.e. unpredicted) one, especially when there is a binary choice between a highly preferred and a dispreferred unit (Roehm et al., 2007; Kretzschmar, 2010; Bornkessel-Schlesewsky et al., 2015; Haupt et al., 2008). Following the above-mentioned studies, we predict that the detection of the preferred auxiliary, i.e. BE in telic contexts and HAVE in atelic contexts, results in an earlier-peaking P3b; the dispreferred auxiliary, i.e. BE in atelic contexts and HAVE in telic contexts, is expected to elicit a late-P3b component. However, we are not sure what impact the bias for BE with the motion verbs under study will have on these ERP patterns.

It is important to keep in mind that in our study, the auxiliary was the last word in the critical test clause with the verbal participle preceding it. This is a crucial difference between our study and the ERP study of Roehm et al. (2012) mentioned in the introduction, where the auxiliary was in second position and the verbal participle came last. Roehm and colleagues found an N400 at the verbal participle when the meaning of the verb did not match the auxiliary. However, the auxiliary was not analyzed in this study.

## 3.3.1. Participants

Twenty-nine monolingual native-speakers of German (mean age 24.8 years, age range: 19–36 years, twenty-two women, all undergraduate students at the University of Cologne) participated in this experiment. None of them reported reading or speech disorders nor any psychological or neurological impairments. All participants were right-handed (assessed by an adapted German version of the Oldfield-handedness questionnaire, Oldfield, 1971).

This study was carried out in the Experimental Linguistics Lab at the University of Cologne (XLinC) in accordance with the national and institutional recommendations adopted by XLinC, which the authors are members of. XLinC received an ethics approval from the Ethics Committee of the German Linguistic Society (https://dgfs.de/de/inhalt/ueber/ethikkomission.html, Deutsche Gesellschaft für Sprachwissenschaft, DGfS) for conducting non-invasive behavioral, eye tracking, and EEG studies with healthy adults (age between 18 and 65) that is in full conformity with the guidelines of the Deutsche Forschungsgemeinschaft (German Research Council, DFG) for non-invasive studies, such as EEG (www.dfg.de/foerderung/faq/geistes\_sozialwissenschaften/). All subjects gave written informed consent in accordance with the Declaration of Helsinki. All participants were paid for participation.

#### 3.3.2. Material and design

As the time course of sentence processing is of particular interest in an ERP study, the order in which the stimuli are presented is crucial (usually, as in our experiment, a word or a phrase in a rapid serial visual presentation (RSVP) method). The incremental processing flow not only involves an evaluation of the current input with respect to various linguistic information types (e.g. word order, morphological and lexical-semantic information), but it also involves evaluation of these types of information with respect to preceding information units (e.g. associative-semantic and morpho-syntactic interpretation, cf. e.g. Crocker, 1994; Marslen-Wilson, 1973; Stabler, 1994) as well as computation of particular and general predictions with regard to potentially upcoming input and currently upheld interpretation (cf. e.g. Hagoort et al., 2004; Kutas and Federmeier, 2000; Stabler, 1994).

All pieces of information that are relevant for auxiliary selection in our study – semantic role, i.e. animacy, telicity and verb lexeme meaning – should be presented before the auxiliary. In order to avoid the interference of discourse-related factors such as information structure (e.g. Lenerz, 1977), the stimulus sentence should contain basic (i.e. unmarked) order and should not be preceded by additional material. We inserted a temporal adverbial between the noun phrase and the locative or goal adverbial in all conditions, e.g. *Dass der Inlineskater letzten Mittwoch auf dem Feldweg* 'that the inline skater last Wednesday on the farm road'. This addition is meant to exclude an attributive reading of the locative adverbial, i.e. to avoid possible sentence continuations like these: *Dass der Inlineskater auf dem Feldweg einen roten Overall trägt* 'that the inline skater on the farm road wears a red jumpsuit'. The structure shown in (16) above and repeated in (19) for convenience fulfills these criteria and has been selected for our experiment.

(19) Stimulus structure for Experiment 1 and 3 (= (16) above):

Dass der Inlineskater / die Radkappe letzten Mittwoch auf dem Feldweg / zur Ampel that the inline skater / the wheel cap last Wednesday on the farm road / to the traffic light

gerollt ist / hat, *verwunderte den Verkehrspolizisten.* rolled BE/HAVE-3sg amazed the traffic policeman.

'That the inline skater / the wheel cap rolled on the farm road / to the traffic light last Wednesday amazed the traffic policeman.'

The only element preceding our critical items is a clause-initial complementizer devoid of lexical meaning. Fronting the subordinate clause containing our critical items avoids sentence wrap-up effects in ERPs elicited by the auxiliary, which

thereby does not constitute the end of the whole sentence. In sum, due to its time-sensitivity, the ERP method imposes the most severe restrictions on the order in which the stimuli have to be presented. Therefore and in order to enhance the compatibility of the results, the ordering shown in (19) was selected for the ERP study (Experiment 3) and the acceptability rating study (Experiment 1). The variables (i.e. the design consisting of the two-level factors ANIMACY, TELICITY and BE/HAVE) and the verbs selected for Experiment 3 were the same as described above for Experiment 1.

For Experiment 3, we created a total of 480 critical items. For this we paired each of the six verbs with twenty different and contextually plausible noun phrases, ten denoting animate referents, the other ten denoting inanimate ones. Always two of those pairs (an animate and an inanimate) were combined with the same contextually appropriate goal or locative prepositional phrase. Up to this point, these steps yield 240 critical items. We varied the combinations of lexical nouns and prepositional phrases as often as possible to avoid repetitions as far as possible. Finally, these items were all paired with the two auxiliaries doubling their number to 480. The resulting 480 items were then equally distributed over four experimental lists according to a Latin-Square design yielding 30 instantiations per list per condition.

In addition to the 120 critical stimuli per list, we constructed 120 filler items that entered each list using six core unaccusative verbs (e.g. *entkommen* 'escape') as well as six core unergative verbs (e.g. *arbeiten* 'work') in a balanced combination with different animate and inanimate noun phrases. Sentence structure was kept identical to the critical conditions by using subordinate clauses that precede their main clause. Fillers were balanced: 50% were grammatical and plausible, 50% were implausible or ungrammatical (ungrammatical auxiliary).

## 3.3.3. Data acquisition and analysis

The experimental sessions were conducted in a dimly lit, sound attenuated room. Participants were seated approximately 1.2 m in front of a 23-in. monitor and were asked to avoid eye blinks and excessive eye movements during stimulus presentation. The stimuli were presented visually in a word-by-word manner (RSVP, 400 ms presentation, 200 ms inter-stimulus interval, ISI) on a computer screen. Phrases (NP, PP) were presented as one string for 500 ms. Each trial began with an asterisk presented for 1000 ms in the center of the screen. After the final word in a sentence, a question mark (followed by 500 ms ISI) appeared on the screen to indicate the first task. Participants were instructed to respond via a button press (left and right, positive response was balanced over participants) within an interval of 2000 ms to judge the current sentence for acceptability (binary forced choice task).

Subsequent to the first task, a recognition task was applied to control for attentiveness by presenting a single word or a phrase on the screen. Participants had to decide whether the presented item on the screen was part of the sentence they just read or not (maximum response time 3000 ms). YES and NO responses (50% each) were balanced for left and right buttons across participants. The next trial started after an inter-trial interval of 1000 ms.

Before the presentation of the 240 experimental trials, participants completed a short practice session of ten items that were structurally identical to but not part of the experimental stimuli. After a block of 40 sentences, participants took a short break (about 2 min). Including electrode preparation, an experimental session lasted approximately 2.5 h.

The electrophysiological data were collected and digitized from 24 scalp electrodes (500 Hz digitization rate, BrainAmp-system, BrainProducts, Germany), re-referenced over linked mastoids and filtered (bandpass .3–20.0 Hz) offline. Electrooculogram was taken from four electrodes at the outer canthi (left, right) and above and below the left eye. EEG data were analyzed using EEProbe software (ANT Enschede, The Netherlands). The data were controlled for eye movement artifacts, noticeable periods were rejected (threshold 40  $\mu$ V sd/200 ms moving window). ERPs were analyzed for four lateral and two midline regions of interest (ROI) collapsing the data over three electrodes each (left-anterior: F3, FC1, FC5; right-anterior: F4, FC2, FC6; left-posterior: CP5, CP1, P3; right-posterior: CP6, CP2, P4; midline-anterior: Fz, FCz, Cz; midline-posterior: CPz, Pz, POz).

ERPs were calculated as mean voltages. Single-subject averages per condition were built by collapsing single trials from 200 ms pre-word onset to 1000 ms post word onset. As all of our experimental items use exactly the identical stimulus structure (i.e. identical sequence of word categories), each difference in the baseline period prior to the critical auxiliary should be due to the critical manipulation and not to differences in the word category of the stimuli. Therefore, i.e. to avoid baseline-induced artifacts in the ERP data, they were not baseline corrected (Drury and Steinhauer, 2012).

ERP responses relative to the critical auxiliary were analyzed as mean amplitude voltages for two different time windows chosen by visual inspection (250–400 ms and 500–700 ms). Grand averages were obtained by collapsing the single-subject averages over participants. Mean amplitude voltages were readout from single-subject average data and analyzed using hierarchical Analysis of Variance (ANOVA) including the fixed factors ANIMACY (animate vs. inanimate), TELICITY (telic vs. atelic), BE/HAVE (*sein* vs. *haben*) ROI (lateral: four levels; midline: two levels), and the random factor SUBJECT. To avoid Type-I errors due to sphericity violations (df > 1), *p*-values were adjusted using the Huynh and Feldt correction (Huynh and Feldt, 1970). Only trials with correct responses to the word recognition task entered the final ERP analysis.

Behavioral acceptability judgments (including only trials with correct responses to the word recognition task) were also analyzed with a hierarchical ANOVA including the fixed factors ANIMACY, TELICITY, BE/HAVE and the random factors



Fig. 7. Grand average ERPs relative to the auxiliary BE (onset at the vertical bar) for nine selected electrodes. Negativity is plotted upwards.

SUBJECT ( $F_1$ ) and ITEM ( $F_2$ ). Responses to the recognition task were only used to control for attentiveness and were not further analyzed (for further details see Philipp et al., submitted for publication).

### 3.3.4. Results

Data of 28 participants entered the final analysis. Data of one further participant were excluded because of poor behavioral performance.

Visual inspection of the ERP waveforms relative to the auxiliary (cf. Figs. 7 and 8) reveal a positive deflection approximately between 200 and 400 ms and between 500 and 700 ms.

Due to the complex pattern of effects, we will describe and analyze the two time intervals separately.

3.3.4.1. ERP effects between 250 and 400 ms. Visually, BE conditions exhibit the largest amplitudes within this time window with only a small variation with respect to the factors ANIMACY and TELICITY. The inanimate telic condition



Fig. 8. Grand average ERPs relative to the auxiliary HAVE (onset at the vertical bar) for nine selected electrodes. Negativity is plotted upwards.

exhibits the largest amplitude in comparison to the other BE conditions in the frontal region, while at the posterior electrode sites both telic BE conditions show a larger positivity in comparison to the atelic counterparts. In contrast, conditions with HAVE exhibit smaller positive deflections and much more variation. In particular, the difference between atelic HAVE and telic HAVE is most pronounced at posterior electrodes, peaking at the midline, while the difference is much smaller at anterior sites. Variations with respect to the factor ANIMACY seem to be very small.

This visual impression was confirmed by the repeated measures ANOVAs of ERP data for the time interval 250–400 ms. Both midline and lateral ROIs reveal a main effect of BE/HAVE (midline ROIs: F(1,27) = 20.43; lateral ROIs: F(1,27) = 22.58; all ps < .001). This confirms the visual impression of the general largest amplitudes for BE against HAVE. We also found an interaction TELICITY by BE/HAVE for midline and lateral regions (midline: F(1,27) = 4.43; lateral: F(1,27) = 6.93; all ps < .05) as well as the three-way interaction ANIMACY by TELICITY by BE/HAVE for lateral ROIs (F(1,27) = 6.25; p < .05). Resolving these interactions by the factor BE/HAVE resulted only for lateral sites in a significant effect of TELICITY within BE conditions (telic conditions more positive than atelic ones: F(1,27) = 4.82; p < .05). TELICITY was not significant for midline ROIs.

More interestingly, the three factors BE/HAVE, TELICITY and ANIMACY interacted with the factor ROI for both the midline regions (TELICITY by ROI: F(1,27) = 9.47; BE/HAVE by ROI: F(1,27) = 4.59; ANIMACY by BE/HAVE by ROI: F(1,27) = 5.35; TELICITY by BE/HAVE by ROI: F(1,27) = 8.87; all ps < .05) as well as for the lateral regions (TELICITY by ROI: F(3,81) = 5.72; BE/HAVE by ROI: F(3,81) = 5.47; ANIMACY by BE/HAVE by ROI: F(3,81) = 3.76; TELICITY by BE/HAVE by ROI: F(3,81) = 7.54; all ps < .05). Resolving these interactions along the different ROIs revealed significant main effects of BE/HAVE (midline anterior: F(1,27) = 17.56; midline posterior: F(1,27) = 20.84; left anterior: F(1,27) = 16.78; right anterior: F(1,27) = 14.97; left posterior: F(1,27) = 19.98; right posterior: F(1,27) = 25.25; all ps < .001) as well as the interactions TELICITY by BE/HAVE in posterior regions (midline: F(1,27) = 9.07; left: F(1,27) = 9.06; right: F(1,27) = 15.79; all ps < .01). Dissolving these interactions by BE and HAVE resulted in a TELICITY effect for HAVE with atelic conditions being more positive at posterior sites than telic ones (midline: F(1,27) = 11.47; p < .01; left: F(1,27) = 4.71; p < .05; right: F(1,27) = 12.27; p < .01) as well as for BE at left posterior electrodes (F(1,27) = 4.55; p < .05), with telic conditions showing a larger amplitude in comparison to atelic ones.

3.3.4.2. ERP effects between 500 and 700 ms. Visual inspection of this time interval suggests that in contrast to the first time window, conditions with HAVE show larger amplitudes than conditions with BE. Additionally, alike the first interval, HAVE conditions exhibit much more variation than their BE counterparts. In particular, while BE conditions seem not to differ to a great degree, HAVE show largest amplitudes for telic conditions in comparison to atelic ones. Furthermore, visual differences with respect to the factor ANIMACY seem to be largest for telic conditions with the animate-telic condition within HAVE showing the most positive deflection.

Repeated measures ANOVAs of the mean ERP data within the time range from 500 to 700 ms confirmed this impression. We found main effects of BE/HAVE and TELICITY for both the midline regions (BE/HAVE: F(1,27) = 29.57; TELICITY: F(1,27) = 16.35; all ps < .001) and the lateral regions (BE/HAVE: F(1,27) = 30.77; TELICITY: F(1,27) = 13.68; all ps < .001), showing larger amplitudes for HAVE against BE and for telic conditions against atelic ones. The interactions are more revealing. We found the interactions TELICITY by BE/HAVE (midline: F(1,27) = 11.74; lateral: F(1,27) = 12.82; all ps < .01), ANIMACY by TELICITY by BE/HAVE (midline: F(1,27) = 4.86; lateral: F(1,27) = 6.25; all ps < .05) and TELICITY by BE/HAVE by ROI (midline: F(1,27) = 9.35; lateral: F(3,81) = 4.91; all ps < .01). Resolving the interactions ANIMACY by TELICITY by BE/HAVE according to the values of BE/HAVE exhibited only for HAVE main effects of TELICITY (midline: F(1,27) = 21.41; lateral: F(1,27) = 20.99; all ps < .001) as well as the interactions ANIMACY by TELICITY (midline: F(1,27) = 4.66; lateral F(1,27) = 5.52; all ps < .05). Tracking back ANIMACY within the latter interactions resulted for lateral electrode sites in a marginal effect of ANIMACY within the auxiliary HAVE and telic events (F(1,27) = 3.83; p = .06). Here, the telic condition with an animate subject shows a positivity against its inanimate counterpart.

The analyses of the TELICITY by BE/HAVE by ROI interactions along the factor ROI revealed main effects of BE/HAVE and TELICITY for midline and lateral electrode sites (BE/HAVE: midline anterior: F(1,27) = 27.26; midline posterior: F(1,27) = 25.65; left anterior: F(1,27) = 22.67; right anterior: F(1,27) = 26.74; left posterior: F(1,27) = 23.33; right posterior: F(1,27) = 31.56; all ps < .01; TELICITY: midline anterior: F(1,27) = 12.74; midline posterior: F(1,27) = 15.80; left anterior: F(1,27) = 8.69; right anterior: F(1,27) = 8.24; left posterior: F(1,27) = 12.45; right posterior: F(1,27) = 13.89; all ps < .01 as well as the interactions TELICITY by BE/HAVE (midline anterior: F(1,27) = 7.73; midline posterior: F(1,27) = 14.65; all ps < .01; left anterior: F(1,27) = 7.22; right anterior: F(1,27) = 5.02; all ps < .05; left posterior: F(1,27) = 15.97; right posterior: F(1,27) = 17.33; all ps < .001). The within-ROI effects of TELICITY reach the threshold of significance only for the auxiliary HAVE for midline electrodes (midline-anterior: F(1,27) = 18.02; midline-posterior: F(1,27) = 22.32; all ps < .001) as well as for lateral regions (left anterior: F(1,27) = 15.13; right anterior: F(1,27) = 10.78; left posterior: F(1,27) = 22.77; right posterior: F(1,27) = 23.43; all ps < .01) with telic conditions showing larger amplitudes in terms of a positive deflection in comparison to atelic conditions.

#### 3.3.5. Discussion

For the main topic of the present paper, which is the interplay between agentivity and telicity, it worthwhile disentangling processing of the verb lexeme from processes related to the auxiliary. To this end, we will first discuss the ERP results obtained for the auxiliary in Experiment 3 and then compare these results with the ERP data for the verbal participle provided in Philipp et al. (submitted for publication). As mentioned, Philipp et al. (submitted for publication) investigate the same data set relative to constituents that precede the clause-final auxiliary.

3.3.5.1. Auxiliary. The processing of BE vs. HAVE may be affected, in principle, by all three types of information available prior to the auxiliary: animacy information, telicity inferred from the semantics of the adverbial PP and the verb meaning referring to a process of motion. The positivity effects we have found at the auxiliary are most plausibly classified as P3b effects due to their posterior topography. Let us recapitulate the results at the auxiliary and illustrate them in Table 5 for convenience.

Let us start the detailed discussion of our results with the main effect of BE/HAVE. Given the bias of the verbs under study in favor of BE, which was confirmed in Experiment 1 and our pilot corpus study, our results are as expected from the literature on the P3b in language processing. BE, the preferred auxiliary, elicited an enhanced early-P3b. HAVE, the dispreferred auxiliary, evoked an enhanced late-P3b.

More interestingly, we found interactions between BE/HAVE, TELICITY and electrode sites, which, after being resolved for topographic distribution, yielded the following significant results. In the earlier time window (250–400 ms), ERP waves at posterior sites were more positive for HAVE in atelic conditions compared to telic ones and for BE in telic conditions compared to atelic ones. In the later time window (500–700 ms), there were larger P3b amplitudes for telic (vs. atelic) contexts with HAVE. Again, these patterns were most pronounced at posterior sites. Our results are partially as expected from the literature on the P3b in language processing. As mentioned at the beginning of section 3.3, the detection of the preferred auxiliary, i.e. BE in telic contexts and HAVE in atelic contexts, was expected to elicit an earlier-peaking P3b. This is what we have observed. The dispreferred auxiliary, i.e. BE in atelic contexts has been confirmed, the expected effect for BE in atelic contexts failed to obtain. This asymmetry between BE and HAVE is plausibly explained by the finding of our pilot corpus study that BE is attested in both atelic and telic contexts while HAVE only occurs in atelic contexts (see section 3.1.5). The dispreference for HAVE in telic contexts is greater than the dispreference for BE in

#### Table 5

Summary of the ERP effects of Experiment 3 on the auxiliary (BE/HAVE). Compared groups are divided by a dotted line. Bold letters mark a more positive deflection for a condition. Condition pairs with significant effects (i.e. amplitude differences in the P3b component) are shaded. Abbreviations: B/H = BE/HAVE, TEL = TELICITY, ANIM = ANIMACY.

	BE	telic	animate
250-400ms		atelic	animate
P3b			inanimate
early	HAVE	telic	animate
decision			inanimate
regarding		atelic	animate
preferred			inanimate
auxiliary	main effect BE >	B/H x TELICITY:	
	HAVE	BE telic > atelic;	
		HAVE atelic > telic	
	BE	telic	animate
	BE	telic	animate inanimate
500-700ms	BE	telic atelic	animate inanimate animate
500-700ms <b>P3b</b>	BE	telic atelic	animate inanimate animate inanimate
500-700ms <b>P3b</b> delayed	BE HAVE	telic atelic <b>telic</b>	animate inanimate animate inanimate <b>animate</b>
500-700ms <b>P3b</b> delayed decision	BE HAVE	telic atelic <b>telic</b>	animate inanimate animate inanimate <b>animate</b> inanimate
500-700ms <b>P3b</b> delayed decision regarding	BE HAVE	telic atelic <b>telic</b> atelic	animate inanimate animate inanimate <b>animate</b> inanimate animate
500-700ms P3b delayed decision regarding dispreferred	BE HAVE	telic atelic <b>telic</b> atelic	animate inanimate animate inanimate inanimate animate inanimate inanimate
500-700ms <b>P3b</b> delayed decision regarding dispreferred auxiliary	BE HAVE main effect HAVE >	telic atelic <b>telic</b> atelic B/H x TELICITY:	animate inanimate animate inanimate animate animate inanimate B/H x TEL x ANIM:
500-700ms <b>P3b</b> delayed decision regarding dispreferred auxiliary	BE HAVE main effect HAVE > BE	telic atelic <b>telic</b> atelic B/H x TELICITY: HAVE telic > atelic	animate inanimate animate inanimate animate animate inanimate B/H x TEL x ANIM: HAVE telic animate >

atelic contexts (cp. also the mean ratings in Table 1). This might explain why only the first constellation evoked an enhanced late-P3b. Our ERP results are also in conformity with the linguistic literature, which unanimously assumes that BE is preferred in telic contexts while HAVE is preferred in atelic contexts (see BeHaveTel in (13b) above).

Finally, visual inspection of ERP waveforms and the significant three-way interaction ANIMACY by BE/HAVE by TELICITY revealed marginally larger late-P3b amplitudes for animates (vs. inanimates) in telic contexts involving HAVE. We cautiously take this weak trend to point into the direction of Be/HaveAgHarmonic in (15b) and to challenge Be/HaveAgInverse in (14b). They are also compatible with the numerical trend reported in Experiment 1 that inanimates are rated better than animates in atelic contexts with HAVE.

Our results also extend previous neurolinguistic research showing that, for lexical-semantic integration, P3b latency distinguishes between predicted-preferred and unpredicted-dispreferred constellations. Specifically, the P3b peaks earlier and shows larger amplitudes for preferred elements compared to dispreferred ones, for which the P3b shows larger amplitudes in a later time window (Roehm et al., 2007; Kretzschmar, 2010; Bornkessel-Schlesewsky et al., 2015). In our study, there is both a general preference (i.e. prediction) for BE as well as a preferred combination of auxiliary and telicity – in each case enhancing the early-P3b amplitude. This contrasts with the P3b peaking in a later time window that is known to follow dispreferred constellations or prediction mismatches (e.g. Kretzschmar, 2010; Bornkessel-Schlesewsky et al., 2015).

In summary, we found robust effects of TELICITY on BE/HAVE selection, whereas agentivity, as varied via ANIMACY of the subject NP, showed only marginal effects. One possible explanation for this may be that ANIMACY exerted its influence prior to auxiliary processing, when the verbal participle was processed. Because ERPs elicited by the auxiliary do not necessarily reflect processing relative to preceding words, the verbal participle in this case, agentivity may have had a greater influence at the verb position without affecting auxiliary processing much. In the following section, we will therefore summarize the ERP data relative to the verbal participle as first presented by Philipp et al. (submitted for publication), and compare the ERP results from both positions with one another to shed more light on the interaction between ANIMACY and TELICITY.

3.3.5.2. Verbal participle. When the verbal participle is encountered, three types of information are assembled: animacy information from the subject noun phrase, telicity inferred from the semantics of the adverbial PP and the verb meaning referring to a process of motion. The results of Philipp et al. (submitted for publication) at the participial verb lexeme are as follows: In the telic conditions, which refer to a goal-oriented motion, conditions with an inanimate subject exhibit an N400 effect against the conditions with an animate subject; in the atelic conditions, which express an aimless motion, items with animates evoked an N400 effect against inanimate conditions. Table 6 illustrates the results (stimulus examples in English translations are also offered for convenience):

The results at the verbal participle are pertinent to the issue whether change of (positional) state is a patient or an agent property. They call into doubt the influential opinion in theoretical linguistics mentioned in the introduction that a change of positional state, as in the telic conditions, is a characteristic property of the patient role (e.g. Dowty, 1991; Pan, 1996; Ackerman and Moore, 1999; Zaenen, 1993). We have formulated this assumption as the prediction TelAgInverse in (14a) above. According to TelAgInverse, the animate-telic condition should have exhibited increased processing costs vis-à-vis the inanimate-telic condition since an agent going through a definite change of (positional) state is claimed to have conflicting role properties. As an animate entity it is preferentially interpreted as an agent, yet a definite change of state characterizes a patient in this line of research. Correspondingly, in the atelic conditions, the inanimate items should have been more difficult to process since they lack the supposedly crucial patient property of a definite change of state.

Philipp et al. (submitted for publication) found opposite patterns, as shown in Table 6. The results are consistent with TelAgHarmonic in (15a) above, which we have derived from language evolution and language acquisition studies (e.g. Rakison and Poulin-Dubois, 2001; Carpenter et al., 2005; Tomasello et al., 2005; Spelke and Kinzler, 2007; Carey, 2009). They claim that goal-directed behavior characterizes animates as agents. In this view, a participant that changes his/her positional state in a goal-directed way independently of another participant is a more prototypical agent

a. Animate e.g. <i>inline skater</i>	Atelic (locative) e.g. on the farm road		N400
b. Animate	Telic (goal)	verbal participle	
e.g. inline skater	e.g. to the traffic light	e.g. rolled	
c. Inanimate	Atelic (locative)	]	
e.g. wheel cap	e.g. on the farm road	]	
d. Inanimate	Telic (goal)		N400
e.g. wheel cap	e.g. to the traffic light		

Table 6					
The ERP effects at the verbal participle	ə (Philipp	et al.,	submitted	for publica	ation).

than a participant that moves aimlessly. The role of an inanimate entity involved in a definite (goal-oriented) change of location (our telic condition) has inconsistent role properties. As an inanimate entity it is preferentially interpreted as a patient, its goal-oriented behavior qualifies it as an agent. Therefore, it is expected to engender increased processing costs vis-à-vis an animate entity involved in a goal-oriented change of location, which is what Philipp et al. (submitted for publication) observed. Correspondingly, in the atelic conditions, which express an aimless motion, items with an animate referent were more difficult to process than items with inanimate referents because aimlessly moving animates are less prototypical agents lacking the agent property of goal-directedness.

Thus, the interaction between agentivity (inferred from animacy) and telicity plays an important role for the processing of the verb lexeme before the auxiliary is encountered. This is in line with previous research on semantic roles and verb semantics, where telicity-related notions are incorporated into the definition of either agent or patient irrespective of auxiliary selection. A comparison of the clear effects at the verbal participle with the weak effects at the auxiliary suggests that the impact of the agentivity-telicity interaction is more pronounced on the verb lexeme than on the auxiliary.

## 4. General discussion

The main aim of our experimental investigations was to scrutinize the interaction between agentivity and telicity. To this end we tested verbs of motion that are flexible with respect to agentivity, i.e. control (manipulated via animacy), telicity (manipulated via a locative vs. goal adverbial), and BE/HAVE-selection with intransitive verbs in German and Mandarin Chinese. Our experimental methods were acceptability ratings for German and Chinese (Experiments 1 and 2) and event-related potential measures for German (Experiment 3).

Pertinent research on the interaction between agentivity and telicity leads to two opposing predictions. According to research on unaccusativity, agentivity and telicity are inversely correlated (e.g. Dowty, 1991; Pan, 1996; Ackerman and Moore, 1999; Zaenen, 1993). The semantic role of an animate entity undergoing a definite change of positional state is assumed to have inconsistent role properties. As an animate argument, it is preferentially interpreted as an agent in control of the motion event, yet by going through a definite change of positional state it is a patient. An inanimate entity lacking the crucial patient property of a definite change of state is assumed to be a less prototypical patient than an inanimate entity undergoing a definite change of state. This line of research led to the prediction TelAgInverse: Inanimates in the telic (locative) condition and animates in the atelic (goal) condition are preferred against animates in the telic (goal) condition.

The prediction TelAgHarmonic, derived from core cognition research, is the opposite: Animates in the telic (goal) condition and inanimates in the atelic (locative) condition are preferred against animates in the atelic (locative) condition and inanimates in the telic (goal) condition. According to core cognition research (e.g. Rakison and Poulin-Dubois, 2001; Carpenter et al., 2005; Tomasello et al., 2005; Spelke and Kinzler, 2007; Carey, 2009), animate agents are harmonically aligned with telic events and inanimate participants with atelic events. An inanimate entity involved in a definite (goal-oriented) change of positional state is assumed to have inconsistent role properties. As an inanimate referent moving aimlessly is assumed to be a non-prototypical agent lacking the property of goal-directedness.

The two lines of research mentioned above incorporate telicity-related notions into the definition of either agent or patient, as formulated in our predictions TelAgInverse and TelAgHarmonic. This leads to the expectation that the interaction under discussion is detectable with the time-sensitive ERP method as soon as the participial verb lexeme is encountered during online processing. This is indeed what Philipp et al. (submitted for publication) observed for German. In the telic conditions, which refer to a goal-oriented motion, the inanimate conditions exhibit a processing disadvantage in form an N400 against the animate conditions; in the atelic conditions, which express an aimless motion, items with animates evoked an N400 effect against inanimate conditions. These results were obtained at the verbal participle. They are in line with the assumption of a harmonic relation between agentivity (i.e. control) and telicity (TelAgHarmonic) and challenge the opposite hypothesis of an inverse relation (TelAgInverse).

A viable way to reconcile the opposed views is to assume that the classification of change of (positional) state depends on causation. If the participant is the instigator of his/her own change of (positional) state in the event named by the verb, as in our stimulus material, it is an agent property. If the change is caused by another participant, it is a patient property. This type of explanation is proposed by Dowty (1991:574) for movement, which he classifies as a proto-agent property, but only when not caused by another participant in the event named by the verb. For Dowty, causation has priority over movement for distinguishing agents from patients. Our suggestion is that this also may hold for change of positional state (which is a specific type of movement) and possibly for change of state in general. Our studies lend support to this more differentiated view on the relation between semantic roles and telicity. However more experimental work on other verb classes, constructions and languages is needed in order to find out where else and in which ways semantic roles and telicity interact.

The results recapitulated above still leave the question unanswered whether agentivity and telicity also interact in determining BE/HAVE-selection. Research based on the Auxiliary Selection Hierarchy (ASH, e.g. Sorace, 2000; Keller

and Sorace, 2003; Aranovich, 2007; Legendre, 2007) assume that agentivity plays a role and correlates inversely with telicity in BE/HAVE-selection, as formulated in our prediction Be/HaveAgInverse: BE, which is optimal in telic contexts, is assumed to favor inanimates, i.e. non-agents. HAVE, which is optimal in atelic contexts, is expected to favor animates, i.e. agents in control of the event. The ERP effects measured for German at the auxiliary in Experiment 3 are pertinent to this question. We have found a marginal processing disadvantage for HAVE with animates in telic contexts in form of a late P3b. We cautiously take this weak trend to challenge Be/HaveAgInverse and to point into the direction of the opposite assumption Be/HaveAgHarmonic. This weak effect is compatible with the numerical trend reported in our Experiment 1 for German. With HAVE in atelic contexts, inanimates were judged slightly more acceptable than animates. The results of our Experiment 2 for Chinese are in line with the findings in German. Animates were rated better with BE (*le*) and inanimates with HAVE (*zhe*). Our combined results add experimentally firm evidence to observations made for other verb classes in previous studies (e.g. Laws, 2010 for Italian; Liu, 2007 and Laws and Yuan, 2010 for Chinese). As mentioned in section 1 of this paper, these studies offered preliminary evidence against the assumption that telicity and agentivity are opposing forces for BE/HAVE.

It is important to keep in mind that acceptability ratings, elicited in Experiments 1 and 2, evaluate test sentences as a whole and thus are unsuitable to tease apart the influence of agentivity and telicity on the verb lexeme from the impact of these factors on BE/HAVE-selection. However, for German flexible motion verbs, which we investigated in terms of acceptability ratings and ERPs, the results suggest a very weak influence of agentivity, i.e. control, on BE/HAVE-selection. This influence was statistically marginal in the ERP study (Experiment 3) and palpable only as a numerical trend in the acceptability study (Experiment 1). The results of the acceptability study for Chinese (Experiment 2) were statistically significant in both ways: Animates were rated better with BE (*le*) and inanimates better with HAVE (*zhe*), as mentioned above. These results reveal a lacuna in approaches that do not include agentivity or animacy as a factor for BE/HAVE-selection (e.g. Zifonun et al., 1997:1862f.; Engelberg, 2000:55f.; Duden, 2009:464f.; Eisenberg, 2013:99f. for German and Smith, 1997; Klein et al., 2000; Xiao and McEnery, 2004 for Chinese). The only factor for BE/HAVE is assumed to be telicity. We incorporated this assumption into the prediction Be/HaveAg.

Regarding the nature of the relation between agentivity and telicity, our results consistently support the assumption of a harmonic correlation for the verb type under study in both languages. However, there are also differences, which are worth discussing even if they are tangential to our main issue. A first difference is the bias in favor of BE in German and its absence in Chinese. A second difference is that animacy (i.e. agentivity) effects on BE/HAVE are clearer in Chinese than in German.

Pending future experimental research, our tentative assumption is that these differences are related to each other. The explanation we would like to propose is based on the hypothesis that the flexible motion verbs under investigation have the telicity feature [locomotion]. This feature was introduced for this class of verbs by Randall et al. (2004). The crucial assumption about this telicity component is that its rank is cross-linguistically variable. Its weight is high in German, leading to a preference for BE. By contrast, its rank is low in other Western European languages under investigation (Randall et al., 2004). Our finding that, in Chinese, BE/HAVE are equally preferred with these verbs might be explained by the low rank of the telicity component at issue in this language. This ranking difference means that the tested motion verbs are biased toward telicity and BE in German, and unbiased either way in Chinese. In terms of the Auxiliary Selection Hierarchy, the German verbs are closer to the unaccusative end, while the Chinese verbs are truly intermediate. It is only for intermediate verbs that Keller and Sorace (2003:88) hypothesize an impact of agentivity on BE/HAVE. Hence it is plausible to assume that the different intermediate positions these verbs occupy on the Auxiliary Selection Hierarchy in Chinese and German lead to animacy (i.e. agentivity) effects on BE/HAVE that are more pronounced in Chinese than in German.

In sum, we have no reasons to assume that the interaction between agentivity (animacy), telicity and BE/HAVEselection is fundamentally different in Chinese and German for the class of verbs under investigation. We have presented firm evidence provided by different experimental methods that agentivity and telicity are harmonically correlated for the verb type under study in both languages. The two differences we have found between Chinese and German may be plausibly treated as epiphenomena of the parameterized role of the telicity factor locomotion, i.e. internal motion. This seems to be the most parsimonious account for our present results. However, future research will need to deepen our understanding of these issues by exploring other verb classes and other languages.

#### Acknowledgements

The research reported here was supported by a grant from the German Research Foundation for the project "Agentivity, Animacy and Telicity: Pragmatic Inferences in Intransitive Clauses" within the priority programme 1727 "XPRAG – New Pragmatic Theories based on Experimental Evidence". We want to thank Ingmar Brilmayer for helpful critical comments on previous versions of the manuscript.

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