Semantic Representations of English and German Motion Verbs

Cover Page Footnote
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Semantic Representations of English and German Motion Verbs*

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It has been argued that real-world structure constrains the semantic representations of verbs, resulting in cross-linguistic convergence of naming patterns for motion events. This study explores the nature of this real-world structure by manipulating individual features of human locomotion in video stimuli and comparing the responses of English and German speakers in an elicitation task. We show that individual features influence naming patterns and that languages encode these features differently. Furthermore, the semantic representations of several German motion verbs sharply contrast with their English equivalents.

1. Introduction

Languages divide the world in different ways. Moreover, the boundaries between semantic categories within a particular language are not necessarily fixed. These two factors contribute to a complicated picture in any cross-linguistic comparison of naming patterns. Still, such research has yielded strong evidence of convergent naming patterns across languages in domains such as color (Berlin & Kay 1969; Kay et al. 1997), emotion (Eckman 1972), body terms (Majid, Enfield & van Staden 2006) and events (Majid, Boster, & Bowerman 2008; Malt et al. 2008). There are at least two major factors contributing to this convergence. First, cognitive biases shared by humans may result in similar construals. Second, there are salient discontinuities in the world to which humans attend, and it is this real-world structure that constrains naming patterns. This paper will focus on how real-world structure constrains the semantic representation of motion verbs.

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Malt et al. (2008) show that structure in the world has a strong influence on the naming patterns of motion events. In a cross-linguistic study in which participants were asked to describe human locomotion, the researchers demonstrate that Dutch, English, Japanese and Spanish speakers uniformly mark a biomechanical distinction between 'walking' and 'running' gaits when naming these events. However, gait is a cluster of co-occurring features and Malt et al.'s (2008) data do not indicate which of these features are encoded by motion verbs. Also, their study is limited to four languages and should be augmented with data from more languages.

The research we report here manipulates cadence independently from other gait features and shows that it is the latter that influence the category boundary between 'walking' and 'running' terms, but cadence influences naming on either side of the boundary. Second, it incorporates naming patterns from a German dialect that suggest Malt et al.'s (2008) claim may be too strong. Though some German verbs of human locomotion do encode the biomechanical distinction between 'walking' and 'running', the term 'laufen' (translated variously as *walk* or *run*) does not. This runs contrary to prior predictions. Moreover, the extent to which cadence influences naming may be language-dependent, as some German verbs appear to be less sensitive to manipulations of cadence than their English counterparts.

The present study therefore contributes to research of event categorization in two ways. First, it adds to our understanding of the semantic representations underlying motion verbs by providing a concise picture of the gait features speakers attend to when naming human locomotion. Second, it compares naming patterns of human locomotion in English and German, revealing unexpected patterns not present in previous cross-linguistic comparisons.

2. Naming Human Locomotion Events

Continuous human locomotion is particularly interesting due to its biomechanical complexity; it is composed of many co-occurring features. These biomechanical features include but are not limited to stride length, knee and elbow bend, foot contact with the ground, and cadence, i.e., the number of steps per unit of time (Kiss, Kocis & Knoll 2004). Combined, these features can be described as a person's gait, or their manner of motion. A speaker may draw on several of these gait features when naming a human locomotion event. Importantly, at a particular speed there is a dramatic switch between the clusters of features often categorized as a 'walking' gait—a pendulum-type body motion where at least one foot stays in contact with the ground at all times—and a 'running' gait—characterized by more elastic, springing movement (Alexander 1992), in which both feet are off the ground at once.

Malt et al. (2008) demonstrate how this real-world structure—namely the dramatic shift in gait—informs the semantic representations of motion verbs in

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Dutch, English, Japanese, and Spanish. While viewing stimuli of a woman on a treadmill at varying speed settings and inclines, participants were asked to fill in the blank in the sentence: "What is the woman doing? She is _____." The striking finding of this study was the uniformity in responses with regard to the 4.5 to 5.5 mph treadmill settings.

For each language, 'walking' terms always appeared from 4.5 mph and slower (and never over 4.5 mph) whereas 'running' terms always appeared from 5.5 mph and faster (and never under 5.5 mph). As mentioned above, this distinction marks an important gait difference. The authors argue that this cross-linguistic convergence is the result of structure in the world exerting strong influence over naming patterns.

This cross-linguistic convergence does not appear to the same extent on either side of the 4.5/5.5 mph boundary. In English, e.g., much more within-language variation for lexemes such as 'jog' and 'run' was found, where use of the latter increases with an increase in treadmill speed (between 5.5 and 8.5 mph), but it is never used 100% of the time.

While the authors acknowledge that there are many features to which speakers may attend, they admit that "the data do not tell us exactly what cues our participants were responding to" (Malt et al. 2008, p. 239). Through a small manipulation of the video stimuli in Study 1and the addition of a German dialect in Study 2, we demonstrate the detailed nature of speakers' semantic representations of gait terms and show how individual features, particularly cadence, can be a driving force behind naming patterns. We suggest that naming on either side of the 4.5/5.5 mph boundary is quite sensitive to cadence. Thus, individual features may significantly affect naming patterns in some circumstances (on either side of the 4.5/5.5 mph boundary) and not others (at the boundary marked by other gait elements).

3. Study 1: English

The first study had two primary goals. The first was to replicate the English findings of Malt et al. (2008). For this reason, we created stimuli as similar as possible to their original human locomotion study. The second goal was to explore the nature of the semantic representations that may underlie naming patterns in terms of relevant features encoded by motion verbs. This required a manipulation of the video stimuli so as to manipulate cadence while controlling other gait features. Cadence was the manipulation of choice because its manipulation with digital tools was tractable.

3.1. Stimuli

Stimuli consisted of 21 videos of a college student on a treadmill at varying treadmill settings (1 mph increments from 2.5 to 8.5 mph), in three

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different playback conditions. Seven of the videos were unmanipulated and shown at Normal Playback. Using Final Cut Express video editing software, the remaining 14 videos were digitally manipulated to be in either 'slow motion' or 'fast motion'. Seven videos were manipulated to Slow Playback, or 20% slower than Normal Playback. The remaining 7 videos were manipulated to Fast Playback, or 20% faster than Normal Playback.[1]

The Slow and Fast Playback conditions are the critical manipulation in this study. In the Normal Playback condition, all features of human locomotion are coordinated. Digital manipulation disrupts this coordination by altering cadence, i.e., the number of steps per unit of time, while controlling other gait elements. (We recognize that cadence is a sub-parameter of gait, but for the purposes of this study we refer to cadence as separate from gait, where the latter remains a collection of co-occurring features such as stride length, knee and elbow bend, ground contact, etc.). For example, with the 6.5 mph Treadmill Setting at Normal Playback, gait (stride length, knee and elbow bend, ground contact, etc.) and cadence are in sync. In the Slow Playback, all of these elements except for cadence remain constant. The stride length, knee and elbow bend, and ground contact are all identical to the Normal Playback condition. However, the cadence is different. There are fewer steps in the same amount of time. In the Fast Playback condition, there are more stride revolutions than the Normal Playback condition. In other words, this manipulation allows us to 'mismatch' cadence with other gait elements.

3.2. Methods

Stimuli were shown to 30 native English-speaking undergraduates at the University of Colorado at Boulder. All undergraduates were monolingual in English with limited experience in a foreign language. Videos were randomized to prevent order biases from previous videos and were displayed using the online survey system Qualtrics. The videos were mixed with 8 distracters featuring the same actor on a treadmill engaging in activities such as crawling and skipping.

Upon presentation of each video, participants were asked to respond to the following question: "What is the man doing? He is ______." Participants were asked to use as few words as possible when describing the motion, but using more than one word was allowed. Moreover, they were instructed to repeat any word

[1]Prior to the study, naturalness ratings for manipulated videos were obtained. Nine undergraduates at the University of Colorado at Boulder were shown video stimuli and asked to answer the question "How natural is this motion?" by providing a rating on a scale from 1 (not natural) to 5 (very natural). The mean naturalness rating for manipulated videos was 2.8, indicating that while the manipulations were noticeable, they were not unnatural.

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they used as many times as they liked. All participants viewed all videos and the data from all participants was included in the final analysis.

All responses were grouped based on the head verb. Responses such as ‘running’ and ‘running quickly’ were all grouped as ‘running’. The ‘other’ category includes responses that appeared infrequently (five or fewer times) within a Treadmill Setting, such as ‘meandering’ or ‘moseying’.

3.3. Results

The results of the first study reveal two important findings. First, the Normal Playback condition replicates the results of Malt et al.’s (2008) study. ‘Walking’ terms are used from 2.5 to 4.5 mph and ‘running’ terms are used from 5.5 to 8.5 mph.

Second, playback condition is shown to influence naming patterns on either side of the 4.5/5.5 mph boundary, such that some videos are named differently depending on playback condition. The overall effect of playback condition was confirmed by a binomial test ($p < .005$).[2] Across all Treadmill Settings (2.5 to 8.5 mph), playback speed influences naming patterns. For example, at the Treadmill Setting of 6.5 mph, the term ‘jogging’ is preferred by 83% of the participants for the Slow Playback condition, 40% for Normal Playback, and only 5% for Fast Playback. A comprehensive view of the data can be seen in Figure 1.

Figure 1 provides a very clear picture of the structure that informs these English motion lexemes: cadence seems to be a critical feature in many terms of human locomotion. Even when other gait features remain constant, a change in cadence can result in a change of the most common lexeme for that event. Indeed, the manipulation causes additional semantic categories to appear such as ‘power walking’[3], which is the most common response for 4.5 mph, but only in Fast Playback. At the very slowest cadence (2.5 mph, Slow Playback), participants are

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[2] To conduct the binomial test, 12 undergraduates from CU Boulder were asked to provide a speed ranking of the lexemes from Study 1 (e.g., ‘running’ was rated as faster than ‘jogging’ by the majority of participants). These speed rankings were then compared to the data in Study 1. Across Treadmill Settings, videos in Slow Playback were more often paired with lexemes that were rated slower than the most common lexemes in Normal Playback (e.g., ‘jogging’ < ‘running’), while videos in Fast Playback were more often paired with lexemes that were rated faster than the most common lexemes in Normal Playback (e.g., ‘running’ < ‘sprinting’). The binomial test compared the number of times the lexeme changed in the predicted direction (e.g. ‘jogging’ < ‘running’ < ‘sprinting’) to the total number times there was a lexeme change due to playback condition.

[3] ‘Power walking’ was not considered a modified form of ‘walking’, but rather a compound lexical term, in part because ‘power’ in this case does not pattern with other adverbial modifiers of ‘walking’, e.g., ‘quickly’, which can occur pre- or post-verbally.

compelled to use a term other than 'walking', though there is less agreement as to what that term should be. This accounts for the large 'other' category here, consisting of words such as 'meandering', 'sauntering', and 'moseying'.

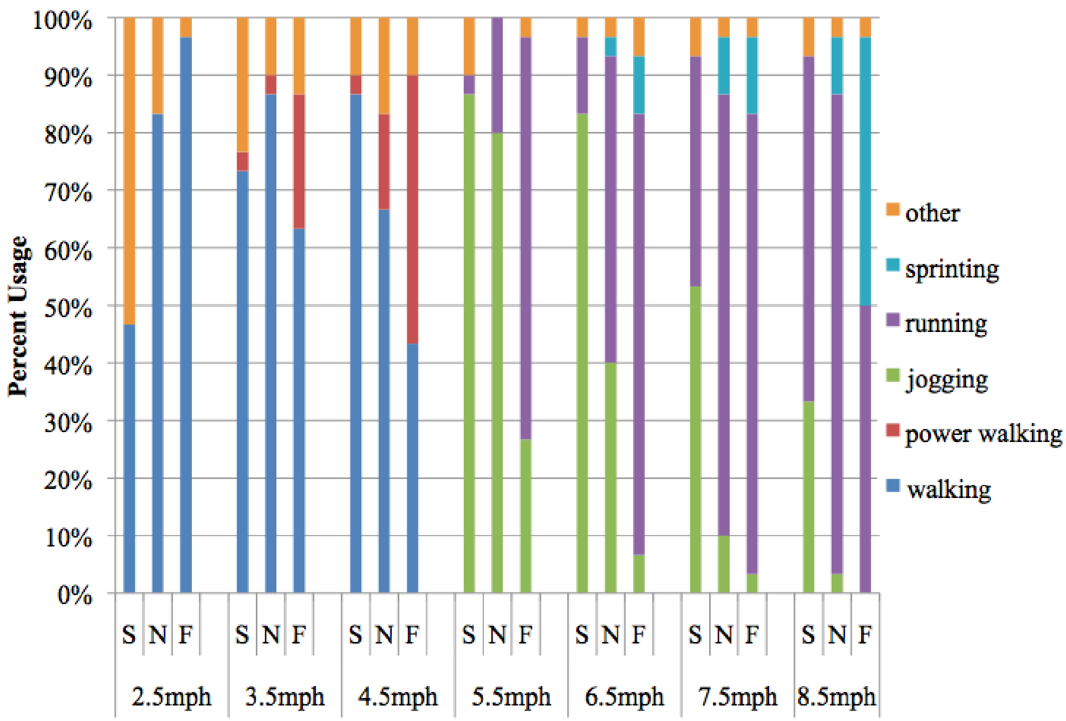

Figure 1: The English data from Study 1. Treadmill Settings from 2.5 mph to 8.5 mph and Playback Conditions are Slow (S), Normal (N), and Fast (F).

Despite their attendance to the playback manipulation, participants did not use the same lexical item to refer to stimuli on either side of the 4.5/5.5 mph boundary. Rather, at this boundary, other gait features seem to be more critical than cadence. If cadence alone were a determining feature, we might expect to see 'running' terms applied to 4.5 mph in Fast Playback, but this is not the case. Increased cadence in this condition did not 'override' the category boundary, nor did decreased cadence in the 5.5 mph Slow Playback condition. In the English data, this is without exception.

Study 1 teases apart cadence from other gait elements and shows that a change in cadence influences naming patterns on either side of the biomechanical boundary. While Malt et al. (2008) indicate that strong structure in the world influences naming patterns, they are agnostic in terms of which features are attended to. Our results indicate that there is clearly ample structure to which speakers can selectively attend, and that a single feature can play a central or peripheral role in driving naming patterns.

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4. Study 2: German

By manipulating cadence while controlling other gait elements, Study 1 provides a concise picture of what external structural elements of human locomotion influence naming patterns. It also opens up the possibility that speakers of other languages will draw upon these structural features differently than English speakers. To explore this possibility, Study 2 replicates Study 1 in a German dialect.

4.1. Stimuli

Study 2 used the same stimuli as Study 1.

4.2. Methods

The videos were shown to 28 speakers of a Bavarian dialect of German known as Rieserisch. This dialect is spoken in the Ries area, the capital of which is the town of Nördlingen. Rieserisch is closely related to the more common German dialect of Schwäbisch, spoken primarily in the state of Baden-Württemberg (Schmidt 1898). Though there are several important differences between the grammar and lexicon of Rieserisch, Schwäbisch, and standard German, specific contrasts between semantic representations of human locomotion verbs in these dialects remain largely unexplored. It is possible that Study 2's results could extend to speakers of more standard German, but this hypothesis requires further investigation.

Speakers ranged in age from 17 to 48. Participants viewed the videos on their own computers through the use of the survey system Qualtrics. Data from 4 speakers were discarded due to incompleteness. Of the remaining 24, all but 2 claimed to have relatively good knowledge of English. An additional 13 claimed knowledge of a third language, and 4 claimed knowledge of a fourth. Therefore, only 2 or the 24 participants could be described as monolingual. All, however, identified themselves as native speakers of the Rieserisch dialect.

Upon presentation of each video, participants were asked to respond to the following question: "Was macht der Mann? Er _____." (*What is the man doing? He is* _____.). Again, participants were asked to use as few words as possible when describing the motion, but using more than one was allowed. They were instructed to repeat any word they used as many times as they liked. All participants viewed all videos.

Again, all responses were grouped based on the head verb. The 'other' category includes responses that appeared infrequently (five or fewer times within a Treadmill Setting), such as 'spazieren' (*stroll*) and 'bummeln' (*saunter*).

4.3. Results

To begin, use of the term 'laufen' gives rise to three noteworthy observations. First, contrary to Malt et al.'s (2008, p. 239) predictions, the term 'laufen'—translated as either *walk* or *run*—was used to refer to stimuli on either side of the 4.5/5.5 mph boundary (see Figure 2). Close analysis indicates that 6 speakers used 'laufen' across the boundary, 14 used 'laufen' but did not cross the boundary, and 4 speakers did not use the lexeme at all. Therefore, usage of 'laufen' across the 4.5/5.5 mph boundary does not seem to be idiosyncratic or limited to one speaker. Second, the use of 'laufen' seems to be most common at 5.5 mph.

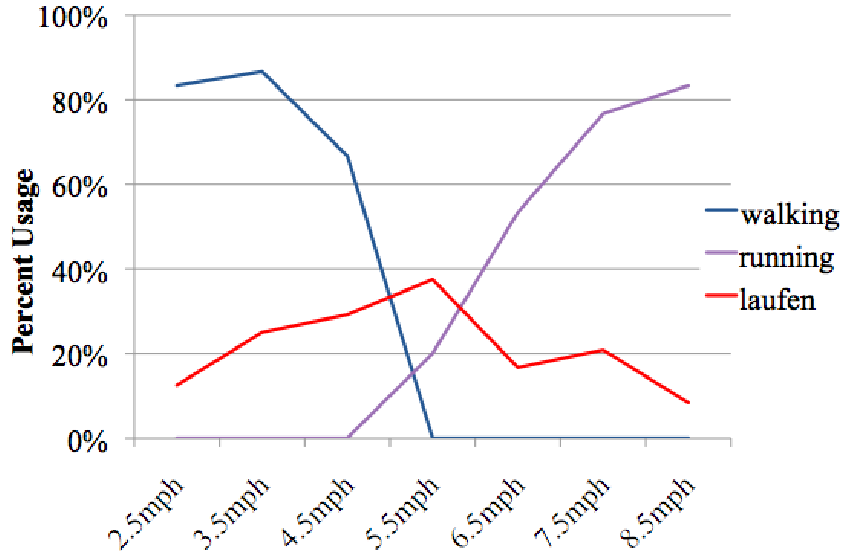

Figure 2: Comparison of English 'walking' and 'running' with German 'laufen' in Normal Playback.

Third, 'laufen' is used at every Treadmill Setting. While never the most frequent term in any given condition, 'laufen' is used with high frequency overall, equal to that of terms such as 'gehen' and 'joggen'. Hypotheses concerning these observations will be addressed in the General Discussion.

The effect of playback condition for verbs other than 'laufen' was confirmed by a binomial test ($p < .05$), indicating that a change in cadence affected the choice of lexeme.[4] The verb 'gehen' (translated as *go* or *walk*) seems to behave differently than English 'walk'. At 2.5 mph, the change in cadence did

[4] Lexical rankings for the binomial test were provided by 3 additional native Rieserisch speakers who did not contribute to the elicitation task in Study 2.

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little to change naming patterns (as seen in Figure 3). The same is true for 4.5 mph: where English speakers designate a category of 'power walking' for 4.5 mph in the Fast Playback condition, German speakers do not seem to agree on a motion lexeme in this same condition. This suggests that 'gehen' may not encode cadence in the same way 'walk' does, and therefore its underlying representation may be qualitatively different.

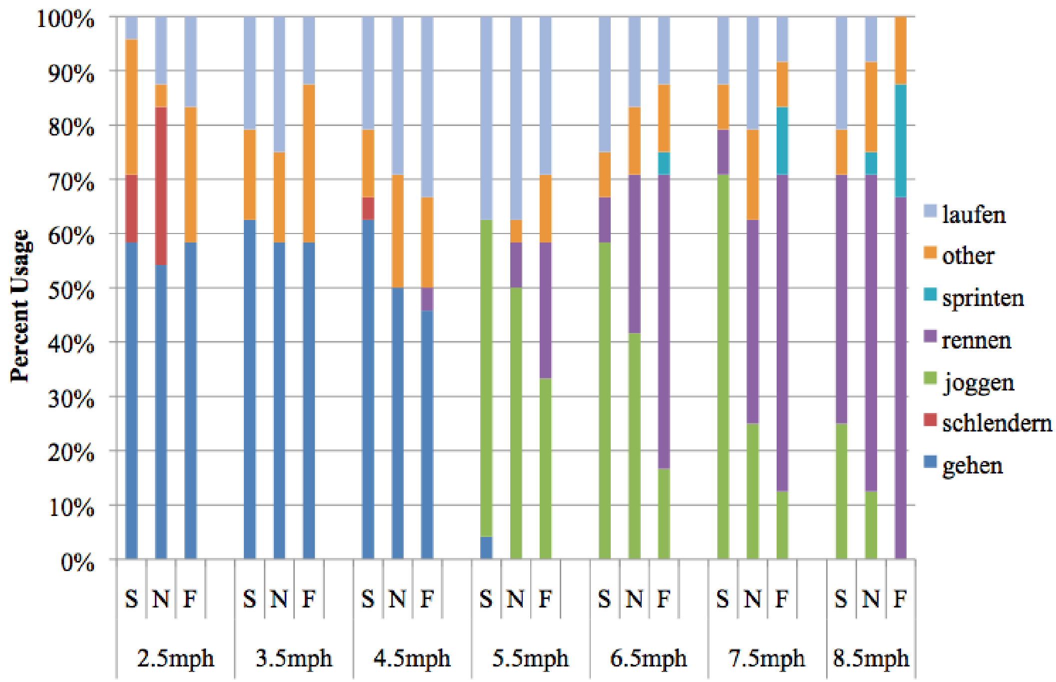

Figure 3: The German data from Study 2. Treadmill Settings from 2.5 mph to 8. 5mph and Payback Conditions are Slow (S), Normal (N), and Fast (F).

Cadence effects for other verbs were similar to their English counterparts. The verbs 'joggen' (*jog*), 'rennen' (*run*), and 'sprinten' (*sprint*) were sensitive to the change in cadence. For example, at 6.5 mph, 'joggen' was used by 58% of the participants in the Slow Playback condition, 42% of participants in Normal Playback, and 17% in Fast Playback.

With the exception of 'laufen', German naming patterns align with those in other languages that mark the biomechanical distinction between 'walking' and 'running'. The term 'gehen' only appears at 4.5 mph and slower; terms such as 'joggen' and 'rennen' only appear from 5.5 to 8.5 mph. As in English, the cadence manipulation did not cause speakers to break this boundary.

5. General Discussion

Both Study 1 and Study 2 bring relevant observations to bear on the nature of the real-world structure that informs semantic representations of human locomotion. They also help support and inform the findings of previous studies. We show that cadence is a structural feature to which English and German speakers attend and that this salience is reflected in naming patterns. Presumably, underlying concepts of these verbs will also highlight cadence in this way.

Both studies show the relative roles of cadence and other gait elements in naming patterns of continuous human locomotion. First, previous hypotheses that the biomechanical distinction between a 'walking' and 'running' gait (the 4.5/5.5 mph boundary) is the primary structure influencing speakers' lexeme choices are strongly confirmed. The manipulation of Playback (and thus cadence) did not cause any speakers to use a 'walking' term from 5.5 mph higher or a 'running' term from 4.5 mph and lower. Clearly, the biomechanical gait distinction is a critical aspect of speakers' semantic representations of these human locomotion verbs at this point in the continuum of motion. However, results also indicate that English and German lexemes are extremely sensitive to the manipulation of cadence. In other words, digitally manipulating playback causes people to change the lexeme they use to describe the event (with respect to Normal Playback). This has important implications.

First, it demonstrates that, though the 4.5/5.5 mph biomechanical distinction is of great importance, so too are cues of cadence. Moreover, the relative weight given to these features when naming depends on where individual events occur in the continuum of motion. At the 4.5/5.5 mph boundary, motion verbs are distinguished by gait features rather than cadence. On either side of this boundary, however, cadence is driving naming patterns to some extent. This is not to say that *only* cadence drives naming patterns in these regions. Rather, it seems that the conjunction between cadence and gait elements (e.g., stride length, knee and elbow bend, ground contact, etc.) is important in the encoding of motion verbs. That is, the semantic space is multidimensional, with cadence (perhaps perceived as speed) set against other gait elements. The combinatory nature of these dimensions gives rise to particular semantic categories, e.g., 'jog' is the conjunction between self-propelled, bounce-and-recoil gaits at medium cadence (see Malt et al. 2011 for similar treatments of this multidimensional space). Furthermore, contextual dimensions are undoubtedly critical (see Labov 1973). For example, people may also attend to the weight of the person (under, average, or overweight), where the locomotion is taking place (indoors, outdoors, on a treadmill), or what they are wearing (casual or sports clothes, etc.). Therefore, subsequent studies in this domain should take into account the complicated nature of semantic representations. Rather than assume a priori that certain structure in the world will determine naming patterns, we suggest that descriptions of semantic representations should proceed by induction, testing how the possible dimensions of semantic space may be encoded in a given language.

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The German verb 'laufen', a difficult term for English speakers, is of particular note. It is commonly translated as either *walk* or *run*. However, as can be seen in Study 2, this translation is not accurate. There is little overlap in terms of the semantic space encoded by English 'walk' and 'run' in comparison to 'laufen'. Therefore, direct translation is problematic or even impossible.

Though such a verb is not present in their data, Malt et al. (2008, p. 239) suggest that it may be "possible that some [languages] do not have separate words for walking and running gaits." While German clearly does have words that mark the biomechanical distinction, 'laufen' is a frequent verb that crosses the 4.5/5.5 mph boundary. In fact, 'laufen' seems to be used most often at these treadmill settings, perhaps indicating a grouping of 4.5 and 5.5 mph to the exclusion of speeds such as 2.5 and 8.5 mph. This is in contrast to previous predictions regarding such a grouping.

One possible interpretation of this finding is that 'laufen' is a term of general motion. There are at least two reasons why this explanation is not likely. First, use of 'laufen' seems to peak at 5.5mph. If it were a term of general motion, then it should be distributed evenly across all treadmill settings. Second, 'laufen' features similar metaphorical extensions as the English manner verb 'run', not of general motion verbs such as 'go'. This is demonstrated in (1) and (2):

(1) Die Maschine läuft.
The machine is running.

(2) Das Wasser läuft.
The water is running.

These reasons are compelling evidence to dismiss the characterization of 'laufen' as a verb of general motion. A second response is that 'laufen' is not a manner verb at all. Instead, it is aspectual, meaning "put into motion without delay" (Cadiot et al. 2006, p. 182). Again, the metaphorical extensions above argue against this treatment, as 'laufen' is used to denote a continuous state, rather than indicating the placement of the event in time. Second, participants only viewed videos in which motion had already begun. The lack of transition from a non-motion state to a motion state in the videos runs counter to this aspectual reading. In other words, the videos do not indicate that the subject was 'put' into motion.

We propose, instead, that 'laufen' is a specific manner verb of continuous human locomotion that simply draws upon different structure than verbs in English, Dutch, Japanese and Spanish. However, due to the lack of response to the cadence manipulation, we are unable to posit which features in particular figure prominently in its semantic representation.

These results also have important implications in regard to so-called 'manner' and 'path' languages (Talmy, 1985). With these studies, we show that 'manner of motion' is not an unanalyzable primitive, as has been assumed in the linguistics literature (Slobin 1996; Talmy 1985) and the psychology literature (Gennari et al. 2002; Papafragou & Selimis, 2010). Rather, 'manner' has a fine-grained structure, and the current studies are an attempt to tease apart this structure (following efforts of e.g., Ikegami 1969).

6. Conclusion

As close follow-ups to previous studies of motion verbs, the two studies presented here have confirmed prior findings while adding to our understanding of the cues to which speakers may attend when naming human locomotion. By manipulating cadence while controlling for other gait elements, Studies 1 and 2 demonstrate that cadence is a critical feature driving naming patterns in addition to the biomechanical distinction between 'walking' and 'running' gaits. The addition of German data provided unexpected results in the form of the lexeme 'laufen', which does not follow the trends found in previous literature. This finding highlights the importance of including as many languages as possible when analyzing semantic representations.

This study has concentrated on the semantic representations of human locomotion verbs. We believe, however, that these semantic representations may have important implications for underlying conceptual representations, as defined by Levinson (1997). It is possible that the differences in how people talk about human locomotion events may also influence how they think about these events. Therefore, this work can inform current research (e.g., Malt et al. 2011) on the relationship between semantic representations and underlying concepts.

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