1. Introduction

It was already pointed out by Aristotle in *Physics* (350BC/1995, Book IV) that all motion takes place in space and time: space is the potentiality and time is the measure of the motion. That link between space and time is reflected in commonly used units of speed, e.g. the kilometer/mile per hour, as well as the largest unit of spatial magnitude, the light-year.\(^2\) Miller and Johnson-Laird (1976) observed that people usually know how long it takes to travel between familiar locations. Even if you do not know how far away your favorite restaurant is in metric terms, you know how long it takes to get there by whichever means of transport you use to reach frequent destinations. Observations of travel time as a popular metric of spatial distance have been made for years in studies on geographical cognition, especially in the context of urban environments (e.g. MacEachren, 1980; Montello, 1997). Barbara Tversky (2011) notes that spatial knowledge on the horizontal plane is derived from motion in time, hence distance in space is often expressed as time. She adds that since each and every motion occurs in space and takes time, space and time are interchangeable and intertwined in numerous senses. For that reason, they seem to form a kind of hybrid.

The link between space and time has been viewed in different ways. Lakoff and Johnson (1980, 1999) argue that we systematically talk and think about time in spatial terms by metaphorical
extension, but not vice-versa, which makes time asymmetrically dependent on space. However, Jackendoff (2002: 356–359) asserts that although conceptions of time and space are thematically parallel, the presumed primacy of spatial relations as the metaphoric grounding of temporal relations may be illusory. He assumes that spatial relations may seem primary due to their association with visual modality, cognitive motor functions, and evolutionary priority. In a recent study of space–time (dis)analogies in language, Langacker (2012) points out that the entanglement of space and time is in a sense circular. On the one hand, space is more basic as the object of conception, which is indicated by the direction of metaphorical conceptions of time in spatial terms. On the other hand, the dynamicity of spatial conception, where time functions as the medium of conception, makes time more basic as the fundamental prerequisite for cognitive processing of space. Time enables the apprehension of space in the subject of conception, which in turn allows for the apprehension of time as an object of conception. This study explores a hypothesis that in the semantic context of motion events (Talmy, 2000a, 2000b) space and time can be viewed as hybrid to one another, which allows for flexible denotation of spatial distance in terms of temporal duration.

2. Entanglement of space and time in cognition

The entanglement of space and time in the human mind is among most intensely pursued problems in the contemporary cognitive science (see Núñez & Cooperrider, 2013 for a review). Grondin (2010) emphasizes that comparisons between psychological space and time are difficult to make because sensory modalities involved in the perception of space have more clearly defined aspects than those involved in the perception of time. Moreover, time does not have as clearly defined categories of experience as space. Cognitive frameworks of time perception are proposed in terms of either dedicated or intrinsic models (see Ivry & Schlerf, 2008 for a review). However, despite 125 years of research, psychology has not yet distinguished a definitive sensory system responsible for perception and processing of time (Hancock & Block, 2012). Neither has research in neuroscience found the neural basis for the processing of temporal intervals and the experience of duration (Wittmann, 2013).

What makes investigations of the relationship between space and time in cognition additionally difficult is that they are attributed different dimensionalities. Time is generally regarded as a linear vector extending ahead into the future and back into the past. On the other hand, space is
discussed in terms of one-dimensional distances, two-dimensional planes, and three-dimensional spaces. Another basic difference between space and time is that the dimension in which time extends, or “flows” as we often say, is not reversible, which has been termed by Galton (2011) as \textit{transience}: what occurs in time, occurs once at that very moment, with no possibility of return.

However, there are also certain similarities observed between psychological space and time. Classic studies in psychophysics (Stevens, 1986) demonstrated that people use structural similarity to associate temporal and spatial stimuli. For example, we associate lines of different lengths with tones of different durations. Both adults and young children recognize them spontaneously as meaningful representations and provide consistent and systematic responses to them in such tasks. Stevens (1986) argues that spontaneous cognitive binding indicates that different dimensions of experience, including spatial length and temporal duration, are represented by analogue magnitudes and participate in cross-modal matching. A Theory of Magnitude (ATOM) proposed by Walsh (2003) assumes that time, space, and number are processed in cognition by a common processing mechanism (see also Cantlon, Platt & Brannon, 2009 for a more recent \textit{Approximate Number System} theory). Moreover, for some people simultaneous perception of space, time, and number is triggered automatically in \textit{synesthesia}, in which an association of time and space occurs as an explicit and vivid experience of time and/or number as occupying a predefined spatial location (Smilek, Callejas, Dixon & Merikle, 2007).

A similarity between spatial and temporal dimensions of psychological distance has been observed in their relation to the level of mental construal. An extensive series of studies on construal of spatial and temporal distance (see Trope & Liberman, 2010 for a review), found that events located further away in space and time are more likely to be represented in terms of abstract and general features at a higher level of mental construal, which is reflected in representations of events and the breadth of object categorization. According to \textit{Construal-Level Theory of Psychological Distance} (Trope & Liberman, 2010), spatial and temporal (as well as other) instances of psychological distance are related to one another, and act in the human mind in a complementary and compensatory fashion.

On the contrary, the asymmetric view holds that representations of time depend on space to a far greater extent than representations of space depend on time. It stems from an observation that the domain of time escapes sensory perception. As put by Lakoff (1993: 218), “(...) we have detectors
for motion and detectors for objects/locations. We do not have detectors for time”. Consequently, it is plausible to assume that time is processed indirectly and structured metaphorically in terms of space (see also Lakoff & Johnson, 1999: Ch. 10).

The view that cognition of time arises as a result of experiencing and processing motion through space has been supported by studies conducted in the domain of metaphorical language and cognition (Boroditsky, 2000; Gentner, Imai & Boroditsky, 2002), which examined spatial conceptualizations of time in language from perspective-specific (moving-time or moving-ego) viewpoints. More recently, the asymmetric view on the relationship between space and time has been additionally supported by cognitive studies using non-linguistic stimuli and responses conducted with adults (Casasanto & Boroditsky, 2008) and young children (Casasanto, Fotakopoulou & Boroditsky, 2010). What all these psycholinguistic studies have in common is that they employ motion as a semantic component that glues space and time together.

3. Linguistic representation of motion events
Motion of an object from one location to another can be characterized in terms of a Source–Path–Goal schema, which is one of the most common structures emerging from our constant bodily experience. As described by Lakoff (1987: 275), “Every time we move anywhere there is a place we start from, a place we wind up at, a sequence of contiguous locations connecting the starting and ending points, and a direction.” He adds that the term destination as opposed to goal can be used when we are referring to a spatial end point. According to Lakoff, this schema is composed of four structural elements: a Source, which is the starting point, a Destination, which is the end point, a Path, which includes a sequence of contiguous locations connecting the starting point with the end point, and a Direction toward the destination (see Hampe, 2005 for reviews of this schema from various perspectives).

Talmy (Talmy, 2000b: 35) distinguishes two types of motion found in motion events: translational motion, when “an object’s basic location shifts from one point to another in space”; and self-contained motion, when “an object keeps its same, or ‘average’ location”. A basic motion event consists of one object, i.e. Figure, moving or located with respect to another reference object, i.e. Ground. The core schema of motion event has four basic internal components, which include additionally Motion and Path. The Path is a path followed or site occupied by the Figure object with
respect to the Ground object. The component of Motion refers to “the presence per se of motion or locatedness in the event” (Talmy, 2000b: 25). Thus, for Talmy the notion of motion event embraces both occurrence of translational motion and location, despite the fact the in the latter translational motion does not occur. Additionally, an associated co-event can be distinguished, which involves two additional components: a Manner in which the motion takes place, and the Cause of its occurrence.

On the basis of patterns used for mapping the semantic components of Manner and Path onto the surface forms, Talmy (2000b, Part 1) postulates distinguishing two main categories of languages: Satellite-framed languages (S-languages) and Verb-framed languages (V-languages). Generally, S-languages, including English, elaborate more on Path than Manner. They tend to conflate Motion+Manner in verb roots with elaboration of Path in prepositional phrases or satellites. Talmy (2000b: 102) defines satellites as immediate verbal constituents other than noun-phrase or prepositional-phrase complement that are in a sister relation to the verb root. On the other hand, V-languages tend to conflate Motion+Path into verbs, whereas Manner is often left to inference or expressed with adverbial phrases. The Manner/Path asymmetry is even more salient in the following compositionality restriction: while in S-languages languages manner verbs can be combined freely with different kinds of Path modifiers, in V-languages, at least some of them, e.g. Spanish, manner verbs cannot be used with telic path phrases, i.e. ones marking an end-of-path location of the moving object (Aske, 1989). These categories, however, are not absolute. V-languages, such as Greek and Spanish have motion verbs that express manner, and English has motion verbs that express path, e.g. cross, enter, or exit. Although Talmy’s division has been contested as inadequate for some Asian languages (e.g. Slobin, 2004), it still stands as valid. Levinson & Wilkins (2006: 527–541) argue that it seems to be more useful for analysis of European languages, rather than the entirety of worldwide sample.

4. Research methodology
This paper discusses hybridity of space and time in what is termed here as motion-framed distance (cf. motion-framed location discussed by Tutton, 2012). It refers to conceptualizations of distance that separates one point from another in physical space in the semantic context of motion events. The aim of this study is to determine a proportion of temporal vs. spatial representations of the
motion-framed distance in linguistic performance of Polish speakers from the perspective of corpus-based cognitive linguistics (Heylen, Tummers & Geeraerts, 2008). This approach to language study brings together the descriptive framework of cognitive linguistics (Croft & Cruse, 2004) with the methodological workbench of corpus linguistics (McEnery & Hardie, 2012). Essentially, it relies on explanatory notions adopted by the cognitive linguistics framework, but approaches them in such a way that their relevance to a given linguistic phenomenon can be empirically validated in large corpora, frequently with an aid of advanced statistical techniques (see Lewandowska-Tomaszczyk & Dziwirek, 2009 for a collection of studies). More specifically, this research employs a corpus-based approach, i.e. one that relies upon quantitative analysis applied to a whole corpus (Tummers, Heylen, & Geeraerts, 2005).

In order to verify how natural it is to express motion-framed distance with spatial vis-à-vis temporal representations this study employs the balanced variant of Narodowy Korpus Języka Polskiego (the National Corpus of Polish, henceforth, the NCP), which is a 240 million word collection of contemporary Polish from a wide range of sources, whose structure loosely mirrors that of the British National Corpus (Przepiórkowski, et al., 2012; see www.nkjp.pl for more information). The NCP has an important advantage of being a publicly available standard reference corpus, which presupposes wide availability of the corpus to other researchers (McEnery & Wilson, 2001: 32). The corpus is examined with queries based on regular expression syntax, which enables anyone interested in attesting or expanding this study to probe the data under the same research conditions with nothing else than a web browser (see Waliński, 2013a for a full listing of queries used in this research accompanied by corresponding concordances retrieved from the NCP). This paper parallels a study conducted earlier for English (Waliński, 2014; see also Waliński, 2013b for a discussion on space and time in distance representations from a broader perspective).

Searching for representations of the motion-framed distance in spatial and temporal terms was implemented by looking for frequencies of spatial and temporal adverbials (Lyons, 1977; Haspelmath, 1997). Adverbials examined in this study express absolute distance, i.e. one denoted in spatial, e.g. “fifty kilometers away”, or temporal units, e.g. “fifteen minutes from Warsaw”. Although the use of adverbials represents a fundamental way of denoting spatial extension, it is far from being
exhaustive of the entirety of ways used for expressing distance in language. Therefore, it must be emphasized that the aim of this study is not to examine the full array of linguistic means available for denoting spatial extents, but to observe a general proportion between spatial and temporal representations of distance in the context of motion events.

This study is additionally restricted to examining representations of the motion-framed distance for two semantic aspects of manner and instrument of motion. It has been established that instrument and manner are not easily disentangled (Wierzbicka, 1996; Goddard & Wierzbicka, 2009). Essentially, instrument and manner share common conceptual ground and participate in the action described by the verb simultaneously in a coordinate manner (see Mari, 2006). Goddard and Wierzbicka (2009) demonstrate that semantics of physical activity verbs in English, Polish, and Japanese ties the kind of instruments used in the action with the manner in which the instrument is used.

A close relatedness of manner and instrument occurs for motion verbs, too. For instance, the verb drive expresses a certain manner of motion, which can be additionally specified by an instrumental adverbial, e.g. drive by car. However, in sentences such as “Every day John drives to work through the suburbs of London”, unless additionally specified, the meaning of drive entails instrumentality, since it is generally understood as ‘traveling by car’. And vice-versa, motion verbs derived from nouns denoting vehicle names, e.g. bicycle, essentially denote the instrument of motion, but also specify a certain manner in which the motion takes place (overland self-propelled locomotion in this case). Therefore, at least for certain motion verbs, it is impossible to make an absolute distinction between instrument and manner because they form a kind of semantic continuum.

5. Findings for manner and instrument of motion

Polish belongs to the S-language group (Talmy, 2000b, Part 1), which generally mark the semantic aspect of motion manner in verb roots. Slavic languages tend to use Motion+Manner conflation rather less specifically than English, relying instead on additional prepositional phrases and nominal

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3 Conceptualizations of distance in space are established, for example, by the scale of mental operations: something situated “near the penny” is conceptualized as situated closer than something “near London” (see Morrow & Clark, 1988; Carlson & Covey, 2005).
forms (see Hasko & Perelmutter, 2010). Kopecka (2010: 241) notes that “Polish does not exploit the slot of the main verb as productively as English does. In Polish, the size of the Manner verb lexicon, although still substantial, appears to be smaller, and the sorts of fine-grained semantic components of Manner lexicalized in the verbs are less diverse”. Polish relies heavily on morphology for marking specific aspects of motion semantics. The semantic aspect of motion manner is often marked in Polish with the genitive case of deverbal nouns derived from motion verbs. For that reason, the search for representations of motion-framed distance in the semantic context of motion manner was implemented by looking for distance expressions involving genitive deverbal nominal forms. Eight nominal forms marking different manners of locomotion, aquamotion, aeromotion, and pedestrian motion were taken into consideration: 

- rejsu [cruise, voyage, flight]
- jazdy [drive, ride, cruise]
- lotu [flight]
- marszu [march]
- żeglugi [sail]
- spaceru [walk]
- zwiedzania [tour, cruise]
- podróży [journey].

Obviously, this selection is far from being exhaustive. The search was implemented with the following lexical pattern:

**SPATIAL OR TEMPORAL UNIT + GENITIVE CASE OF DEVERBAL MOTION NOUN; SLOP FACTOR=1, PRESERVE ORDER=YES**

Because one cannot expect lexical items from the above lexical pattern to always follow directly one after another in linguistic performance, searching was implemented with proximity queries to afford for occurrence of additional modifiers between the query terms. Essentially, proximity queries (Bernard & Griffin, 2009) allow for searching with a slop factor, which specifies how far apart lexical items included in a query can be from one another to be still returned as a result to the query. The slop can be used in combination with a binary (yes/no) preserve order option, which indicates whether the original order of query terms should be preserved in results. For the purpose of this research, queries were implemented with the slop value of 1, and the preserve order option set to “yes”.

Units of time measurement selected for analysis include minuta, godzina, dzień [minute, hour, day], and units of space measurement kilometr, metr, mila [kilometer, meter, mile], together with their abbreviations. Although Polish speakers do not normally express distance with imperial units, e.g. yards or miles, mila [morska] (the [nautical] mile) is used in the context of sea travels.
Unfortunately, proximity queries increase the recall of results at the expense of their precision (see Pęzik, 2011). Because of that, the resulting set had to be reviewed to exclude examples sharing the defined sequence/proximity of lexical items by coincidence. Corpus queries returned altogether 1406 examples matching the query terms in the NCP, but only 1096 concordance lines were recognized as valid representations of the motion-framed distance in spatial or temporal terms. The results found for the genitive forms of deverbal nouns derived from motion verbs are presented in Table 1.

<table>
<thead>
<tr>
<th>Manner of motion</th>
<th>Denoted in spatial terms</th>
<th>Denoted in temporal terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>rejsu</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>jazdy</td>
<td>34</td>
<td>391</td>
</tr>
<tr>
<td>lotu</td>
<td>8</td>
<td>138</td>
</tr>
<tr>
<td>marszu</td>
<td>16</td>
<td>213</td>
</tr>
<tr>
<td>żeglugi</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>spaceru</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>zwiedzania</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>podróż</td>
<td>7</td>
<td>177</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>64</strong></td>
<td><strong>1032</strong></td>
</tr>
<tr>
<td><strong>Proportion</strong></td>
<td><strong>6%</strong></td>
<td><strong>94%</strong></td>
</tr>
</tbody>
</table>

Table 1. Representations of motion-framed distance in spatial and temporal terms found in the NCP for the semantic aspect of motion manner

Table 1 shows that for the semantic aspect of motion manner the number of representations in temporal terms 1032 (94%) significantly exceeds the number of representations in spatial terms 64 (6%). This tendency is particularly conspicuous for lexemes amply represented in the corpus, i.e. jazdy, marszu, podróż, which indicates that the overall proportion does not arise from a coincidental occurrence in the corpus.

A parallel procedure was executed for the semantic aspect of motion instrument. Polish typically marks instrumentality of motion with the instrumental case of nominal forms denoting transportation means and/or prepositional phrases. The lexical pattern was modified to include instrumental forms of transportation means. A selection of motion instruments was restricted to eight different vehicles: rowerem [by bike], łodzią [by boat], autobusem [by bus], samochodem [by car], autokarem [by coach], samolotem / odrzutowcem [by plane / jet], pociągiem [by train], and piechotą [on foot]. The pedestrian motion was additionally specified with the prepositional phrase.
na piechotę [on foot], which is frequently used in this context. The following lexical pattern was used for queries:

**SPATIAL OR TEMPORAL UNIT + INSTRUMENTAL CASE OF TRANSPORTATION MEANS; SLOP FACTOR=1, PRESERVE ORDER=YES**

Searching was implemented in a parallel fashion using proximity queries with the *slop* value of 1, and the *preserve order* option set to “yes”. The same selection of spatial and temporal units was used.

Corpus queries returned 397 matching examples from the NCP. The resulting set was reviewed to exclude coincidental hits. In the outcome, 279 concordance lines were recognized as valid representations of the motion-framed distance in spatial or temporal terms. The results found for the instrumental nominal forms denoting different transportation means are presented in Table 2.

<table>
<thead>
<tr>
<th>Instrument of motion</th>
<th>Denoted in spatial terms</th>
<th>Denoted in temporal terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>rowerem</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>lodzią</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>autobusem</td>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>samochodem</td>
<td>10</td>
<td>82</td>
</tr>
<tr>
<td>autokarem</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>samolotem / odrzutowcem</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>pociągiem</td>
<td>1</td>
<td>44</td>
</tr>
<tr>
<td>piechotą / na piechotę</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>48</strong></td>
<td><strong>221</strong></td>
</tr>
<tr>
<td><strong>Proportion</strong></td>
<td><strong>18%</strong></td>
<td><strong>82%</strong></td>
</tr>
</tbody>
</table>

Table 2. Representations of motion-framed distance in spatial and temporal terms found in the NCP for the semantic aspect of motion instrument

Table 2 shows that the inclination to express motion-framed distance in temporal terms can also be observed for the semantic aspect of motion instrument. The number of representations in temporal terms 221 (82%) significantly exceeds the number of representations in spatial terms 48 (18%). It is more conspicuous for some instruments, e.g. *samochodem, pociągiem* than for others, e.g. *rowerem, na piechotę*, where it is more balanced. Nevertheless, the number of examples retrieved from the corpus for this semantic aspect is substantial enough to assume that the overall proportion does not
arise from a coincidental occurrence in the corpus.

6. Spatial-temporal hybridity of distance representations

Although it is impossible to discuss linguistic tendencies in absolute numbers, the results reported above indicate that in the semantic context of motion events Polish speakers tend to express spatial distance in temporal terms more frequently than in spatial terms. Curiously enough, similar results were obtained for English using the British National Corpus (Walinski, 2014). Since the inclination to express motion-framed distance in temporal terms appears to occur cross-linguistically, we can plausibly assume that it is modulated by the presence of the semantic element of motion, rather than by lexical patterns alone. In more general terms, the results suggest that in the semantic context of motion events space and time can be regarded as complementary to one another, rather than being asymmetrically dependent. This specific hybridity of motion-framed distance can be observed more directly in certain instances of language use found through a concordance analysis, e.g. “Odwiedziłam Kadyny – kilometr od Zalewu Wiślanego, pół godziny drogi od Elbląga” [EN: “I visited Kadyny – located one kilometer away from the Vistula Lagoon and half an hour away from Elbląg” (found in the full archive of the National Corpus of Polish) or “[Apartments are] situated only 200 metres from the beach and within a three minute walk from the shops and nightlife” (found in the BNC). Such examples demonstrate that spatial and temporal representations can be combined on equal footing to express distance and location in space.

Since the linguistic representation of space is largely relativistic and approximate, rather than Euclidean and quantitative (Talmy, 2000a: Ch. 1 & 3), it comes naturally to language users to express spatial distance in terms of the time required to execute a motion event. In motion-framed scenarios, it is absolutely natural for us to specify the distance to Mars in months of space traveling, or the distance to Mt. Everest peak in days of climbing, without even noticing the conceptual shift from spatial to temporal domain of representation. This way of expressing distance is highly versatile. It can be used to express a distance unknown precisely in spatial terms, e.g. “The village centre is about seven minutes walk away”, and allows for expressing a distance from the speaker’s subjective point of view as a particularly short/long way to a destination, e.g. “The station’s only five minutes away” (which may equal to about 10 kilometers, if traveling by fast train), “[The] main camp must be nearly two days march away” (which may also equal to about 10 kilometers, if
marching in a particularly difficult mountain/arctic terrain). Denoting spatial distance in terms of travel time is particularly convenient in urban environments, where reaching destinations depends not as much on the spatial separation as on the traffic intensity at different times of the day (MacEachren, 1980; Montello, 1997).

### 7. Conclusion

The results suggest that in motion-framed scenarios space, time, and motion can be viewed as elements of a unified conceptual frame, which dictates the relationship between space and time in a complementary fashion. Kövecses (2005: 53) discusses a **Time-Motion** schema, within which elements can stand for each other in the form of **metonymies**. He notes that in English one can say, for example, “I slept for **fifty miles** while she drove” (**Distance For Time-Duration**), as well as “San Francisco is **half an hour** from Berkeley” (**Time-Duration For Distance**). He argues that this unified literal frame of universal experiences can be viewed as the experiential basis for the **Time Is Motion** metaphor. In the light of this study, it is plausible to presume that in semantic contexts of motion the scope of universal experiences extends to embrace the conceptualization of spatial relations, as well.

The metonymical relationship between space and time in motion was pointed out by Engberg-Pedersen (1999), who notes that we can use names of places, which are primarily spatial words, to denote punctual moments in time in terms of spatial locations, e.g. “I haven’t had a drink since London”. This also indicates that in the context of motion events cognition of space and time are tightly bound to the **Space-Time-Motion** schema, within which any two elements can stand for the third one: time elapsed in motion can be used to express spatial distance; space traversed in motion can be used to identify duration (which is commonly used for telling the time by the Sun’s position in the sky); a punctual moment in time can be used to specify a location passed while traveling; and a specific location passed during traveling can be used to refer to a specific moment in time. This metonymical hybridity of space and time is likely to be related to the unity of time, space, and motion observed by Aristotle in the surrounding world or, perhaps, even to spatial–temporal relativity assumed by Einstein’s Relativity Theory (see Hawking, 1988: Ch. 2 for a review; see also Bączkowska, 2011 for an application in cognitive linguistics).
References


