Space and time in medium-mediated expressions of distance

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Abstract: This study demonstrates an overall proportion between spatial and temporal representations of distance for the semantic attribute of motion medium on the basis of objectively verifiable frequencies of language patterns found in the British National Corpus. It demonstrates that in the semantic context of medium-mediated expressions of distance English speakers have a tendency to denote distance in space both in spatial and temporal terms, with temporal representations being used almost as frequently as spatial ones. This study complements earlier findings on the complementarily of spatial and temporal representations of distance in motion events for the semantic attributes of motion manner and instrument. Taken together, the results indicate that in the semantic context of motion events, space and time, are correlated metonymically rather than being asymmetrically dependent.

Keywords: motion events, time, space, distance, cognitive corpus-based linguistics

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1. Introduction

Timing and time perception are vital to survival in space for both animals and humans. Bats, owls and other species form an accurate, topographic representation of space by triangulating a position on the basis of interaural time differences from landmarks (Grothe, 2003). For these species, telling space is telling time over multiple timescales, which is possible due to a number of functional and neural mechanisms of interval timing that have emerged from evolution (Buhusi & Meck, 2005). Humans employ time to represent space in numerous devices, including radar, which establishes distance representations on a principle of emitting radio waves and collecting their reflections from objects, and GPS (Global Positioning System), which determines a position by triangulating temporal information (the difference or coincidence in phase of signals) from satellites. As pointed out by Hawking (1988: 22–23), nowadays time is used to measure distances precisely because we can measure temporal duration more accurately than spatial length. For example, currently the length of meter is defined as the distance traveled by light in 0.000000003335640952 second, as measured by a cesium clock, which corresponds to the historical definition of the meter marked on a particular platinum bar kept in Paris.

Tversky (2011) points out that knowledge of space on the horizontal plane is derived from motion in time, hence spatial distance is often expressed as time. Observations of travel time as a popular metric of spatial distance have been made for years in studies on geographical cognition (e.g.
MacEachren, 1980). It is particularly conspicuous in the context of urban environments, where reaching destination points depends not as much on the spatial separation as on the traffic intensity at different times of the day (Wagner, 2006: 16). Normally, even if we do not know the exact metric distance to our workplace or favorite shopping centre, we know how long it takes to get there—by whichever means of transport we use to reach our usual destinations. In the light of previous studies (Waliński, 2013, 2014a), it appears that in the semantic context of motion events (Talmy, 2000a, 2000b), we tend to express spatial distance in temporal terms. This provides a highly versatile means of expressing distance according to the speaker’s subjective profiling needs, irrespective of separation in the metric terms. This study demonstrates an overall proportion between spatial and temporal representations of distance found in the British National Corpus for the semantic attribute of motion medium.

2. (Dis)analogies between psychological space and time

As emphasized by Grondin (2010), comparisons between psychological space and time are difficult to conduct because the sensory modalities involved in the perception of space have more clearly defined aspects than those involved in the perception of time. Time does not have as clearly defined categories of experience as space, either. After 125 years of research, psychology has not yet distinguished a definitive sensory system responsible for the 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 transience.
What occurs in time, occurs once at that very moment, with no possibility of
return (cf. Bergson, 1922/2002: 205-222 for a discussion on the evanescent
nature of time).

However, there are also certain similarities observed between
psychological space and time. For instance, classic studies in psychophysics
(Stevens, 1986) demonstrated that people use structural similarity to
associate various temporal and spatial stimuli. For example, we associate
lines of different lengths with tones of different durations, and vice versa.
Both adults and young children recognize them as meaningful
representations and provide consistent and systematic responses to them in
psychophysical tasks. Stevens (1986) argues that this spontaneously
occurring 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 (cf.
Walsh, 2003). That observation has been frequently employed in modern
cognitive studies conducted with adults, young children, and infants (e.g.
Casasanto & Boroditsky, 2008; Casasanto, Fotakopoulou & Boroditsky,
2010; Srinivasan & Carey, 2010) employing non-linguistic tasks for
spontaneous alignment of representations of temporal duration with representations of spatial length.

A similarity between spatial and temporal dimensions of psychological distance has also been observed in their relation to the level of mental construal. Studies on construal of spatial and temporal distance (see Trope & Liberman, 2010 for a review), have demonstrated 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 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 way.

3. (A)symmetry between space and time in cognition
One view on the relationship between space and time in the human mind assumes that representations of time depend on space to a far greater extent than representations of space depend on time. It stems from a reflection that while the domain of space is directly accessible through the senses, the domain of time escapes sensory perception. Lakoff and Johnson (1980, 1999) demonstrate that we systematically talk about time in spatial terms by metaphorical extension, but not vice-versa, which makes time asymmetrically dependent on space. Consequently, it is plausible to assume that time is processed indirectly and structured metaphorically in terms of space (Lakoff & Johnson, 1980, 1999; see also Clark, 1973). The asymmetric view holds that the cognition of time arises as a result of experiencing and
processing motion through space. It has been supported by studies conducted in the domain of metaphorical language and cognition (e.g. 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 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; Srinivasan & Carey, 2010).

An alternative proposal holds that the relationship between space and time in cognition is symmetric. It is epitomized by ATOM theory (A Theory of Magnitude) proposed by Walsh (2003), which assumes that time, space, and number are processed in cognition by a common processing mechanism. The ATOM theory underpins its claims with an extensive number of neuropsychological findings, brain imaging studies, single-unit studies, and TMS (Transcranial Magnetic Stimulation) studies, which report shared brain areas for processing space, time, and number as an analogue magnitude (see Bueti & Walsh, 2009 for a review). A more recent proposal (Cantlon, Platt & Brannon, 2009) postulates a specialized Approximate Number System (ANS), which represents the number of discrete objects or events as a continuous mental magnitude.

The symmetric theories are supported by numerous neuropsychological findings, developmental research on magnitude representation in human infants, and studies on magnitude processing in primates, in which patterns consistent with the symmetric processing have been observed (see Dehaene & Brannon, 2011, for a comprehensive review...
of research on space, time, and number in the brain). Moreover, for some people simultaneous perception of time, number, and space is triggered automatically in *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).

In a recent study of space–time (dis)analogies in language, Langacker (2012) summarizes certain linguistic parallelisms closely tied to time and space, which make it plausible to view space and time in a complementary manner. 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. From that perspective, the relationship between time and space appears to be somewhat circular: 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.

4. Space and time in medium-mediated expressions of distance

This study investigates what is termed in this paper as *motion-framed distance* (cf. *motion-framed location* discussed by Tutton, 2012), which refers to a distance that separates one point from another in space in the semantic context of motion events. A *motion event* has been characterized by Talmy (2000b: 25) as a situation containing motion and the continuation of a stationary location alike. Essentially, the *basic Motion event* consists of
four internal core components: (1) the presence or absence of the motion (Motion); (2) the moving entity (Figure); (3) the object with respect to which the Figure moves (Ground); (4) the course followed by the Figure with respect to the Ground (Path); and two components of an associated co-event: (5) the manner in which the motion takes place (Manner); and (6) the cause of its occurrence (Cause). In the context of this study it is important to emphasize that the component of Motion refers to “the presence per se of motion or locatedness in the event” (Talmy, 2000b: 25), which means that the notion of motion event embraces both occurrence of translational motion and location, despite the fact that in the latter the Figure does not change its position with respect to the Ground. Levinson (2003: 96) notes that the description of motion involves an additional set of parameters that denote not only change of location, but also manner, instrument, medium of motion, as well as other attributes. This paper focuses on the medium of motion, which is discussed in cognitive linguistics under different labels. Langacker (2008) subsumes it under an umbrella term of landmark. Talmy (2000a, 2000b) generally refers to it as the Ground, which acts as a spatial reference point for the motion/location of the Figure.

4.1 Methodology of research

This paper investigates how the motion-framed distance is denoted with spatial vis-à-vis temporal terms from a corpus-based cognitive linguistics perspective. As put by Heylen, Tummers and Geeraerts (2008: 92), the corpus-based cognitive linguistics relies on explanatory notions adopted by the cognitive linguistics framework (see Croft & Cruse, 2004), but approaches them in such a way that their relevance to a given linguistic
phenomenon can be empirically validated in large corpora (see McEnery & Hardie, 2012), frequently with an aid of advanced statistical techniques (see Lewandowska-Tomaszczyk & Dziwirek, 2009 for examples of studies).

In order to verify empirically how natural it is to express medium-mediated motion-framed distance with spatial vis-à-vis temporal representations, this research employs the British National Corpus (henceforth, the BNC), which is a 100 million word collection of samples of written and spoken contemporary British English from a wide range of texts, not limited to any particular subject field, genre, or register (see www.natcorp.ox.ac.uk for more information). Since its compilation the BNC has been used by researchers in a variety of contexts, including research on lexicalization patterns of motion events (e.g. Filipović, 2007). In this study, the corpus is examined with queries based on simple regular expression syntax, which provides for easy replicability of the study (see Waliński, 2014b for a listing of queries accompanied by corresponding concordances retrieved from the BNC).

The examination was implemented by looking for frequencies of spatial and temporal adverbials that express absolute distance, i.e. denoted in spatial, e.g. “three miles by water”, or temporal units, e.g. “fifteen minutes by road”. Although the use of adverbials represents a fundamental way of expressing spatial extension, it is far from being exhaustive of the entirety of ways used for representing spatial distance in language (see Carlson, 2010 for an overview). However, the aim of this paper 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 in the motion-framed expressions of distance.
This study is additionally restricted to examining representations of the motion-framed distance for the semantic attribute of motion medium. However, it must be emphasized that semantic attributes of motion are not easily disentangled. For instance, the expression by air not only encodes a medium of motion but also implies a certain manner of travelling, typically flying, which in turn involves a range of instruments used for that purpose, e.g. a plane or jet, etc. (see Goddard and Wierzbicka, 2009 for a study demonstrating how the 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). Therefore, at least for certain instances of medium-mediated expressions of distance, it is impossible to make an absolute distinction between medium, manner, and instrument because they form a kind of semantic continuum.

5. Representations of motion-framed distance for the medium of motion
Talmy (2000b) considers conflation of Motion + Ground in verbs roots as a minor pattern in linguistic representation of motion events, and notes that in English this semantic attribute is predominantly expressed with prepositional phrases. For that reason, the search for spatial and temporal instances of medium-mediated expressions of distance was implemented by looking for distance expressions involving certain prepositional phrases using the following lexical pattern:

QUANTIFIER + SPATIAL or TEMPORAL UNIT + PREPOSITION + MEDIUM OF MOTION; SLOP FACTOR=3, PRESERVE ORDER=NO
Units of space measurement selected for the analysis involve both metric and imperial units typically used in the U.K., kilometres, metres, miles, and yards including their American variants of spelling (kilometers and meters). Units of time measurement involve ones typically used to express duration of traveling, i.e. minutes, hours, and days. A selection of motion media examined in this research involves ten environments typically involved in journeying, i.e. air, field(s), forest(s), land, mountain(s), railway(s), road(s), sea(s), snow, and water. A selection of prepositions was limited to by and through. Essentially, this combination offers 20 basic variants, which is obviously far from being exhaustive for English since it employs also other prepositions in this context, e.g. “over mountains”, “on snow”, etc. Still, the selection seems to be reasonably plausible for the purpose of this study.

Because one cannot expect lexical items in the above lexical pattern to always follow directly one after another in linguistic performance, searching was implemented with proximity queries (Bernard & Griffin, 2009) to afford for occurrence of additional modifiers between the query terms. Essentially, it allows 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. Moreover, it offers an additional 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 study, queries were implemented in a relaxed manner with the slop value of 3, and the preserve order option set to “no”. In the outcome, the pattern identifies more specific environments, e.g. “winding road”, “blinding snow”, and “hostile waters”, etc., as well as instances where the prepositional phrase
occurs in the frontal position, e.g. “Niagara Falls by road is only 11 hours South-West of Toronto”. To boost precision of the proximity queries, quantifiers (cardinal numbers and determinatives) were incorporated in the pattern. It was possible due to a part-of-speech annotation of the BNC, which marks cardinal numbers, spelled both in words and digits, with the <CRD> tag (Garside, Leech & McEnery, 1997).

Because the use of proximity queries increases the recall of results at the expense of their precision (see Pęzik, 2011), the resulting set of concordances retrieved from the BNC had to be reviewed to eliminate examples sharing the defined sequence/proximity of lexical items by coincidence, e.g. “I see you refreshed by two days of country air”. Out of 164 concordance lines retrieved from the BNC, 48 were recognized as valid representations of the motion-framed distance in spatial or temporal terms, e.g. “the town of Bridgwater, ten miles away by road”, or “a smallish island over two hours from Glasgow by air”, etc. The results found for the selected prepositional phrases are presented in Table 1.
<table>
<thead>
<tr>
<th>Medium of motion</th>
<th>Denoted in spatial terms</th>
<th>Denoted in temporal terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>by/through air</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>by/through field(s)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>by/through forest(s)</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>by/through land</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>by/through mountain(s)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>by/through railway(s)</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>by/through road(s)</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>by/through sea(s)</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>by/through snow</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>by/through water</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
<td><strong>21</strong></td>
</tr>
<tr>
<td><strong>Proportion</strong></td>
<td><strong>56%</strong></td>
<td><strong>44%</strong></td>
</tr>
</tbody>
</table>

Table 1. Representations of motion-framed distance in spatial and temporal terms found in the BNC for the semantic attribute of motion medium

Although the overall number of examples retrieved from the BNC for the semantic attribute of motion medium is not particularly extensive, it can still serve as an indicator of the relationship between space and time in motion-framed distance representations. Table 1 shows that although for the analyzed media of motion the number of spatial representations 27 (56%) exceeds the number of temporal representations 21 (44%), the ratio is
balanced rather than totally dissimilar. It is noteworthy that a comparable proportion occurs for the phrase most amply represented in the corpus, i.e. *by road*, which indicates that the overall result does not arise haphazardly.

The results reported above demonstrate that in the semantic context of motion events English speakers tend to express motion-framed distance both in spatial in temporal terms. Although it is impossible to discuss language in terms of absolute numbers, the proportion of spatial vs. temporal representations found in the BNC for the semantic attribute of motion medium is congruent with observations made in earlier studies (Waliński, 2013, 2014a) that expressing spatial distance in temporal terms is a common way of denoting spatial extents in the semantic context of motion events.

6. Conclusions

The results suggest that in the context of motion events space and time can be regarded as complementary to one another. That complementarity can be observed more directly in certain instances of language use found in the BNC, e.g. “Apartments are situated only 200 metres from the beach and within a three minute walk from the shops and nightlife”. Such examples demonstrate that spatial and temporal representations can act on an equal footing in expressions of distance and location in space (see also Tutton, 2012).

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. That way of expressing
distance is highly versatile. It can be used to express a distance from the speaker’s subjective point of view as a particularly short, e.g. “New York is only fifty minutes away by air”, which may equal to hundreds of miles in the metric terms, or long way to a destination, e.g. “The station was nearly two days march away though the snow”, which may equal to several miles, if marching in a particularly difficult arctic terrain.

The tendency to use temporal expressions of distance in the context of motion events can possibly be explained in terms of the canonical event model proposed by Langacker (1991: Ch. 7; 2008: Ch. 11). The model assumes that any force-dynamic event unfolds primarily in time, where it is temporally bounded and has its own temporal location. Accordingly, motion events inherently involve the temporal dimension as the primary domain of their conceptualization. In the outcome, temporal representations frequently feature in linguistic expressions of the motion-framed distance (see also Radvansky & Zacks, 2011).

It was already pointed out by Aristotle in Physics (350BC/1995b) that all motion takes place in space and time: space is the potentiality, and time is the measure of motion. Engberg-Pedersen (1999) points out 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” (PLACE FOR A PUNCTUAL MOMENT IN TIME). Kövecses (2005: 53; see also Lakoff & Johnson, 1999: 152) notes that in English one can say, “I slept for fifty miles while she drove” (DISTANCE FOR TIME-DURATION) and “San Francisco is half an hour from Berkeley” (TIME-DURATION FOR DISTANCE). He adds that in such expressions space, time, and motion act as correlated domains joined in a single literal conceptual
frame of the **Time-Motion** schema. In the light of this study, it appears that the schema actually extends to embrace **Space-Time-Motion** as elements of a unified frame of universal experiences, in which elements can stand metonymically for each other. Obviously, the frame can serve as the experiential basis for the **Time is Motion** metaphor in two major variants: *motion of objects* and *motion along a path* (see Lakoff and Johnson, 1999: Ch. 10), but within its scope time cannot be viewed solely as an asymmetric metaphorical extension of space. Instead, space and time appear to act in a complementary fashion in the human mind, at least in motion-framed scenarios.

**References**


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