The examination of temporal and spatial cognition of speakers from various language families

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Abstract

This study examines the effects of language on temporal and spatial cognition among speakers of six languages from three language families: West Slavic (Polish and Slovakian), Finno-Ugric (Hungarian and Finnish), and Indo-European (English and German). A total of 110 participants completed a series of tasks that assessed their perception of time and space. The results revealed a significant difference in temporal cognition between Finno-Ugric and West Slavic/Indo-European speakers, suggesting that language influences how people perceive time. This study provides partial evidence for the linguistic relativity hypothesis, which proposes that language shapes perception. Further research is needed to explore the underlying mechanisms and implications of this finding.

Keywords: descriptive linguistic relativism, temporal cognition, spatial cognition, memorization task, Finno-Ugric, West Slavic, Indo-European

Introduction

Language is not a clear-cut scientific concept, but rather a cultural or historical one, according to many linguists, such as Noam Chomsky. For example, the languages spoken in Germany and the Netherlands are much more closely related than some varieties of Chinese. But we can use the rough, common-sense distinctions between languages for our purposes.

Today, there are more than 4,000 languages in use, and each one is quite distinct from many others. The differences are especially noticeable between languages of different families, e.g., between languages that belong to the Indo-European family, like English, Hindi, and Ancient Greek, and languages that do not, like Hopi and Chinese.

Some thinkers have argued that language has a big influence on experience and thought. They claim that each language reflects a worldview and that languages that are very different reflect very different views, so people who speak different languages think differently about the world.

This idea is sometimes called the Whorf-Sapir hypothesis, after the linguists who popularized it. But the term linguistic relativity, which is more widely used today, has the advantage that it makes it easier to separate the idea from the specific views of Whorf, which are often disputed[1]. The idea that different languages divide the world in different ways, and that this affects how their speakers think about it, has some

[1] Gumperz, J. J., & Levinson, S. C. (Eds.). (1996). **Rethinking linguistic relativity**. Cambridge University Press.

appeal. But the question of how much and what kind of impact language has on thought is an empirical question that requires empirical research.

Although linguistic relativism is perhaps the most well-known version of descriptive relativism, there is more emotion and conviction than evidence on both sides of the debate. As usual in discussions of relativism, it is important to avoid thinking in extremes. The key question is whether there are versions of linguistic relativism that are interesting and plausible between those that are trivially true (the Babylonians did not have a word for 'telephone', so they did not think about telephones) and those that are dramatic but very likely false (people who speak different languages see the world in completely different ways).[2]

This paper was written with the aim of finding evidence for the temporal and spatial aspects of the descriptive version of linguistics relativism. It is important to note that the author being a high school student only had access to open source papers and articles. Therefore the paper will not discuss or cite any paywalled papers.

Data

To ensure the validity and reliability of the data, 10% of the outlier data from the temporal perception-related tasks were excluded due to concerns about dishonest answers and the outliers' data distortion effect. Additionally, participants who

[2] Baghramian, Maria and J. Adam Carter, "Relativism", *The Stanford Encyclopedia of Philosophy* (Spring 2022 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2022/entries/relativism/>.

completed the test in less than 3 minutes or did not complete at least 50 percent of the test were also erased from the data due to concerns about the quality of the data that they provided. The final temporal dataset consists of 110 participants with 23 Hungarian participants, 12 Finnish, 19 Germans, 29 English participants, 12 Slovakian, and 10 Polish. The spatial part of the research received less attention, and only 84 and 79 participants provided complete and accurate answers to all the questions. The memorization task collected only 74 responses that were considered acceptable. In the final dataset, the mean number of items recalled by the respondents was 4.6, with an average of 0.1 non-existent items recalled. Sociographic data was collected and examined. The research found no significant effect of education/age/gender on any of the tasks.

Methodology

The study recruited participants from six languages, using SurveyMonkey and Reddit as the platforms for data collection. The languages were selected from three different language families, with two languages per family, in an attempt to control for the potential influence of culture on the results. However, this method is not flawless, as languages within the same family may still share some cultural similarities.

The research used the Dunn's test and the Kruskal-Wallis test to compare the effects of language. They are able to compare more than two independent samples of different sample sizes.

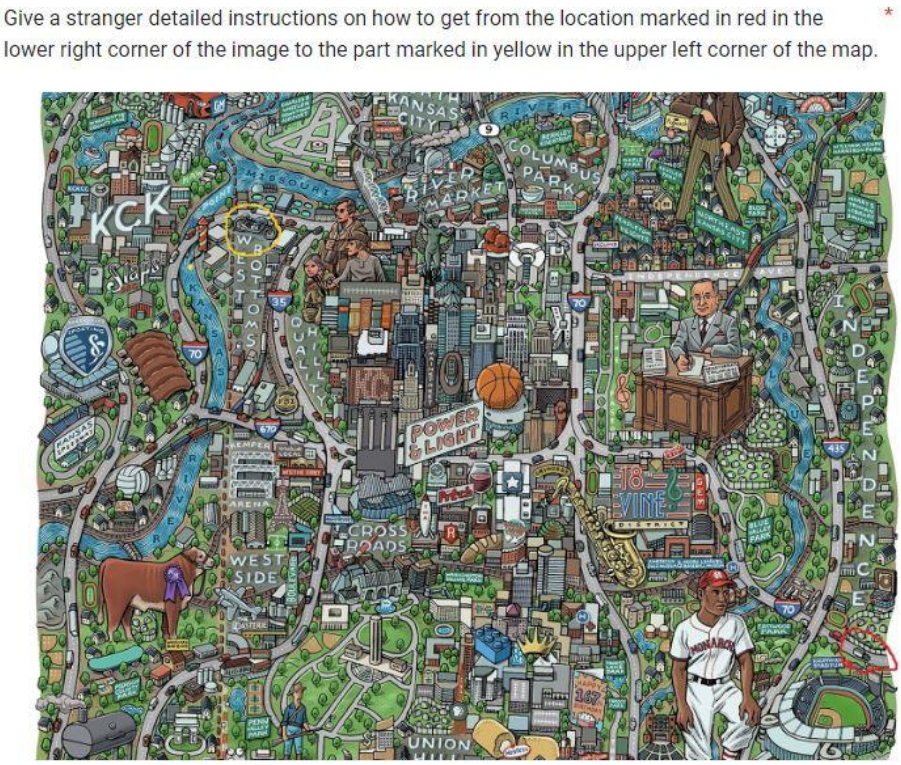
A significant Kruskal-Wallis test indicated that at least one sample stochastically dominated one other sample. The test does not identify where this stochastic dominance occurs or for how many pairs of groups of stochastic dominance are obtained.

Due to the limitation of the Kruskal-Wallis test, the research used Dunn's test to determine which languages differed statistically significantly.

Spatial cognition

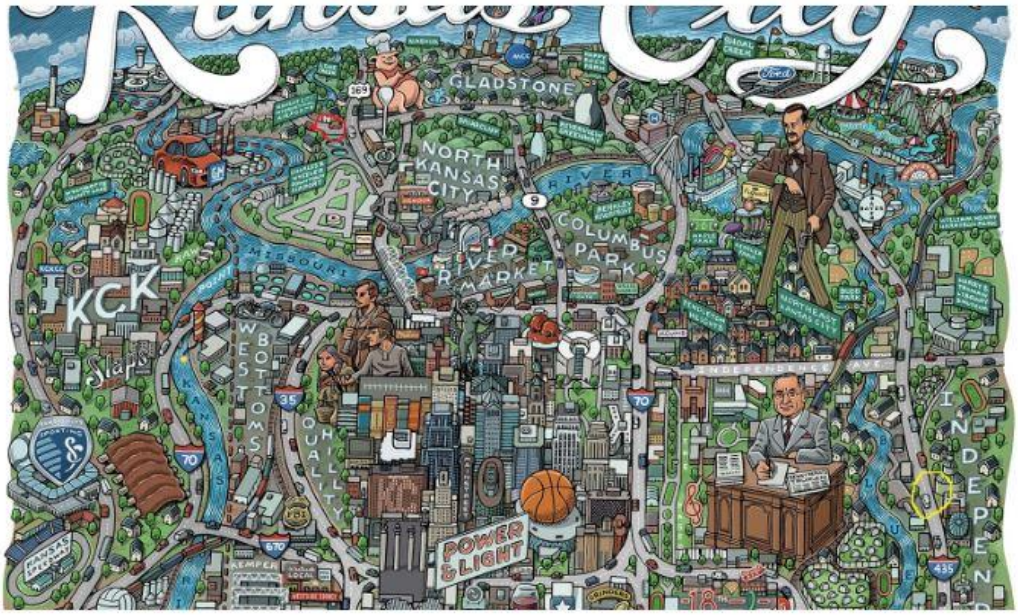
Map-based direction giving task

Participants were given a map and were asked to give directions to passers-by as depicted in the images below:



Note. Map-based direction giving task 1

Give detailed instructions to a passer-by on how to get from the zone marked in red in the upper left corner of the image to the zone marked in yellow in the lower right corner of the image. *

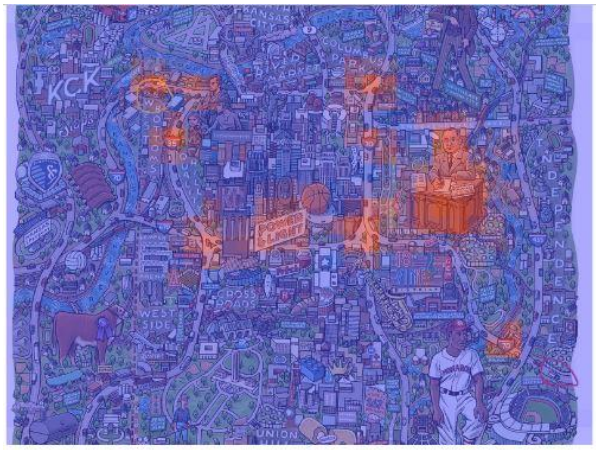


Note. Map-based direction giving task 2

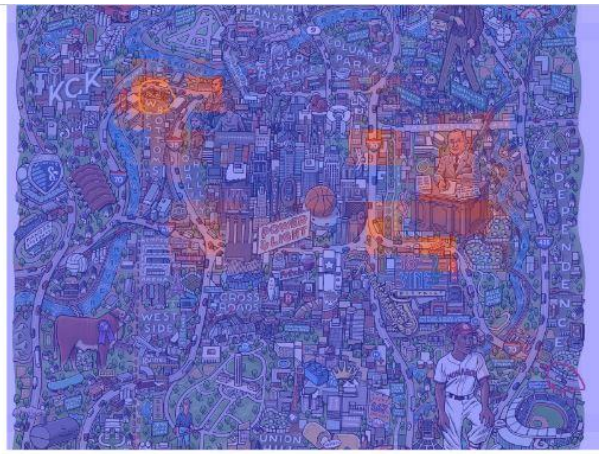
The map purposefully contained several reference points and several possible routes to the destination.

The hypothesis was that speakers from different languages would reference these landmarks at different rates, or would pick routes at significantly different rates.

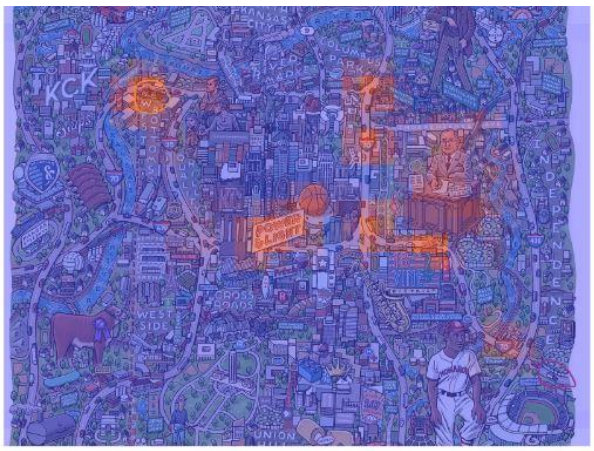
Map-based direction giving the task 1



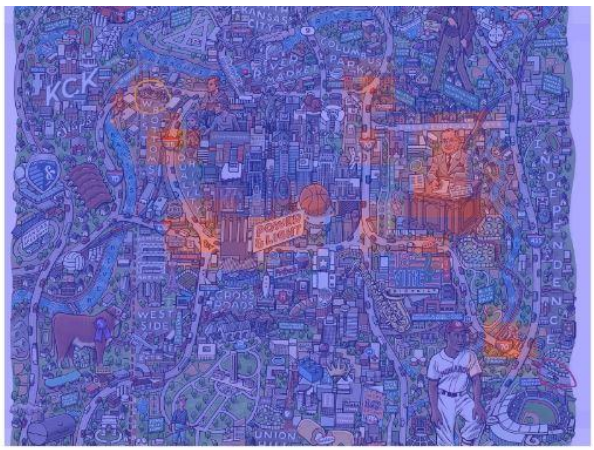
Hungarian



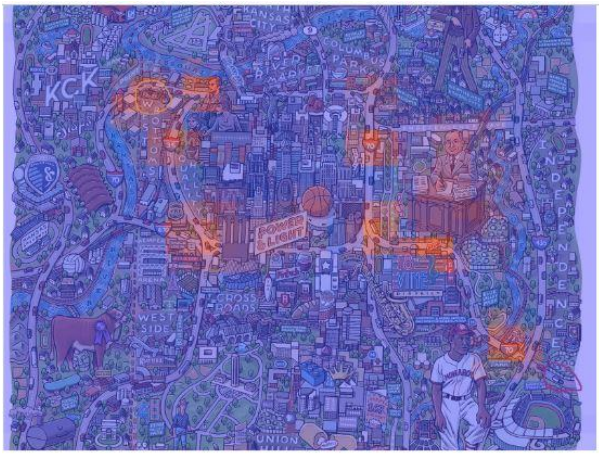
Finn



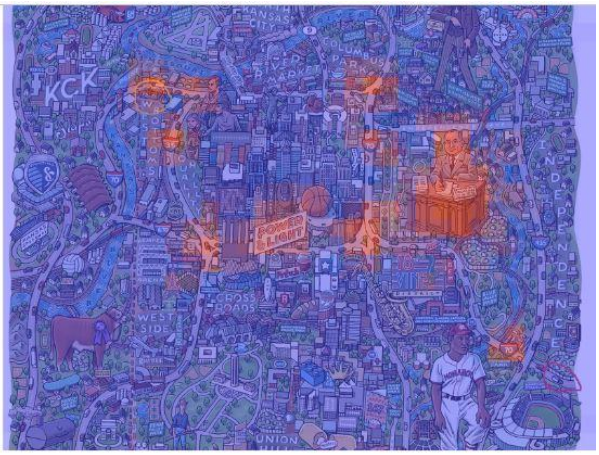
Polish



Slovakian



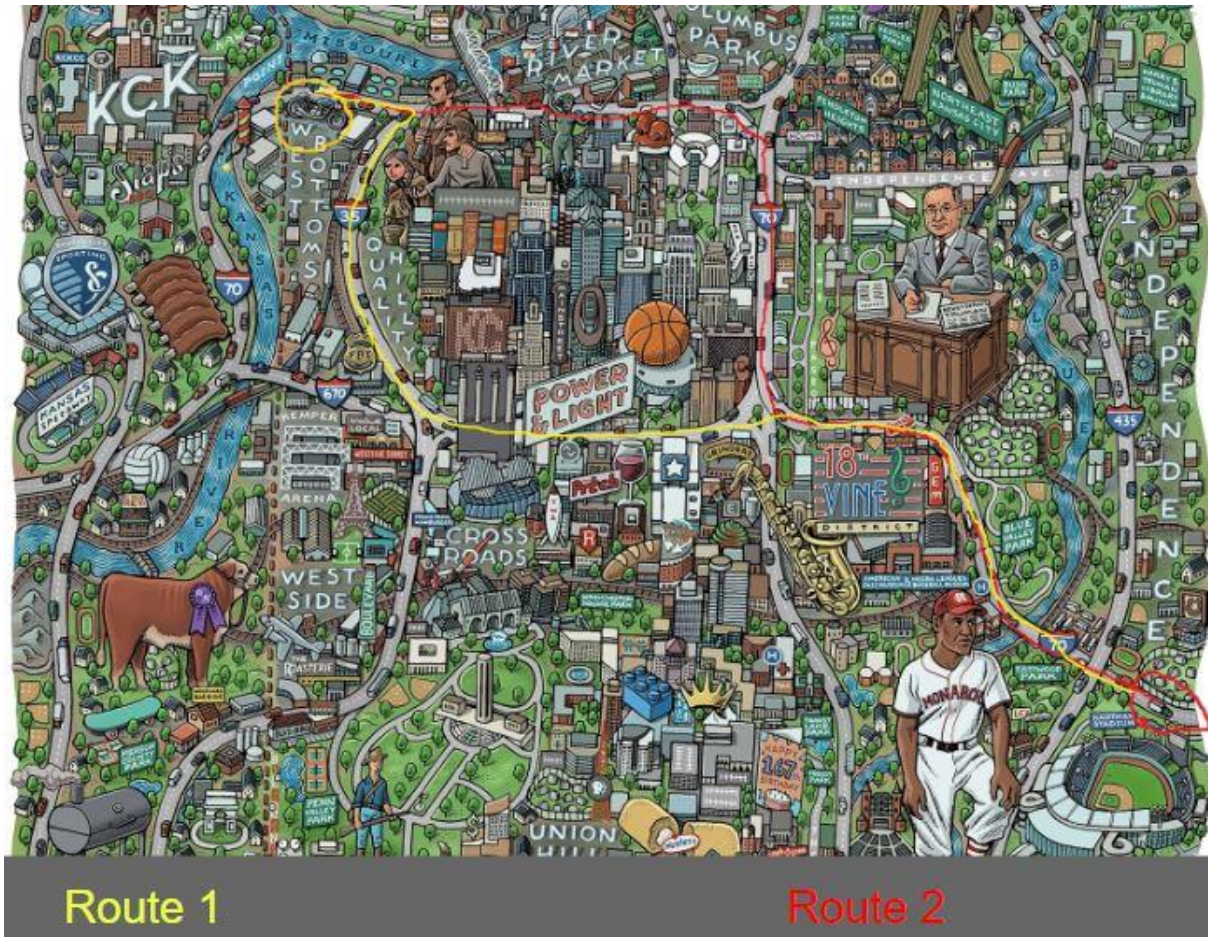
German



English

Note. The pictures were divided into a 30x30 grid. All referenced items were recorded on the map. The heatmaps shown here are relative, meaning that the number of memorized

items in each square was scaled proportionally to the total number of items memorized in that language to arrive at the final shade of the squares as shown in the images above.



	Hungarian	Finn	English	German	Slovakian	Polish
Percent referencing Mr.Truman	33,33%	11,11%	54,17%	20,00%	12,50%	14,29%
Number of participants referencing Mr.Truman	7	1	13	3	1	1
Number of participants with sufficent route description	21	9	24	15	8	7

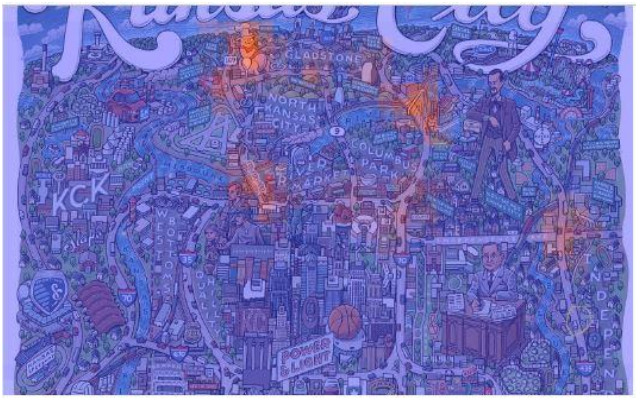
	Hungarian	Finn	English	German	Slovakian	Polish
Route 1 %	42,86%	55,56%	58,33%	60,00%	50,00%	42,86%
Route 1	9	5	14	9	4	3
Route 2 %	57,14%	44,44%	41,67%	40,00%	50,00%	57,14%
Route 2	12	4	10	6	4	4
Number of participants with sufficent route description	21	9	24	15	8	7

Results

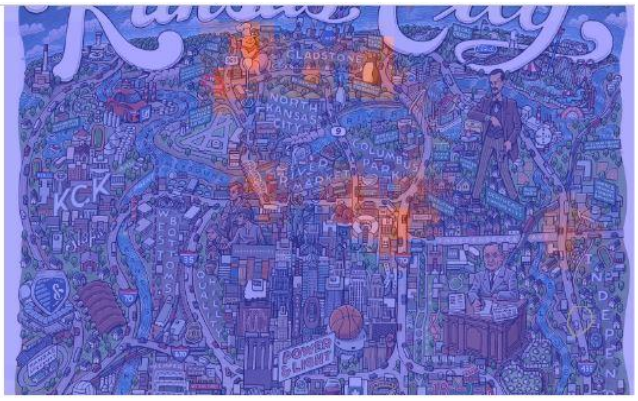
The route choices made by the participants did not show any significant differences across languages. However, a notable finding was that English speakers referred to

Mr. Truman either by name or by description (e.g., “the guy behind the giant table”) more frequently than speakers of other languages. The researcher speculates that this might be due to the higher rates of recognition of the former US president among the participants from the US, which influenced their route descriptions. However, the research did not record the proportion of US participants among the native English speakers, which weakens the validity of this hypothesis.

Map-based direction giving the task 2



Hungarian



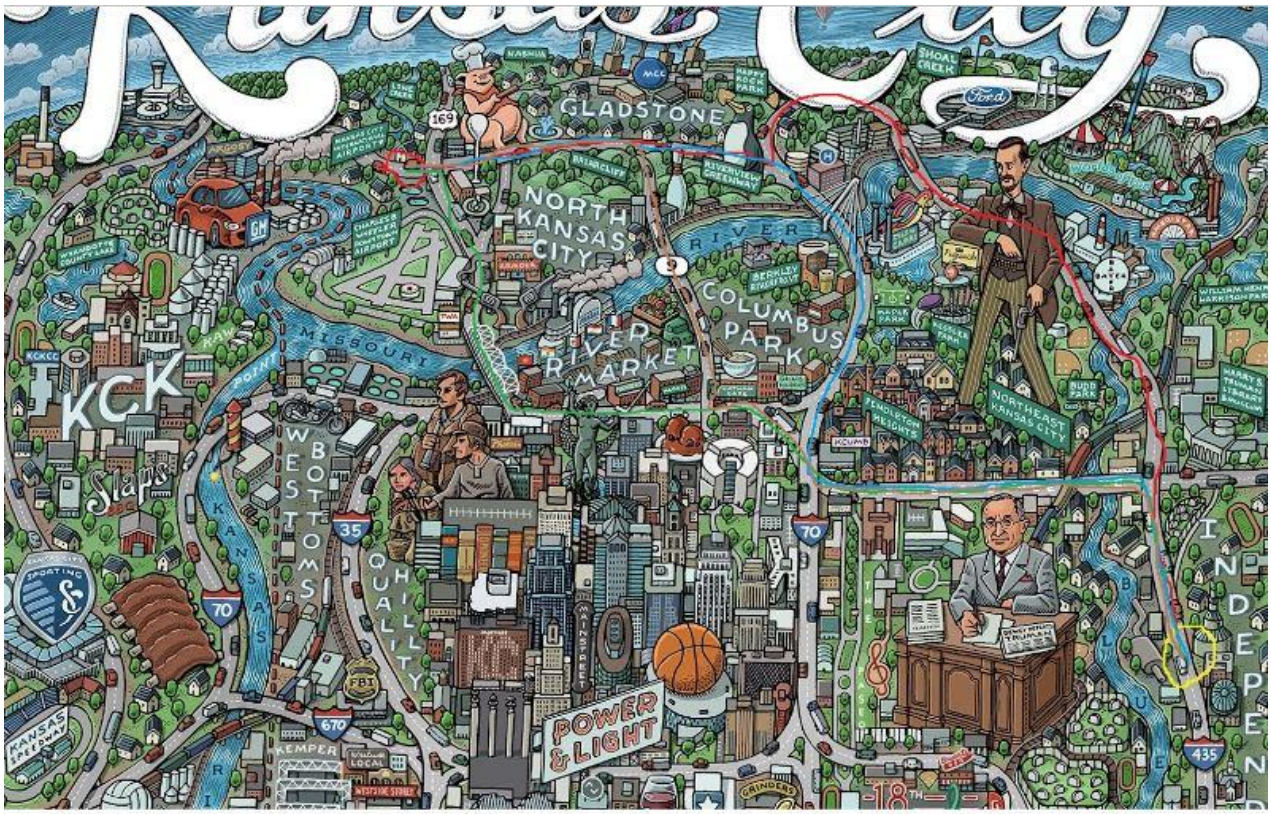
Finn

Polish

Slovakian

German English

Note. The pictures were divided into a 30x30 grid. All referenced items were recorded on the map. The heatmaps shown here are relative, meaning that the number of memorized items in each square was scaled proportionally to the total number of items memorized in that language to arrive at the final shade of the squares as shown in the images above.



Route 1 Route 2 Route 3 Route 4

	Hungarian	Finn	English	German	Slovakian	Polish
Route 1 %	15,00%	11,11%	13,64%	7,14%	14,29%	0,00%
Route 1	3	1	3	1	1	0
Route 2 %	30,00%	33,33%	27,27%	35,71%	42,86%	57,14%
Route 2	6	3	6	5	3	4
Route 3 %	35,00%	33,33%	40,91%	28,57%	28,57%	28,57%
Route 3	7	3	9	4	2	2
Route 4 %	20,00%	22,22%	18,18%	28,57%	14,29%	14,29%
Route 4	4	2	4	4	1	1
Number of participants with sufficent route description	20	9	22	14	7	7

Results

The route choices made by the participants did not show any significant differences across languages.

	Hungarian	Finn	English	German	Slovakian	Polish
%	57,14%	33,33%	11,11%	75,00%	100,00%	100,00%
Number of participants referencing the susupension bridge	4	1	1	3	2	2
Number of participants who choose Route 3	7	3	9	4	2	2

A notable finding was that Finn and English speakers referenced the suspension bridge at substantially lower rates. As the results did not manifest in the same language family, the results are probably mainly attributable to chance and not to English or Finn.

	Hungarian	Finn	English	German	Slovakian	Polish
%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Number of participants referencing the susupension bridge	0	0	0	0	0	0
Number of participants who choose Route 3	4	2	4	4	1	1

A consistent and surprising finding was the absence of any reference to the bridge by the participants who chose Route 3. A plausible explanation for this phenomenon is that the bridge had an atypical design that resembled a road, rather than a conventional bridge.

Memorization task

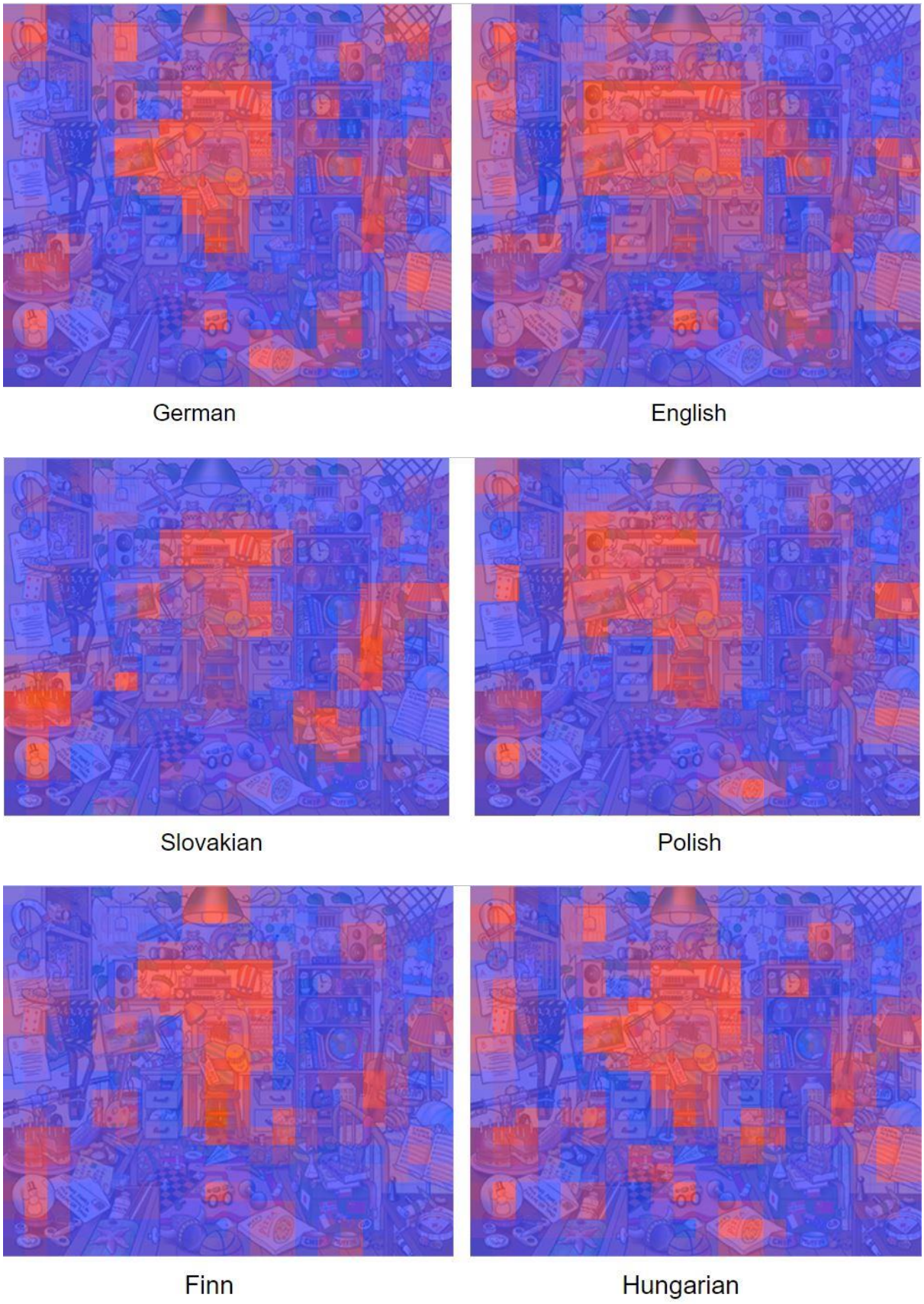
The research question's purpose was to examine the effect of language on spatial cognition by using a picture of a cluttered room as a stimulus. From the stimulus,

participants had to encode(memorize) and retrieve(recall) 5 items. To eliminate the recency effect, a memory phenomenon where the last items in a list are better recalled, the researcher manipulated the order of the questions. The stimulus question was presented first, followed by other unrelated questions, and the retrieval question was presented last. This increased the retention interval between encoding and retrieval, which reduced the likelihood of recalling the most recent items with a higher probability.

Memorize at least 5 objects from the picture and move on. At the end of the test we will ask about the memorized objects. *

Note. Memorization task as presented to the participants

The research hypothesized that language will affect either or both the dispersion of the location of memorized items and the location itself.



Note. The picture was divided into a 20x20 grid. Each object was categorized into at least 1 cell(or more if the item was large). The heatmaps shown here are relative,

meaning that the number of memorized items in each square was scaled proportionally to the total number of items memorized in that language to arrive at the final shade of the squares as shown in the images above.

Results

The study employed quantitative methods to measure the statistical significance of the results. The spatial coordinates of the items were recorded and analyzed. However, some aspects of the results remained qualitative, due to the challenges of quantifying the exact size of the items, and the time limitations of recording the colors of the memorized items.

Descriptive Statistics ▼

	Finn	German	Hungarian	Slovakian	English	Polish
Mean	9.241	9.414	9.517	9.862	9.414	9.517
Std. Deviation	4.015	4.230	4.540	4.249	5.362	3.970
Minimum	1.000	1.000	2.000	2.000	1.000	2.000
Maximum	17.000	18.000	19.000	18.000	18.000	18.000

Note. Descriptive statistics for the X coordinates. Coordinate 1 is the leftmost

Descriptive Statistics

	metrics					
	English	Finn	German	Hungarian	Polish	Slovakian
Mean	13.033	12.833	12.167	12.033	12.233	12.367
Std. Deviation	4.709	4.235	5.490	5.654	5.257	5.391
Minimum	4.000	4.000	1.000	1.000	1.000	1.000
Maximum	20.000	20.000	20.000	20.000	20.000	20.000

Note. Descriptive statistics for the Y coordinates. Coordinate 1 is on the bottom.

Kruskal-Wallis Test

Kruskal-Wallis Test

Factor	Statistic	df	p
Language	0.462	5	0.993

Post Hoc Tests

Dunn

Dunn's Post Hoc Comparisons - Language

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
English - Finn	0.180	94.983	92.567	0.857	1.000	1.000
English - German	0.497	94.983	88.317	0.619	1.000	1.000
English - Hungarian	0.562	94.983	87.433	0.574	1.000	1.000
English - Polish	0.462	94.983	88.783	0.644	1.000	1.000
English - Slovakian	0.303	94.983	90.917	0.762	1.000	1.000
Finn - German	0.317	92.567	88.317	0.752	1.000	1.000
Finn - Hungarian	0.382	92.567	87.433	0.702	1.000	1.000
Finn - Polish	0.282	92.567	88.783	0.778	1.000	1.000
Finn - Slovakian	0.123	92.567	90.917	0.902	1.000	1.000
German - Hungarian	0.066	88.317	87.433	0.948	1.000	1.000
German - Polish	−0.035	88.317	88.783	0.972	1.000	1.000
German - Slovakian	−0.194	88.317	90.917	0.846	1.000	1.000
Hungarian - Polish	−0.101	87.433	88.783	0.920	1.000	1.000
Hungarian - Slovakian	−0.259	87.433	90.917	0.795	1.000	1.000
Polish - Slovakian	−0.159	88.783	90.917	0.874	1.000	1.000

For Y coordinates

Kruskal-Wallis Test

Kruskal-Wallis Test

Factor	Statistic	df	p
Country	0.410	5	0.995

Dunn

Dunn's Post Hoc Comparisons - Country

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
English - Finn	0.226	87.534	84.552	0.821	1.000	1.000
English - German	0.132	87.534	85.793	0.895	1.000	1.000
English - Hungarian	0.061	87.534	86.724	0.951	1.000	1.000
English - Polish	−0.042	87.534	88.086	0.967	1.000	1.000
English - Slovakian	−0.362	87.534	92.310	0.717	1.000	1.000
Finn - German	−0.094	84.552	85.793	0.925	1.000	1.000
Finn - Hungarian	−0.165	84.552	86.724	0.869	1.000	1.000
Finn - Polish	−0.268	84.552	88.086	0.789	1.000	1.000
Finn - Slovakian	−0.588	84.552	92.310	0.557	1.000	1.000
German - Hungarian	−0.071	85.793	86.724	0.944	1.000	1.000
German - Polish	−0.174	85.793	88.086	0.862	1.000	1.000
German - Slovakian	−0.494	85.793	92.310	0.621	1.000	1.000
Hungarian - Polish	−0.103	86.724	88.086	0.918	1.000	1.000
Hungarian - Slovakian	−0.423	86.724	92.310	0.672	1.000	1.000
Polish - Slovakian	−0.320	88.086	92.310	0.749	1.000	1.000

For X coordinates

The Kruskal-Wallis test and the Dunn post hoc test revealed no significant differences in the coordinates, indicating that language did not have a significant effect on the dispersion or the location of the memorized items. Although it was not quantified, the researchers observed that the size of the items was the main driver of item selection.

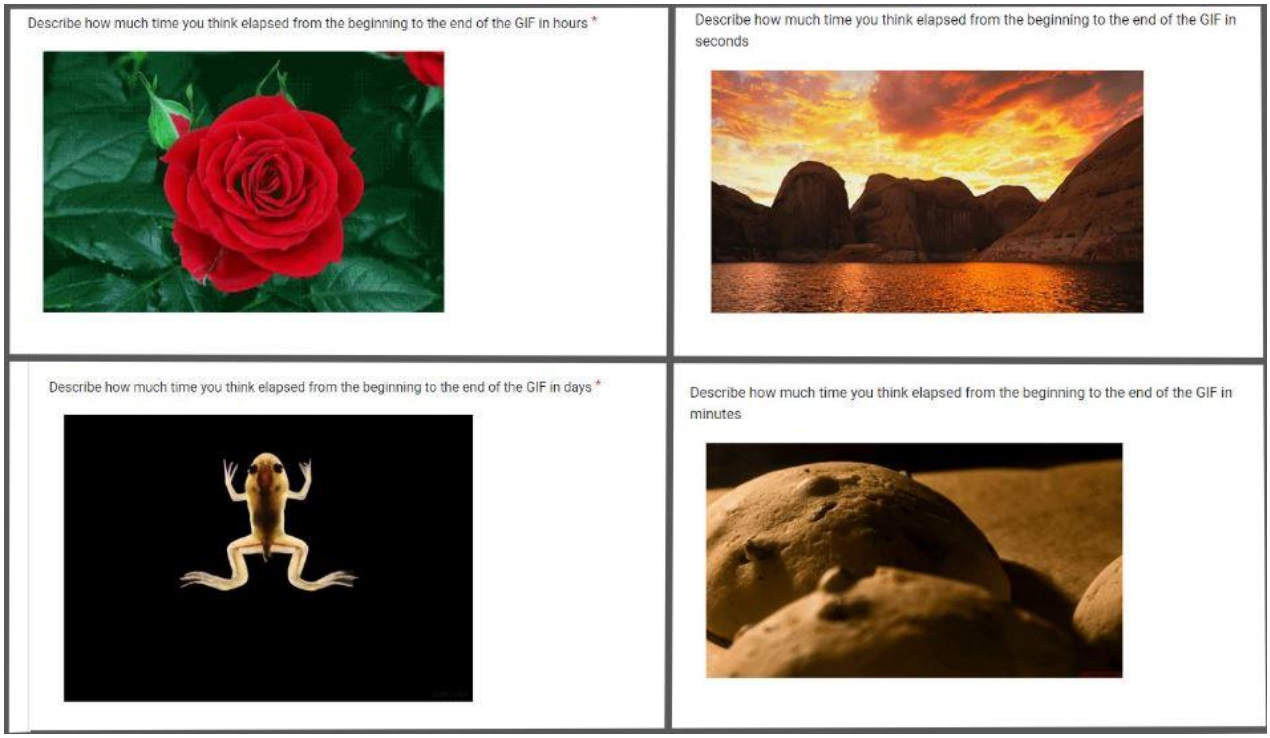
Future research

A possible suggestion for future research is to use maps that contain culture-specific items that could help to reduce the effect of cultural noise, and to distribute the large items more evenly across the map, as they were the main factor influencing the item selection. This could help to assess whether language has an actual impact on the dispersion of attention.

Temporal Cognition

Time estimation task

Participants were given the task of estimating the duration of looped videos(GIFs) as shown in the pictures below. The videos' real duration differed by orders of magnitude in order to test both short and long-term temporal cognition.



Describe how much time you think elapsed from the beginning to the end of the GIF in days and hours *

Rövid szöveges válasz

As described in the Data section, participants with outlier scores, which constituted 10% or at least one participant per language, were excluded from the analysis to obtain more reliable results. This was necessary due to the small sample size of some languages, which had less than 15 participants, and the high risk of data distortion caused by them. Participants were also told which unit of time to use to further avoid data distortion.

The descriptive statistics are presented in the images below:

Descriptive Statistics (all numerical values are in hours)

	Hungarian	Finn	German	English	Slovakian	Polish
Mean	398.586	421.310	452.517	452.690	460.517	514.759
Std. Deviation	252.257	269.791	254.500	253.150	238.202	225.172

Descriptive Statistics (all numerical values are in days)

	Hungarian	Finn	German	English	Slovakian	Polish
Mean	65.862	67.310	71.517	76.759	76.069	78.724
Std. Deviation	44.452	41.799	40.102	48.474	49.008	45.098

Descriptive Statistics ▼ (all numerical values are in days)

	Hungarian	Finn	German	English	Slovakian	Polish
Mean	92.517	82.207	98.586	95.724	108.069	119.034
Std. Deviation	58.260	56.246	55.063	55.566	56.455	62.808

Descriptive Statistics (all numerical values are in minutes)

	Hungarian	Finn	German	English	Slovakian	Polish
Mean	63.345	94.414	82.172	85.310	86.276	65.621
Std. Deviation	51.138	40.388	27.971	59.130	43.454	45.396

The research also computed a cumulative rank table based on the means and standard deviations of the distributions and applied a cumulative normal distribution function to estimate the corresponding ranks.

The cumulative rank statistics are displayed in the images below:

Percentiles of means						
GIF destcription	Hungarian	Finn	German	English	Slovakian	Polish
Frog Embryo	0,09895835664	0,1550315925	0,4114666919	0,7770081547	0,7364385321	0,871149349
Cookie being cooked	0,09513809604	0,1301861268	0,5849190639	0,6802995875	0,7077088471	0,8860025157
Grape changing to raisin	0,09600900644	0,2330888209	0,5247961153	0,5265357441	0,6044746935	0,9494598945
A rose blooming	0,2964080137	0,4759915467	0,752145527	0,3882025706	0,08996937063	0,9380575542
Means of time distribution						
GIF destcription	Hungarian	Finn	German	English	Slovakian	Polish
Frog Embryo	65,86206897	67,31034483	71,51724138	76,75862069	76,06896552	78,72413793
Cookie being cooked	63,34482759	65,62068966	82,17241379	85,31034483	86,27586207	94,4137931
Grape changing to raisin	398,5862069	421,3103448	452,5172414	452,6896552	460,5172414	514,7586207
A rose blooming	92,51724138	98,5862069	108,0689655	95,72413793	82,20689655	119,0344828

Hypothesis

The research hypothesized that at least one of the three language families(West Slavic, Finno-Ugric, Indo-European) would significantly deviate in their perception of time.

Results

Kruskal-Wallis Test

Factor	Statistic	df	p
Countries	16.100	5	0.007

Dunn

Dunn's Post Hoc Comparisons - Countries

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
English - Finn	1.450	14.500	7.250	0.147	1.000	1.000
English - German	0.150	14.500	13.750	0.881	1.000	1.000
English - Hungarian	2.050	14.500	4.250	0.040	0.605	0.525
English - Polish	−1.600	14.500	22.500	0.110	1.000	0.877
English - Slovakian	0.350	14.500	12.750	0.726	1.000	1.000
Finn - German	−1.300	7.250	13.750	0.194	1.000	1.000
Finn - Hungarian	0.600	7.250	4.250	0.549	1.000	1.000
Finn - Polish	−3.050	7.250	22.500	0.002	0.034	0.032
Finn - Slovakian	−1.100	7.250	12.750	0.271	1.000	1.000
German - Hungarian	1.900	13.750	4.250	0.057	0.861	0.632
German - Polish	−1.750	13.750	22.500	0.080	1.000	0.801
German - Slovakian	0.200	13.750	12.750	0.841	1.000	1.000
Hungarian - Polish	−3.650	4.250	22.500	< .001	0.004	0.004
Hungarian - Slovakian	−1.700	4.250	12.750	0.089	1.000	0.802
Polish - Slovakian	1.950	22.500	12.750	0.051	0.768	0.614

Note. The research uses p to determine the significance of the results.

The analysis of the aggregated data from the four GIFs revealed significant differences in temporal cognition among languages from different language families, as indicated by the Kruskal-Wallis and the Dunn post hoc tests. These differences suggest that language has a large influence on how people perceive time in this specific instance. Specifically, the Dunn post hoc test showed that English-Hungarian, Finn-Polish, and Hungarian-Polish pairs had significant ($p<0.05$) differences in their temporal cognition. Pairs such as German-Hungarian, Polish-Slovakian, and German-Polish were close to the threshold of statistical significance. The data strongly implies that speakers of the Finno-Ugric language family have a distinct way of perceiving time. The fact that the Finno-Ugric language family deviated from the rest, should come as no surprise as it is the most separated of the three.

These results are in line with Asgari et al.'s finding that the Finno-Ugric language family was substantially separated from other language families based on their hierarchical clustering of 50 languages based on word embedding.[3]

The research post hoc hypothesizes that the differences in the temporal structures of the languages, such as the difference in tense marking, and use of aspectual or modal particles, and the order of temporal adverbials, could have led to the formation of different temporal models.

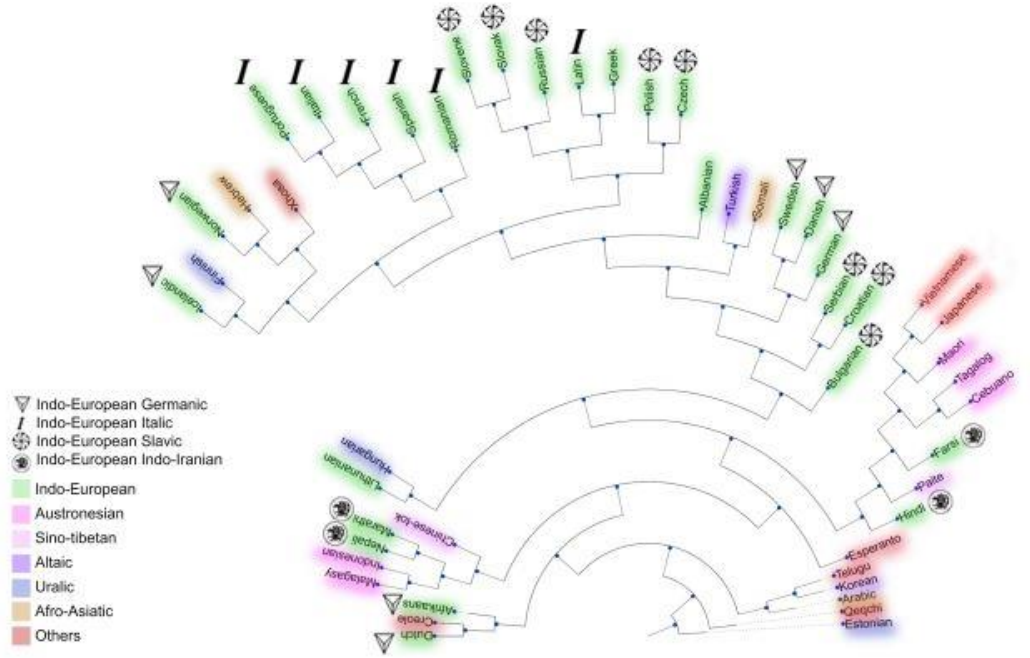


Figure 1: Hierarchical clustering of fifty natural languages according to divergence of joint distance distribution of 4097 aligned words in bible parallel corpora. Subsequently we use colors to show the ground-truth about family of languages. For Indo-European languages we use different symbols to distinguish various sub-families of Indo-European languages. We observe that the obtained clustering reasonably discriminates between various families and subfamilies.

Note. Image from Asgari et al, 2016

[3] Asgari, Ehsaneddin, and Mohammad R. K. Mofrad. "Comparing Fifty Natural Languages and Twelve Genetic Languages Using Word Embedding Language Divergence (WELD) as a Quantitative Measure of Language Distance." *arXiv*, 2016, https://arxiv.org/abs/1604.08561.

Uncertain time estimation task

Participants were given the task of estimating the duration of a GIF in seconds. The GIF shows beautiful scenery with a lake in the focus that waves for an indefinite amount of time. As discussed in the data section 10% of the outlier values were removed. Additionally, answers that exceeded 2000 seconds were capped down to 2000 seconds.

Results

Descriptive Statistics (all numerical values are in days)

	Metrics					
	English	Finn	German	Hungarian	Polish	Slovakian
Mean	335.100	303.657	329.786	297.343	383.714	350.371
Std. Deviation	323.585	243.977	311.165	229.104	306.111	322.922

Kruskal-Wallis Test ▼

Kruskal-Wallis Test

Factor	Statistic	df	p
Language	15.089	5	0.010

Post Hoc Tests

Dunn

Dunn's Post Hoc Comparisons - Language

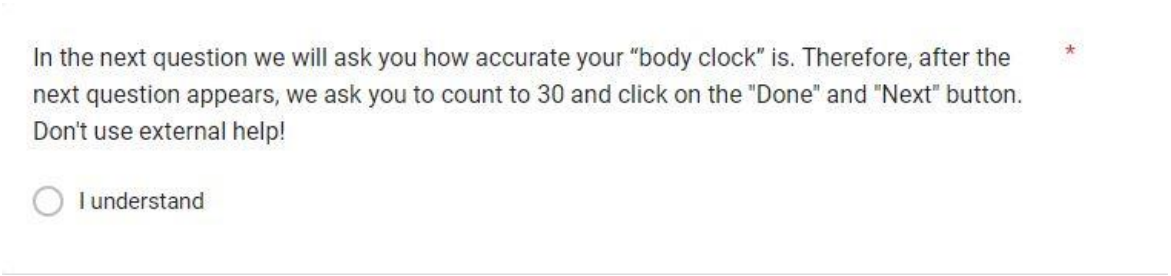
Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
English - Finn	−0.869	132.396	147.122	0.385	1.000	1.000
English - German	0.250	132.396	128.236	0.802	1.000	1.000
English - Hungarian	−0.285	132.396	137.375	0.775	1.000	1.000
English - Polish	−2.051	132.396	166.814	0.040	0.604	0.443
English - Slovakian	−2.890	132.396	182.207	0.004	0.058	0.054
Finn - German	1.114	147.122	128.236	0.265	1.000	1.000
Finn - Hungarian	0.549	147.122	137.375	0.583	1.000	1.000
Finn - Polish	−1.151	147.122	166.814	0.250	1.000	1.000
Finn - Slovakian	−1.998	147.122	182.207	0.046	0.686	0.457
German - Hungarian	−0.524	128.236	137.375	0.600	1.000	1.000
German - Polish	−2.299	128.236	166.814	0.021	0.322	0.258
German - Slovakian	−3.131	128.236	182.207	0.002	0.026	0.026
Hungarian - Polish	−1.673	137.375	166.814	0.094	1.000	0.850
Hungarian - Slovakian	−2.485	137.375	182.207	0.013	0.194	0.168
Polish - Slovakian	−0.885	166.814	182.207	0.376	1.000	1.000

The data from the GIF revealed significant differences in the cognition of time uncertainty among many languages, as indicated by the Kruskal-Wallis and the Dunn post hoc tests. Specifically, the Dunn post hoc test showed that English-Polsih, English-Slovakian, Finn-Slovakian, German-Polish, German-Slovakian, and Hungarian-Slovakian pairs had significant differences ($p<0.05$). The research hypothesizes that some distinctive characteristics of the temporal structure of West Slavic languages gave rise to a different temporal model.

Future research should try to replicate the results and further examine how speakers of different languages deal with temporal uncertainty.

Time reproduction task

Using the reliable tool of cognitive researchers the “30-second task”[4] to both distract participants to avoid the recency effect and to measure their temporal cognition in an easily quantifiable way.



The research hypothesized that the data would show significant differences between speakers of different languages, and planned to use the data to verify it. However, later its purpose was changed to filter out participants who did not pay attention. This decision was made due to the low sample size, which could have yielded false positives in this case. Participants who fell outside of the range of 15 to 45 seconds were removed from the data. The final polished dataset looks like this:

Descriptive Statistics ▼

	Hungarian	Finn	German	English	Slovakian	Polish	Aggregate
Valid	23	12	19	29	12	10	105
Mean	31.783	28.833	29.053	29.517	33.167	31.400	30.448
Std. Deviation	3.529	0.937	1.870	1.920	2.167	1.776	2.707
Minimum	24.000	27.000	26.000	26.000	28.000	29.000	24.000
Maximum	38.000	30.000	32.000	33.000	36.000	34.000	38.000

Conclusion

This study has investigated the effects of language on temporal and spatial cognition among speakers of six languages from three language families: West

[4] Serial Position Effect (Glanzer & Cunitz, 1966; Murdock, 1962)

Slavic (Polish and Slovakian), Finno-Ugric (Hungarian and Finnish), and Indo-European (English and German). The study has employed a series of tasks that measured the participants' perception of time and space in various domains. The study has found a significant difference in temporal cognition between Finno-Ugric and West Slavic/Indo-European speakers, and in uncertain temporal cognition between West Slavic and Finno-Ugric/Indo-European speakers, indicating that language influences how people perceive time. This study has provided partial evidence for the linguistic relativity hypothesis, which suggests that language shapes perception. However, the study has also encountered some limitations, such as the small sample size, the lack of control for other factors that may affect cognition, and the difficulty of measuring spatial cognition with online tasks. Therefore, further research is needed to explore the underlying mechanisms and implications of the linguistic influence on temporal and spatial cognition, as well as to extend the findings to other languages and cultures.

References

Asgari, Ehsaneddin, and Mohammad R. K. Mofrad. “Comparing Fifty Natural Languages and Twelve Genetic Languages Using Word Embedding Language Divergence (WELD) as a Quantitative Measure of Language Distance.” *arXiv*, 2016, https://arxiv.org/abs/1604.08561

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Other

The link to the research’s Google Survey can be accessed here