Utrecht University

Master Social Psychology

MASTERTHESIS

Persian Movements:

Congruence between script directionality and movement direction & its impact on time perception

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Abstract

Li (2014) has shown that congruence between the spatial grounding of time and movement direction leads to faster perception of time passage in Dutch participants. This study was designed to assess whether this effect can be attributed to script directionality. By tasking Iranian bilingual participants to read and write in Persian (from right to left) it was excepted that after this priming task a movement from right to left would be perceived as faster, as opposed to faster time passage of a movement from left to right (as is the case in Dutch participants). No clear results were found for the reversal of the effect in Iranian participants nor was the same effect found as in Dutch participants. Thus the results provide no backing for the hypothesis that script directionality is the main influencer in faster time perception of a left to right movement. A possible limitation of the study was that some participants had too much experience in Western script directionality which distorted the results. Analysis of a subsequently sent questionnaire suggested that a significant portion of the tested participants represented the past on the left and showed the same time perception effects as Dutch participants. Future research should test participants that are only fluent in Persian to assess whether the effect does reverse in Iranian monolingual participants.

Introduction

''Time and space are modes by which we think and not conditions in which we live".

Einstein (Calaprice, 1996)

Since Einstein's *special* and *general* theories of relativity, the way science thinks about the nature of space and time and the way in which space and time are perceived to be related has been revolutionized.

In Philosophy a distinction is made between *Physical* time and *Psychological* time (Dowden, 2011). Physical time is measurable time, also called public time. This is the concept physicists refer to when they talk about time. In contrast with physical time is *Psychological* Time. This is the perception of time, the phenomenological quality of time. It is how fast or slow we experience time. The domain of psychological time is where this current paper will venture. In it the connection between space perception and time perception will be further explored.

Just as in the physical world, time and space connect in the psychological realm as well. This is evident in language. We tend to think and talk about time using spatial metaphors (Lakoff & Johnson, 1980) & (Johnson & Lakoff, 2002). We talk and think about time in terms of space (e.g. 'a short hour'), but not the other way around (Casasanto & Boroditsky, Time in the mind: Using space to think about time, 2008). This asymmetric relationship in language between space and time can be linked to the elusiveness of physical time. Time is more elusive and abstract than space, because space can be observed and experienced directly, but time can only be observed indirectly.

Numerous studies reveal that spatial features can affect time perception (Casasanto & Boroditsky, Time in the mind: Using space to think about time, 2008), (Casasanto & Bottini, 2014).

These studies show that the link between time and space in language extends beyond language to our basic representations of space and time. People incorporate irrelevant spatial information into their temporal judgments, even in purely non-linguistic tasks. The reverse is not found: people don't tend to use temporal information to make spatial judgments. An example of this asymmetric cross-dimensional interference effect is in Casasanto & Boroditsky's '*Do we think about time in terms of space?*' (2003). In this experiment it was tested whether cross-dimensional interference between duration and displacement estimations of moving stimuli could be detected and if this observed interference of the one domain on the other would be symmetric or asymmetric. It was found that in trials of the same duration, lines that travelled a shorter distance were judged to take a significantly shorter time, and lines that travelled longer distances were judged to take a longer time. However, no significant effect was found of duration on the estimation of distance. In short: evidence points to that we tend to both think and talk about time using spatial metaphors and that (irrelevant) spatial features can affect temporal judgments. In other words irrelevant spatial features can influence psychological time.

The way in which people use space to talk and think about time varies across cultures. For example native Mandarin speakers tend to think about time in a vertical way (as is inherent in Mandarin language), even when they are using English (Boroditsky, 2001). Depending on what language people use, different results will be found in what spatial features will effect time perception. For example in a non-linguistic, psychophysical experiment on Greek and English speakers it was found that English speakers' time perception was influenced by irrelevant

distance between cues, whereas Greek speakers' time perception was only influenced by irrelevant volume cues (Casasanto, Boroditsky, & Phillips, 2004), (Casasanto, 2008), (Casasanto, 2013). This can be traced back directly to the language itself because volume metaphors to describe time are much more frequent in the Greek language than in the English language (Casasanto, Boroditsky, & Phillips, 2004) & (Casasanto, 2008).

Another variation between cultures & languages is the way in which the abstract concept of time is grounded spatially. In Western languages the past is usually associated with the left side, whereas the future is associated with the right side. This can also be found in non-linguistic tasks; participants had a faster reaction time when past and future time where linked onto respectively left and right keys, than when the opposite mapping was used (Santiago, Lupáñez, Pérez, & Funes, 2007). Another way in which this spatial grounding of time manifests is in numerical reasoning; this is termed the SNARC effect (Dehaene, Bossini, & Giraux, 1993). The SNARC effect posits that reaction time to small numbers will be faster when responses are with the left hand, while reaction time to big numbers will be faster responding with the right hand. There is some evidence that this reverses in Iranian participants (Dehaene, Bossini, & Giraux, 1993). It had also been found that Hebrew speakers were faster to respond, when making temporal order judgments, when the right hand key was assigned to 'earlier' and the left hand key to 'later', as to the opposed pattern that was observed in English speakers (Fuhrman & Boroditsky, 2007). In an auditory task where Spanish and Hebrew participants would hear a word and had to respond with either a left or right key to categorize the word as in the past or future, the same pattern was found. Spanish participants where faster responding to words in the past with the left hand and to words concerning future with the right hand, whereas Hebrew participants showed the opposite pattern (Ouellet, Santiago, & Israeli, 2010).

This reversal in how time is grounded in space can be explained in various ways. One often used way is the Whorfian hypothesis (Casasanto, 2008). This hypothesis will be more explored in the discussion part of this research.

A more fitting explanation, in this research, for the left-right grounding of time in space and the cross cultural/lingual difference in time perception is that this is due to script directionality. This explanation posits that the left-right mapping of past and future is determined by habits in reading and writing (Maass & Suitner, 2011). Instead of *linguistic factors* determining the horizontal grounding of time onto space, *experiential factors* like reading and writing from left to right determine the make-up of our mental representations and consequently influence our (time) perception. In line with this explanation is the premise that the interaction we have with the environment determines our cognitions more, than inherent features of a language influence our thinking. Research on exposing participants to an alternative orthography supports this premise that experience and interaction with the environment influences time perception and that this influence is contextually dependent on orthography. Casasanto (2014) found that when participants were exposed to a new orthography, this influenced their spatial representations of time in a subsequent task. He found that exposure to a new orthography can change the orientation and direction of the mental timelines of participants within a very short period of exposure time. He concluded that this flexibility of the mental timeline is due to the existence of a hierarchy of implicit associations that are based on different kinds of experiences. In this way conceptualizations of time are culture specific on one level of analysis, but universal in another level of analysis. There is evidence from bilingual participants for this explanation as well. It has been found that when a test was conducted in Hebrew (a right to left language), English-Hebrew bilinguals showed a right to left bias in mental timeline, while the reverse was

found when the same test was conducted in English (Maass & Suitner, 2011).

Evidence that supports this explanation has until now always been of a static form (Santiago et al., 2007; Maas & Suitner, 2011), meaning that past and future where associated with a given spatial configuration (i.e. *Left* associated with *Past*). A spatial feature that is more directly related to reading and writing (and thus script direction) is spatial movement. In recent research (Li et al., (2014, manuscript)) it was demonstrated that a left to right movement of a circle (which concurred with the reading and writing direction of the tested participants) influenced time perception. When comparing left to right, right to left, down-up and up-down movements, participants would perceive time to be passing significantly faster in the left-to-right movement as compared to the other movements. One possible cause of this effect is the reading/writing direction. To further test this possibility, in the current study, we tested it with Iranian participants. If the effect that Li et al. observed was due to the lef to right reading/writing direction, we would expect to observe the opposite effect with Persian participants, as Persian is read and written from right to left.

It can be expected that in the case of Iranian participants time will be perceived as faster passing with a right to left movement as compared to other directions of movement. In this experiment Iranian bilinguals will first be exposed to a reading and subsequent writing task that is in Persian, so to invoke their experience with right to left reading and writing. After this reading/writing task the same design Li used will be used to test time perception and movement direction with the only difference that instructions will be in Persian instead of English.
The underlying hypothesis on which this experiment is based is what I term the ‘o*verhypothesis’.* This overhypothesis can be formulated as the following: *When script directionality and movement direction are congruent, time will be perceived as faster.* More specific the main

hypothesis for this experiment is that time will be judged as passing faster for the right to left movement as compared to the other movements due to the script directionality of the Persian language. However, as the participants are used to reading and writing in English and/or Dutch as well, an alternative hypothesis is that the effect of direction of movement on time perception will be insignificant due to distortion between the languages.

Method section

Participants

Thirty-one participants completed all conditions in this study: 14 of them were male, 17 female. Ages ranged from 23 to 44 (M = 30.03, SD = 4.92). Participants were recruited in Utrecht and Delft by advertising on social media, specifically by approaching international students in *Facebook* groups for Iranians in the Netherlands. Participants were paid five euros for participating in the experiment.

All participants were born in Iran and able to fluently write and read Persian. Four participants have lived in the Netherlands for more than 5 years. All are University students or were educated at University level or other higher education level in the past.

Materials/ Apparatus

Two Persian texts were used as a priming task (see procedure). Both these texts were selected from http://www.healthtranslations.vic.gov.au . This site was used because of the ease of finding two identical texts in Persian and in English. The first text was about safety practices during storms, and the second text was about getting a good and healthy sleep rhythm.

Procedure

Participants were tested in a standard psychological lab setting (consisting of a chair, a table and a computer/laptop). Participants finished the task on the computer/laptop. The experiment was programmed with E-Prime 2.0. All the text (including the instruction, the reading texts and the tasks) in the experimental was presented in Persian.

The experiment consists of two parts. In the first part, considering that participants live in the Netherlands now, they might have less exposure to their mother language. Therefore, to prime their sense of Persian, we presented participants two Persian texts for reading; afterwards

they were asked to recall the texts and write down as much as they could. In the second part, we presented participants the key task about making judgments of the speed of time passing.

A 5 (direction of movement: left to right/right to left/up to down/down to up/static) * 3 (duration of movement: 10s/15s/20s) within subjects repeated-measures design was used in this task. In total, each participant was presented with 15 experimental trials. In each trial, a circle was either moving horizontally from left to right or from right to left, or moving vertically from up to down or down to up, or being static in the center of the computer screen. The circles were moving or being static for 10 s, 15 s or 20 s. After each trial, participants were asked to indicate how fast they thought time was passing during the trial by answering the question: *How fast do you think time was passing during this trial?* Participants could indicate their answers on a 9-point scale (from 1-very slowly to 9-very fast).

Before the task, participants were presented 5 trials for practice. The 5 trials were presented in the five directions with different duration: from left to right, from right to left, from up to down, from down to up and static for 10 s, 20 s, 15 s, 20 s and 20 s, respectively. The same question on the judgments of the speed of time passing was asked after each practice trial.

Two weeks after conducting the experiment, we sent participants a questionnaire (see appendix) to collect more information about their background (e.g., for how long they have been living in the Netherlands), which might have influence on the effect we expected.

Results

Repeated-measures analysis of variance was conducted with direction of movement and duration of movement as two within-subjective factors.

The effect of direction of movement on the judgments of the speed of time passage was found significant, $F(1.84, 55.17) = 17.00$, $p < .001$, $\eta_p^2 = .36$, showing that time was judged as passing slower when the stimulus was standing still (static) as compared to moving left-right, right-left, up-down or down-up ($M_{LR} = 4.60$, SD = .23 ; $M_{RL} = 4.54$, SD = .25 ; $M_{UD} = 4.52$, SD = .29 ; $M_{DU} = 4.23$, SD = .29 ; $M_S = 2.65$, SD = .342).

The effect of duration of movement was also significant, $F(2, 60) = 90.81$, $p < .001$, , $\eta_p^2 = .75$, showing that the judgments of the speed of time passage decreases with the increasing duration of movement ($M_{100ms} = 5.00$, SD = .24 ; $M_{150ms} = 4.07$, SD = .22; $M_{200ms} = 3.25$, SD = .22).

The interaction between direction of movement and duration of movement was found to be significant as well, $F(4.62, 108.44) = 13.44$ $p < .001$, $\eta_p^2 = .31$, which indicated that the effect of direction of movement on participant's judgment of time passage depends on the duration of movement.

A simple analysis showed the following (excluded are comparisons to static conditions)* In the 100ms condition a significant difference was found between:

- M_{LR} and M_{UD} (.42, $p = .045$, $\eta_p^2 = .13$, CI [.01, .83]),
- M_{LR} and M_{DU} (1.87, $p < .001$, , $\eta_p^2 = .64$, CI [1.35, 2.40])
- M_{RL} and M_{DU} (1.84, $p < .001$, $\eta_p^2 = .59$, CI [1.27, 2.41])
- M_{UD} and M_{DU}(1.45, $p < .001$, $\eta_p^2 = .63$, CI [1.041, 1.863])

In the 150ms condition a marginally significant difference was found between

- M_{LR} and M_{RL} (.29, $p = .07$, $\eta_p^2 = .11$, CI [-.03, .61])

In the 200ms condition significant differences were found between

- M_{LR} and M_{DU} (-1.07, p = .012, η_p^2 = .19, CI [-1.87,-.26]),
- M_{RL} and M_{DU} (-.94, p = .02 , η_p^2 = .16, CI [.15, 1.72])
- M_{UD} and M_{DU}(-.68, p = .03, η_p^2 = .14, CI [-1.29, -.06])

**The confidence intervals used in the simple analyses are all confidence intervals for differences between the conditions.*

Post-hoc analysis with the questionnaire

When only the participants that represent the past on the left are analyzed (using the aforementioned questionnaire), a marginally significant difference between the left-right and the right-left movement (M_{LR} = 4.38, SD = .36 ; M_{RL} = 4.09, SD = .25) is found (.289 p = .091, η_p^2 = .58, CI [-.052, .630]) is found.

Correlational analysis of the questionnaire revealed that participants who speak more Persian than English tend to represent the past more on the right than participants who speak more English or Dutch (r = .49, p = .03). Participants that prefer living in Iran more than living in the Netherlands tend to represent the past more on the right (r = .56, p = .01). A significant correlation between feeling more at home in the Netherlands than in Iran and representing the past on the left was found as well (r = .52, p = .02). In addition a marginally significant correlation was found between representing the past on the left and for how long the participants had learned English (r = .39, p = .078).

Discussion

When Iranian bilinguals where exposed to Persian (right to left) writing and reading tasks, they didn't judge time to be passing faster when observing a dot moving from right to left as compared to observing a dot moving in other directions. The only clear difference between movement directions was that participants judged time to be passing slower when observing a static dot as compared to observing the dot move in any other direction. Thus unrelated spatial features of movement can influence time perception.

Expectedly, participants also judged time to be passing slower when the duration of the dot appearing on the screen increased. When analyzing the interaction effect of direction and duration on time judgment it was found that when the stimulus duration was 150ms a left to right movement was judged as taking a longer time compared to a right to left movement. Analysis of the later sent questionnaire revealed that a significant part of the participants represented the past on the left and the future on the right. When only these participants were analyzed it was found that a left to right movement was judged as passing faster than a right to left movement. Further analysis of the questionnaire revealed that:

- Participants who speak more Persian than English tend to represent the past more on the right than participants who speak more English or Dutch.
- Participants that prefer living in Iran more than living in the Netherlands tend to represent the past more on the right.
- When participants felt more at home in the Netherlands they represented the past more on the left.
- When participants had a longer history of learning and using English they tended to represent the past more on the left.

The premise of this study was that when script directionality and movement direction would have been congruent, time would be perceived as passing faster. The results were not in agreement with this premise. Participants did not judge time to be passing faster with a right to left movement after being exposed to their native language. Our alternative hypothesis was that no effect would be found due to distortion effects between the two languages. The results seem to be in alignment with this alternative hypothesis. Following this line of thinking it can be argued that because participants are used to writing and reading in Western languages (respectively Dutch and English) no clear effect was found between directions. But as mentioned above, further analysis did reveal some effects.

It can be speculated that two effects work to cancel each other out. The first effect is the same as is found in Dutch participants by Li et al. (2014); this effect is that a left to right movement will be judged as passing faster than a right to left movement, whereas the second effect is the one that was originally predicted (right to left movement is judged as passing faster than left to right). Arguably the distorted results are due to the possibility that in some participants the first effect applies, whereas in the rest of the participants the second effect applies. Why are these two effects found in participants that are all bilingual and have all participated in the same priming task to 'invoke their native language'? As mentioned before in this discussion, a significant part of the participants (a majority) indicated that they represented the past on the left while the rest of the participants indicated that they represented the past on the right. When these participants (that represented the past on the left) were analyzed, the same effect that Li et al. (2014) found earlier is observed. It can be thus speculated that the way the participants represent time (past on the left, future on the right or vice versa) is the determining factor in which effect will show. Why is there such a difference between participants? The

correlational analysis of the questionnaire, as mentioned above, suggests that the more 'Westernized' the participants were, the more they represented the past on the left. Because the majority of the participants were more 'Westernized', the expected effects did not show. These 'Westernized' participants were perhaps so used to left to right languages that the writing and reading task was not enough to reverse the effect found in Western participants.

This brings to question the flexibility of with which people activate special schemas for temporal sequences as described by Casasanto (2014). In his research it was found that short exposure and training with a new orthography was sufficient to reverse the mental timeline. Our research results are in opposition to this claim, since one would expect our priming tasks to be sufficient to reverse the mental timeline as well. A recent experiment by Li (unpublished, 2014) also questions this flexibility of mental timelines. In this experiment based on Casasanto's mirror reading experiment (2014) the same design was used as in this study, the only difference being the language (Dutch). In this variation the entire Dutch instructions were mirrored. Surprisingly, the same effects as before were found (a movement from left to right was judged as passing faster than a movement from right to left), instead of what one would expect based on Casasanto's research (namely that a right to left movement would be judged as passing by faster).

It can still be the case that writing direction is the main predictor of the effect of faster time perception in left to right movement, but it might also be that factors inherent in the language influence this effect. This was touched upon very briefly in the introduction as the Whorfian hypothesis. This hypothesis posits that the language we use directly determines our perception of the world (Whorf, 2012). This version of the Whorfian hypothesis is recently renamed as the *Strong* Whorfian hypothesis (Casasanto, 2008). In more recent (psychological)

literature a more nuanced version of the Whorfian hypothesis is formulated. This version is called the *Deep* Whorfian hypothesis. It states that the particular language that we speak can influence the representations we build for the purpose of speaking as well as the non-linguistic representations we build for remembering, perceiving and acting on the world around us (Casasanto, 2008). The *deep* Whorfian explanation for the cross cultural variation in the spatial grounding of time and the subsequent difference in time perception can be formulated as follows: ‘’The way the abstract concept of time is grounded spatially (left –right) and subsequent differences in time perception is due to factors inherent in the language’’. What these factors might be will need to be explored in further research. There is a problem with this explanation however, because in the English language there is no correlate to be found that explains why time is represented on a horizontal line and not vertically (as is the case with Mandarin language (Boroditsky, 2001)).

The primal weakness of this study lies in the fact that recruiting bilinguals is not a complete reversal of the original design. Recruiting participants that are only fluent in Persian (or a similar right to left language such as Hebrew) would solve this problem. If in such a research design the same effects as in this research, or similar effects as in Li et al. (2014), would be found that would exclude the explanation that the effect is due to writing direction alone.

Another variation would be to randomly assign half of the Persian bilinguals to a group that has the same design as the current study and the other half to a group that has the same design but translated in English instead of Persian. Comparing these groups can shed a light on how flexible the effect of faster time perception can be in bilinguals and if the priming in native language truly gives a clear effect.

Conclusions

Unrelated spatial features of movement can influence time perception. Past research showed that script direction can be a major contributor to this. We hypothesized that movement direction influences time perception by way of script direction. To test this we recruited Persian bilinguals. Results were mixed. Upon further analysis, participants were probably too 'Westernized' and used to both script directions which distorted the results. Doing this same experiment again with participants that are only fluent in Persian would give results that are clearer to interpret.

References

Boroditsky, L. (2001). Does language shape thought? Mandarin and English speakers' conceptions of time. *Cognitive psychology 43*(1), 1-22.

Calaprice, A. (1996). *The Quotable Einstein.* Princeton, NJ: Princeton University Press.

Casasanto, D. (2008). Who's afraid of the big bad Whorf? Crosslinguistic differences in temporal language and thought. *Language learning 58*(s1), 63-79.

Casasanto, D. (2013). Experiential Origins of Mental Metaphors: Language, Culture and the Body. In M. Landau, *Metaphorical Thought in Social Life.* Washington, DC: American Psychological Asociation Books.

Casasanto, D., & Boroditsky, L. (2003). Do we think about time in terms of space. *In Proceedings of the 25th annual meeting of the Cognitive Science Society*, 216-221.

Casasanto, D., & Boroditsky, L. (2008). Time in the mind: Using space to think about time. *Cognition 106*(2), 579-593.

Casasanto, D., & Bottini, R. (2014). Mirror reading can reverse the flow of time. *Journal of Experimental Psychology: General 143*(2), 473.

Casasanto, D., Boroditsky, L., & Phillips, W. (2004). How deep are effects of language on thought? Time estimation in speakers of English, Indonesian, Greek, and Spanish. *Proceedings of the 26th annual meeting of the Cognitive Science Society*, 186-191.

Dehaene, S., Bossini, S., & Giraux, P. (1993). The mental representation of parity and number magnitude. *Journal of Experimental Psychology: General 122*(3), 371.

Dowden, B. (2011). *Time.* Retrieved July 3, 2014, from Internet Encyclopedia of Philosophy: http://www.iep.utm.edu/time/

Fuhrman, O., & Boroditsky, L. (2007). Mental time-lines follow writing direction: Comparing English and Hebrew speakers. *Proceedings of the 29th annual conference of the cognitive science society* , 1007-1001.

Johnson, M., & Lakoff, G. (2002). Why cognitive linguistics requires embodied realism. *Cognitive linguistics, 3*(13), 245-264.

Lakoff, G., & Johnson, M. (1980). Metaphors we live by. *Chicago: U of Chicago P (2003)*.

Li, X. (2014). Grounding time in space: spatial movement and subjective perception of speed of time passage. *Unpublished*.

Maass, A., & Suitner, C. (2011). Spatial constraints on social cognition. *Social Psychology 42*(3), 159-164.

Ouellet, M., Santiago, J., & Israeli, Z. (2010). Is the future the right time? *Experimental psychology 57*(4), 308.

Santiago, J., Lupáñez, J., Pérez, E., & Funes, M. J. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review 14*(3), 512-516.

Whorf, B. L. (2012). *Language, thought, and reality: Selected writings of Benjamin Lee Whorf*. Cambridge, Massachusetts: Mit Press.

Appendix – Questionnaire (1)

For how long have you been living in the Netherlands? Please put the number of months below.

How often do you go back to Iran?

- More than twice a year
- Twice a year
- Once a year
- Less than once a year

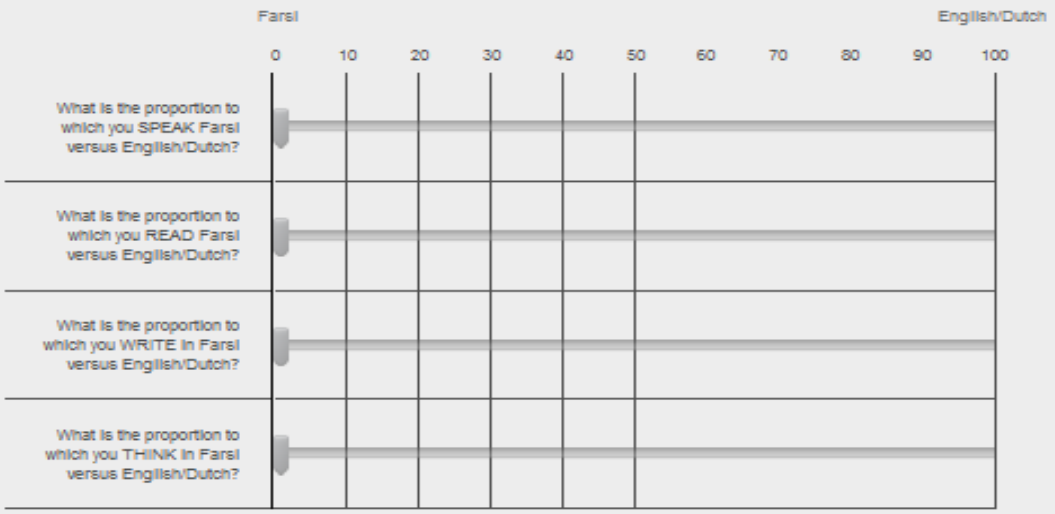
For how long have you learned English?

- less than 1 year
- 1-3 years
- 3-5 years
- more than 5 years

How do you represent the past and the future in a horizontal line?

- the past on the left and the future on the right
- the past on the right and the future on the left
- both are possible
- I am not sure

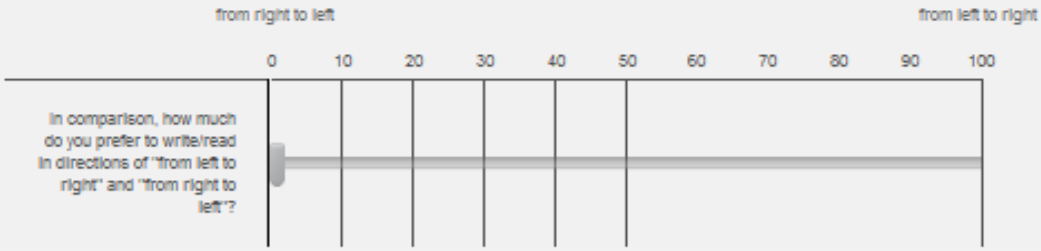
In the following, please indicate the proportion to which you speak, write, etc. the following languages.



Appendix – Questionnaire (2)

In the following, please indicate the proportion to which you like the life, culture, etc. in the following countries.

Please indicate your answers to the following questions by moving the sliders.



Thanks very much for your cooperation! Would you please write down your name below? That can help us track back who hasn't taken part in the survey. It is very important for us to have a complete database. Thanks very much!