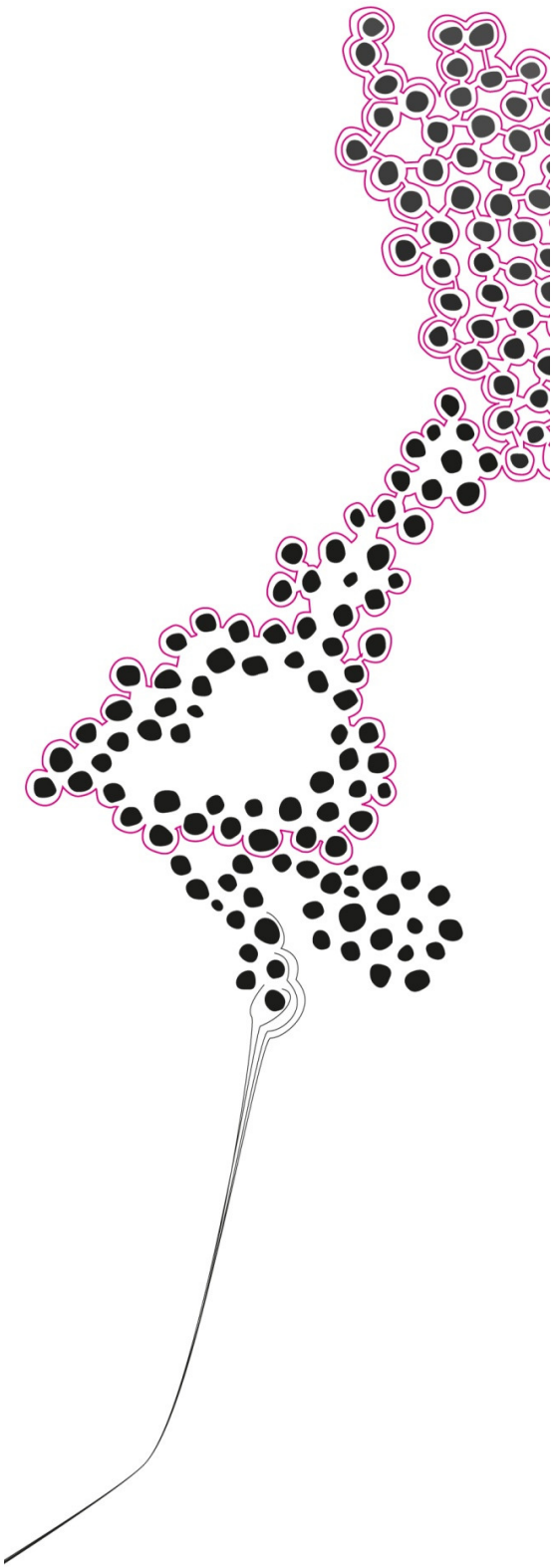

ARE NORTHERN ROUTES PERCEIVED AS BEING MORE STRENUOUS?

EVIDENCE FROM AN IMPLICIT AND AN EXPLICIT MANIPULATION OF STRENUOUSITY

BACHELOR THESIS

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Abstract

During the last decades, many heuristics have been found that guide human route planning. Often, these heuristics lead to biases in route planning. Recently, Brunyé, Mahoney, Gardony and Taylor (2010) found a new bias: the southern route preference. When people can choose between two routes of equal length that connect an eastern and a western point, they choose the southern route more often than the northern route. Brunyé et al. suggested that this preference may be grounded in the perception of the northern route as being more strenuous.

This study investigated this idea by using an implicit and an explicit measure. According to the framework of Embodied Cognition, physical states can influence cognition without people noticing it. By letting participants wear a weighted backpack when performing a route choice task, the implicit idea of perceiving the northern route as being more strenuous is examined. An explicit manipulation was employed as well; participants had to choose a route based on route descriptions that were explicitly and clearly embedded in more or less strenuous scenarios.

None of the experiments provided results that confirm the suggestion that the northern route is perceived as being more strenuous than the southern route. The implicit measure showed that wearing a weighted backpack did not lead to a stronger southern route preference compared to not wearing a backpack. The explicit measure did not show differences between route choices after hearing strenuous or non-strenuous scenarios.

Because the results of this study do not support the suggestion that northern routes are perceived as being more strenuous than southern routes, it is more presumable that the southern route preference is caused by something else. An interesting topic for further investigation might be the influence of people's spatial framework (Franklin and Tversky, 1990), which states that people conceptualize space in terms of three axes. Asymmetries in these axes might influence route choice. It might be interesting as well to compare route choice of people from regions located in the Southern Hemisphere with route choice of people from the Northern Hemisphere, to examine whether this influences route choice.

Samenvatting

In de afgelopen decennia zijn er veel heuristieken gevonden die een invloed hebben op het navigeren door mensen. Vaak leiden deze heuristieken tot een bias in de route planning. Recentelijk hebben Brunyé, Mahoney, Gardony en Taylor (2010) een nieuwe bias gevonden: een voorkeur voor de zuidelijke route. Als personen kunnen kiezen tussen twee routes van gelijke lengte die een oostelijk en een westelijk punt verbinden, wordt de zuidelijke route vaker gekozen dan de noordelijke. Brunyé et al. suggereerden dat deze zuidelijke voorkeur veroorzaakt wordt door de perceptie die mensen hebben dat de noordelijke route inspannender is.

In deze studie is deze suggestie onderzocht met behulp van een impliciete en een expliciete meting. Volgens het framework van Embodied Cognition kan de fysieke toestand van personen de cognitie beïnvloeden zonder dat men zich daar van bewust is. In een experiment hebben mensen met een zware rugzak op hun rug een routekeuzetaak uitgevoerd om op deze manier te onderzoeken of mensen impliciet het idee hebben dat de noordelijke route zwaarder is. Voor de expliciete meting werd proefpersonen gevraagd routes te kiezen aan de hand van scenarios die het afleggen van een route beschreven. Deze scenarios varieerden in hoe inspannend deze waren: sommige scenarios klonken erg inspannend, anderen waren ontspanend.

De resultaten bevestigen niet de suggestie dat de noordelijke route beschouwd wordt als meer inspannend. De impliciete meting liet zien dat het dragen van een zware rugzak niet leidt tot een sterkere voorkeur voor de zuidelijke route. De expliciete meting liet geen significant verschil zien tussen routekeuze na het horen van een inspannend of een ontspannend scenario.

Omdat de resultaten van deze studie de suggestie dat de noordelijke route als meer inspannend wordt gezien niet ondersteunen, is het waarschijnlijker dat de voorkeur voor de zuidelijke route wordt veroorzaakt door iets anders. Een interessante richting voor verder onderzoek zou de invloed van het spatieel framework (Franklin en Tversky, 1990) zijn. Volgens dit framework conceptualiseren mensen ruimte aan de hand van drie assen. Assymetrie in deze assen zou routekeuze kunnen beïnvloeden. Ook zou het interessant zijn om routekeuze van mensen op het zuidelijk halfrond te vergelijken met die van mensen op het noordelijk halfrond om te bepalen of deze regio's een invloed hebben op routekeuze.

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Introduction

Although most people are of the opinion that it does not take much time and effort to find the shortest and most efficient route, research shows that choosing routes is guided by several heuristics when more than one shortest route can be chosen (Bailenson, Shum, & Uttal, 1998; Christenfeld, 1995; Gärling & Gärling, 1988; Ueberschaer, 1971). A heuristic is a strategy that guides decision making without people always being always aware of it. These (implicit) rules of thumb make route planning less difficult and time consuming when many routes can be chosen but often systematic biases are present in the route choices people make (Christenfeld, 1995, Bailenson et al., 1998).

During the last decades, many route planning heuristics have been found. For example, people tend to choose the route which has the fewest turns and landmarks (Sadalla & Staplini, 1980; Seneviratne & Morrall, 1986). Next to that, people try to choose a route with the lowest number of crossings (Seneviratne & Morrall, 1986) and try to defer making a turn as much as possible (Christenfeld, 1995)

Recently, Brunyé, Mahoney, Gardony and Taylor (2010) claimed to have found another route planning heuristic: the southern preference heuristic. Brunyé et al. asked people to plan a route between two points, an eastern and a western point, using a map. Two routes of the same length could be chosen between these two points. The main difference between the routes was the fact that one of the routes was a northern route, and the other a southern route. Because the routes were comparable, one would predict a 50-50 ratio (%) between both routes. It turned out that about 63 percent of the people chose the southern route; this bias was termed the southern route preference. No significant differences were found between choosing the eastern or western route between a northern and a southern point.

Brunyé et al. (2010) suggested that the southern route preference may be grounded in the perception of north as going uphill and therefore as being more strenuous. Participants did not misperceive the northern route as longer than the southern route but they rated the northern routes as having more scenic potential, caused by the perceived higher elevation of the northern route. Furthermore, participants rated the calorie expenditure of northern routes marginally higher than the calorie expenditure of southern routes, probably caused by greater height-differences.

The aim of this study was to expand the conclusions of Brunyé et al. (2010) about the explanation of perceiving the northern route as being more strenuous. The method Brunyé et al. used to explore why the southern route preference exists was a quite explicit

one: they measured scenic potential and calorie expenditure. Asking participants such questions could result in an increased awareness of the explanation of the southern route preference that is examined, potentially influencing the results.

This study expanded research of Brunyé et al. (2010) by using an implicit measure, which is based on the Embodied Cognition view. The framework of Embodied Cognition states that mental processes are rooted in people's interaction with the environment (Brouillet, Heurly, Martin & Brouillet, 2010). Several experiments have shown that body states can have an influence on the cognition, for example the experiment of Strack, Martin & Stepper (1988) which showed that people's affective responses are influenced by their facial activity. When participants hold a pen in their mouth in a way that facilitated muscles associated with smiling, more intense humor responses were reported compared to the condition in which participants hold a pen in their mouth in a way that inhibited smiling associated muscles.

Based on research of Witt and Proffitt (2008), Brunyé et al. (2010) suggested that body states can influence route selection as well. Witt and Proffitt (2008) stated that when someone intends to perform an action, he first imagines this action; he runs a motor simulation of the action. Someone's perception of an imagined action is influenced by his ability to perform this intended action and the energetic requirements to perform the action. For example, when wearing a weighted backpack or when fatigued, people estimate hills as being steeper than they are (Bhalla & Proffit, 1999). Wearing a weighted backpack influences metric distance judgments as well; distances were perceived to be greater by people who did wear a backpack than by those who did not (Proffitt, Stefanucci, Banton, & Epstein, 2003). Research of Witt, Proffitt and Epstein (2004) showed that participants who had to throw a heavy ball estimated the thrown distance to be longer than participants who had to throw a light ball. Brunyé et al. suggest that these motor simulations of intended actions influence route selection. However, they did not investigate this suggestion.

As the aforementioned examples show that physical manipulations can influence the cognitive state of people without them noticing it, this research used this as an implicit measure to examine whether people perceive the northern route as being more strenuous. As more physical effort leads to an overestimation of distances and slants, it should also lead to perceiving the northern route as being more strenuous and therefore choosing the southern route more often. Present study used the same manipulation as Proffitt et al. (2003), whereby participants were asked to wear a weighted backpack. In this way the hypotheses were tested that a southern route preference will be found when participants wear a backpack and that increased physical effort (wearing a backpack) leads to a stronger

southern route preference compared to the condition without physical effort (in which participants were in a relaxed sitting down position). No differences between the eastern and western route were expected.

If the results were to support the hypotheses, this would support Brunyé et al.'s (2010) suggestion concerning motor simulations of intended actions as well: it would then appear that the physical effort of wearing a backpack influences the simulation of the different route options and that those differences between these simulations influence route choice. However, when the data were not to show differences between the two conditions, this would falsify Brunyé et al.'s suggestion. Previous studies showed that motor simulations can influence cognition. If no differences in route choice were to be found, that would indicate there is no difference between the motor simulations of the two conditions. Since the backpack will have no influence on the simulation, it may then be concluded that a route is not being perceived as being more strenuous than the other.

Next to the implicit measure, an explicit measure was used to examine whether or not people have an explicit idea of the northern route as being more strenuous. Brunyé et al. (2010) suggested that people might perceive the northern route as being more strenuous based on experiment results that showed that scenic potential ratings (related to the assumed elevation) of northern routes were higher than of the southern routes and that calorie expenditure ratings of the northern routes were marginally higher than ratings of the southern route. Because the differences in calorie consumption ratings Brunyé et al. found were only marginal, it is interesting to find out whether a related measure supports their results.

This study expanded the explicit measures of Brunyé et al. (2010) by examining whether route choice of participants is influenced after they have listened to short scenarios of travelling a route. The activities described in these scenarios varied in how strenuous they were, in this way "strenuous scenarios" and "non-strenuous scenarios" were created. These different kinds of scenarios could lead to differences in route choice when participants are asked which route they would probably choose to travel. If people do perceive the northern route as being more strenuous, they probably want to avoid this route when the scenario sounds strenuous. Therefore, the hypothesis was that a southern route preference would be found after hearing both kinds of scenarios but that this preference would be stronger after hearing a strenuous scenario compared to after hearing a non-strenuous scenario. Between eastern and western routes, no differences were expected.

If the southern route preference would indeed be stronger after hearing strenuous scenarios compared to non-strenuous scenarios, this would be in line with Brunyé et al.'s (2010) finding of higher calorie consumption ratings of the northern routes and thus with the suggestion that the northern route is perceived as being more strenuous. When no differences between strenuous and non-strenuous scenarios would be found, this would be in contradiction to the results of Brunyé et al. Their suggestion however is based on experiments that had a different approach than this experiment. In Brunyé et al.'s study participants were asked each trial to rate the calorie usage of a single route and were not asked to make a choice between two routes as done in this study. Next to that, in this experiment, participants were asked explicitly to listen to the scenarios and imagine themselves in that situation, something that was not explicitly asked to do in the study of Brunyé et al. It may be that the approach of this experiment is more natural for the participants, something that may lead to different results, despite the fact that the same suggestion has been investigated.

Method

Participants

Forty-eight students of the University of Twente (38 females; age M=20.6, SD=4.89) participated as partial fulfillment of course requirements. The experiment was approved by the local ethics committee and all participants signed an informed consent.

Materials and design

Maps

Maps that were used for this experiment have been developed by Brunyé et al. (2010). Brunyé et al. chose two real-world environments from Pittsburgh, (Pennsylvania, USA) and Chicago (Illinois, USA), using Google Maps at a zoom level of 1 cm = 34.8 meter. The maps measured 1200*793 pixels and each map contained a compass rose and thirteen landmarks: a park, a chapel, a dance club, a bike shop, a hotel, a café, an information booth, a theater, a grocery store, a restaurant, and three metro stations. Each landmark was represented by an icon that was defined in a legend. The maps are shown in Appendix I. Brunyé et al. created two versions of each map by rotating the original map 180º in order to control for differences in route complexity. The compass rose was however not rotated to maintain the north-up orientation, and text in the map was properly oriented. For this experiment, street names in the rotated maps were changed in order to prevent participants from recognizing the (rotated) maps. In the first experiment (the implicit measure), each participant used two maps; the other two maps were used in the second experiment (the explicit measure). The order of the maps was counterbalanced between participants.

Routes

For each map, Brunyé et al. (2010) developed twenty routes. Ten of these routes were non-dilemma routes (there is one best route to select) and ten of the routes were dilemma-routes in which two routes could be selected that were of equal length. Half of these dilemma-routes were north-south dilemmas, in which participants could select a northern or southern route. The other half of the dilemma-routes contained an east-west dilemma, see Table 1. Appendix II shows the dilemma routes. For the first experiment, the ten dilemma-trials and the ten non-dilemma-trials were used. For the second experiment, only the dilemma-trials were used, as shown in Table 1.

Table 1. Overview of trials of the experiment. In the first experiment, dilemma and non-dilemma trials were used. The second experiment consisted of dilemma trials only.

Experiment	Block	Trials		
		Dilemma trials		Non dilemma trials
		North-south	East-west	
1 (Implicit)	1	5	5	10
	2	5	5	10
2 (Explicit)	1	5	5	-
	2	5	5	-

Scenarios

In the first experiment, no scenarios were read aloud by the experimenter but participants were asked to describe the best route between two points. In the second experiment, participants had to listen to a short scenario at the beginning of each trial and try to picture themselves in the scenario. Half of these scenarios contained strenuous verbs (strenuous scenarios), the other half contained non-strenuous verbs (non-strenuous scenarios). A card sorting method was used to sort a set of Dutch verbs that are related to movement in to “strenuous verbs” and “non-strenuous verbs”. Ten people were asked to sort the words in three categories: A. “Uphill, strenuous, difficult, headwind”, B. “Downhill, relaxing, easy, tailwind”, C. “Other”, see Appendix III. A chi-square test showed that the classification of the verbs was not random, and that there was a relation between the verbs and the three categories, $\chi^2(104)= 367.5$, $p<.001$. After rejecting words that would result in illogical sounding scenarios, five words that were often rated as “strenuous” and five words that were often rated as “non-strenuous” were selected and used to make scenarios (in Dutch). An example of a strenuous scenario was (translated to English): “you have bought many groceries because you will have a party next weekend. Because the car is damaged, you have to carry everything by yourself from … to … “. One of the non-strenuous scenarios was: “you do not have to go to college today, so you have the whole day off. That means you can take the dog out for a nice walk. You walk with the dog from … to … “. The complete set of scenarios is shown in Appendix IV.

Backpack

Participants had to wear a backpack of one fifth to one sixth of their reported weight throughout the first experiment. This manipulation is based on previous research that used the same manipulation successfully (Bhalla & Proffit, 1999; Proffitt et al., 2003). In order to determine the weight of the backpack, the participant's self-reported weight was used, see Table 2. Plastic two-liter milk cartons, filled with water, were used to load the backpack.

Table 2. Criterion used to determine weight of the backpack given to participants

Participant weight (kg)	Backpack weight (kg)
<55 kg	9 kg
55-68 kg	11 kg
69-81 kg	14 kg
>81 kg	16 kg

Procedure

The study existed of two experiments, which were both performed by all participants. In the first experiment, the implicit influence was examined, in the second experiment the explicit influence. After signing the informed consent and filling in a short questionnaire (sex, age, weight, origin) the backpack was loaded and participants were asked to put it on. Participants were asked to stand in front of a 22" monitor that displayed the maps. As people should not be aware of the real relation between the backpack and the experiment, they were explained that the standing position and the backpack were used to make the experiment-situation more realistic, compared to experiment-situations in which participants are in a sitting down position. During the first experiment, participants completed two test blocks, one for a map of Chicago and one for a map of Pittsburgh, in counterbalanced order across participants. Participants were asked to make themselves familiar with the map, after which the experimenter probed the participants' landmark knowledge by asking them to point at several locations that were read out loud. If the landmark location knowledge was good, participants were asked to explain the best route from origin to destination in 20 trials. Participants were told that the best route was the fastest or shortest route. Participants had to report the best route verbally and in the meantime the experimenter recorded the chosen route. No time limit was used. After the first block, participants were allowed to have a short break before continuing with the second block, which had the same procedure as the first

block. After the second block, participants were allowed to put off the backpack and have a short break before starting with the second experiment.

For the second experiment, participants were asked to sit down in front of the screen. Because this experiment was an explicit measure, participants were explained that the scenarios they had to listen to varied in how strenuous they are and that this variation might influence the route choice. Participants were asked to repeat the task in their own words, to be sure that the influence of the scenarios became clear to the participants. The second experiment consisted of two blocks of ten dilemma trials each. At the beginning of each block, participants had to familiarize the maps, in the same way as in the first experiment. After that, for each dilemma trial, a scenario was read aloud and the participants were asked to describe the route that they would probably travel themselves in the situation of the scenario. Between both blocks of the second part, participants were allowed to have a short break.

Data Analysis

For each dilemma trial, the chosen route was recorded (north or south, or east or west). The non-dilemma trials did not contain directional conflicts and were therefore not analyzed. Analyses were performed for the two dilemma types separately. Because the collected data was not an ordinal, scale measure but a nominal, categorical measure, non-parametric tests were used for analysis with a significance criterion of $p < .05$.

For the first experiment, chi-s quare tests were used to analyze whether or not there were differences between the proportions of chosen routes. In previous research at the University of Twente, the same experiment has been executed without the physical effort (i.e. people were sitting down and not wearing a backpack). A chi-square test was used to analyze whether there were differences in route choices in north-south dilemmas between both experiments. For the second experiment, chi-square tests were used to analyze whether there were differences in route choices after hearing strenuous and non-strenuous scenarios.

To get an impression of the influence of the individual dilemmas on route choice, mean proportions of routes per dilemma per map were calculated (using data of experiment 1). It might be that the two routes of a dilemma were not comparable on each aspect which would lead to a “street bias”; preferring specific streets, even when maps are rotated. The mean proportions south and west per dilemma per city (not divided per version of a map) were calculated as well. This gave an impression whether each dilemma contributes equally

to the overall biases found or that the overall biases were caused by only one or several dilemmas which showed strong route preferences. Data of experiment 1 is used for this analysis as well.

Results

Experiment 1

On north-south dilemma trials, participants chose the northern route 177 times (36.9%) and the southern route 303 times (63.1%), see Figure 1a. A chi-square test showed that this difference is significant, $\chi^2(1) = 33.1$, $p < .001$. On east-west dilemma trials, participants chose the eastern route 238 times (50.1%) and the western route 237 times (49.9%), which does not differ significantly, $\chi^2(1) < 1$. See Figure 1b.

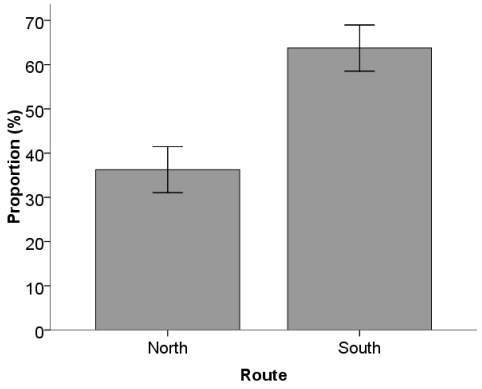

Figure 1a. Proportion route choice (%) on north-south dilemma trials. Error bars represent 95% confidence interval.

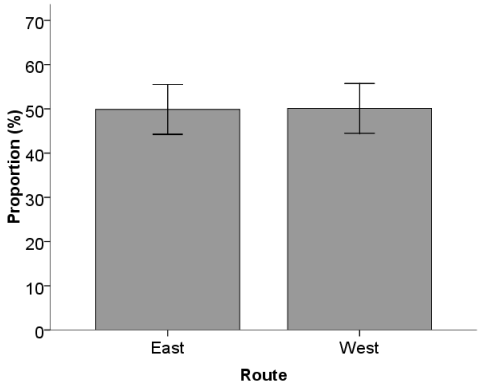

Figure 1b. Proportion route choice (%) on east-west dilemma trials. Error bars represent 95% confidence interval.

We analyzed (with a chi-square test) whether there was a difference in route choice on north-south dilemmas between this experiment and the previous experiment in which participants did not wear a backpack but were in a relaxed sitting down position. This experiment showed a proportion southern route choice of 63.1%, the experiment without backpack showed a proportion southern route choice of 60.2%. These proportions did not differ significantly, $\chi^2(1) < 1$.

No differences between men and women or between German and Dutch participants were found on the proportion of route choice (all *p*'s > .1).

Experiment 2

In the second experiment participants had to choose a route, based on a scenario they had to listen to. Half of these scenarios were strenuous, the other half were non-strenuous. Figures 2a-d show the proportion of route choices per dilemma type and per type of scenario.

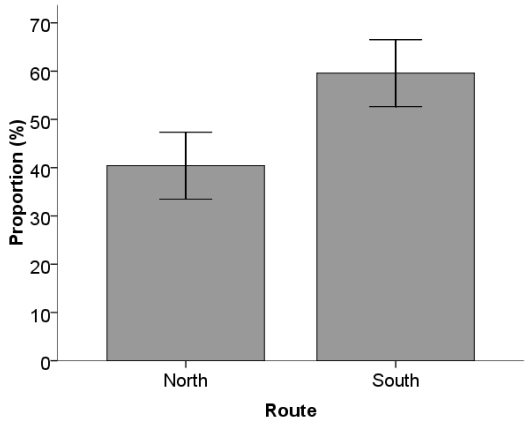

Figure 2a. Route choice north-south dilemmas, non-strenuous scenarios.

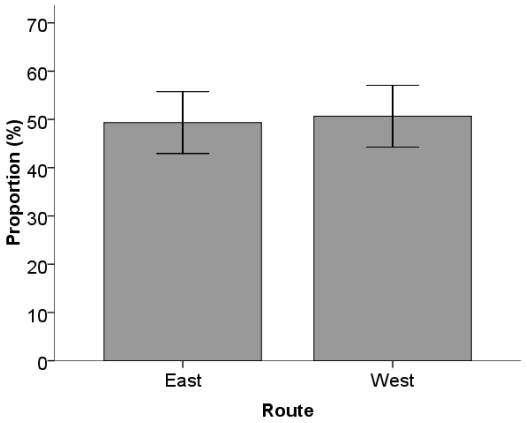

Figure 2b. Route choice east-west dilemmas, non-strenuous scenarios.

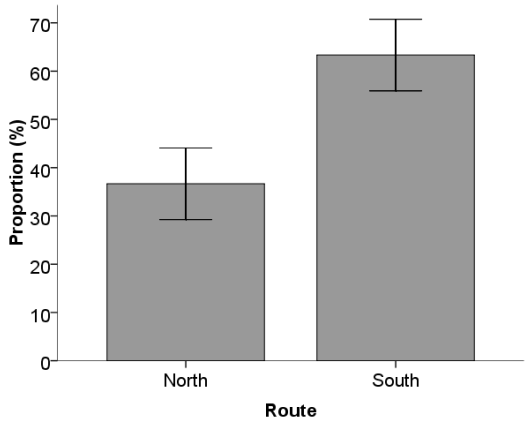

Figure 2c. Route choice north-south dilemmas, strenuous scenarios.

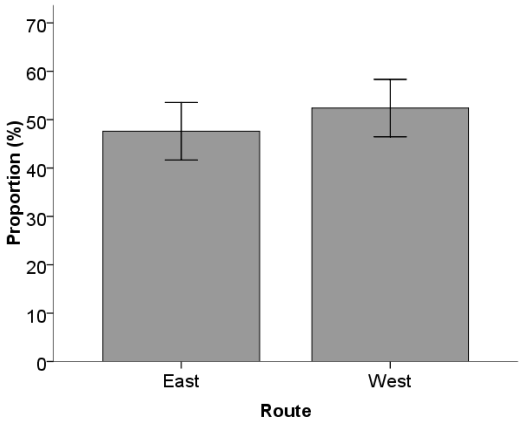

Figure 2d. Route choice east-west dilemmas, strenuous scenarios.

Chi-square tests were performed to analyze whether there were differences in route choices for each type of dilemma and type of scenario. As shown in Table 3, a chi-square test showed significant differences between the number of northern and southern routes in strenuous ($\chi^2(1) = 17.1$, $p < .001$) as well as non-strenuous scenarios ($\chi^2(1) = 9.2$, $p = 0.002$). No significant differences were found between the eastern and western routes.

Table 3. Frequency and proportion of route choices per dilemma type and dilemma.

Dilemma type	Scenario	Trials	Chosen Route (Number)				χ^2	*p*
			North	South	East	West		
North-South	Strenuous	240	88 36.7%	152 63.3%	-	-	17.1	<.001
North-South	Non-strenuous	239	96 40.2%	143 59.8%	-	-	9.2	0.002
East-West	Strenuous	237	-	-	113 47.7%	124 52.3%	< 1.0	0.475
East-West	Non-strenuous	235	-	-	116 49.4%	119 50.6%	< 1.0	0.845

The southern route was chosen in 63.3% of the 240 north-south dilemma trials following a strenuous scenario and in 59.8% of the 239 north-south dilemma trials following a non-strenuous scenario. A chi-square test showed that there was no significant difference between the proportions southern route choice after hearing strenuous and non-strenuous scenarios, $\chi^2(1) < 1$.

The eastern route was chosen in 52.3% of the 237 east-west dilemma trials following a strenuous scenario and in 50.6% of the 235 east-west dilemma trials following a non-strenuous scenario. A chi-square test showed that there was no significant difference between the proportions western route choice after hearing strenuous and non-strenuous scenarios, $\chi^2(1) < 1$.

Analysis of individual dilemmas

Next to the overall proportion of route choice, the proportions of route choice per dilemma per map were calculated to analyze whether there were dilemmas that led to a street bias (choosing the same streets, even when maps are rotated) and to get an impression whether the overall biases found were caused by all the dilemmas equally. For each map (C1, C2, P1, P2), for each dilemma was calculated how often (in %) the southern and western routes were chosen, see figures 3a-d. As can be seen, several dilemmas had large differences in route choice between the two versions of a map. For example north-south dilemma 1 for Chicago led to 29.2% southern route choice when using map C1 but to 95.8% southern route choice when using map C2. Also for example east-west dilemma 4 for Chicago showed large differences.

The mean proportions south and west per dilemma per city were calculated (not divided per version of a map) to get an impression whether each dilemma contributes equally to the overall biases found. These values are shown in the last columns of Tables 4a-4d. As can be seen in Table 4a, each north-south dilemma on the Chicago-maps had a mean proportion southern route of at least 50%. Table 4b shows that four east-west dilemmas on the Chicago maps had a mean proportion west between 39.6% and 47.9% and one dilemma had a mean proportion west of more than 60%. As Table 4c shows, the north-south dilemmas of Pittsburgh all have proportions south between 58.3% and 72.9%. Table 4d shows that the east-west dilemmas of the map of Pittsburgh had mean proportions west varying from 43.8% to 61.4%.

As these analyses were meant to get an impression of the influence of individual dilemmas and the results do not indicate that further analysis is needed, no statistical analyses have been done.

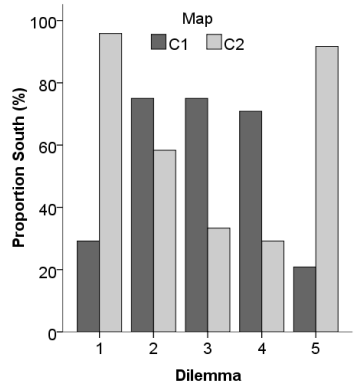

Figure 3a. Proportion southern routes per dilemma per map of Chicago

Table 4a. Mean proportions south per dilemma of both maps of Chicago.

Dilemma	Mean proportion south (%)		
	C1	C2	Mean C1-C2
1	29.2	95.8	62.5
2	75.0	58.3	66.7
3	75.0	33.3	54.2
4	70.8	29.2	50.0
5	20.8	91.7	56.3

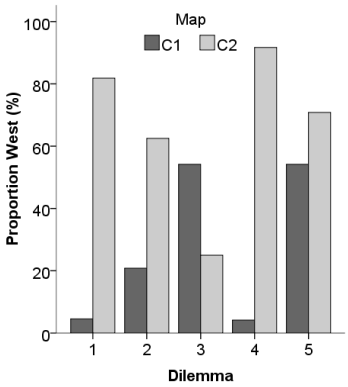

Figure 3b. Proportion western routes per dilemma per map of Chicago

Table 4b. Mean proportions west per dilemma of both maps of Chicago.

Dilemma	Mean proportion west (%)		
	C1	C2	Mean C1-C2
1	4.6	81.8	43.2
2	20.8	62.5	41.7
3	54.2	25.0	39.6
4	4.2	91.7	47.9
5	54.2	70.8	62.5

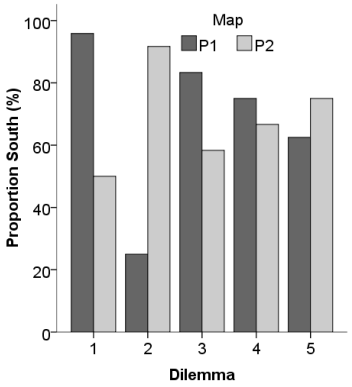

Figure 3c. Proportion southern routes per dilemma per map of Pittsburgh

Table 4c. Mean proportions south per dilemma of both maps of Pittsburgh.

Dilemma	Mean proportion south (%)		
	P1	P2	Mean P1-P2
1	95.8	50.0	72.9
2	25.0	91.7	58.3
3	83.3	58.3	70.8
4	75.0	66.7	70.8
5	62.5	75.0	68.8

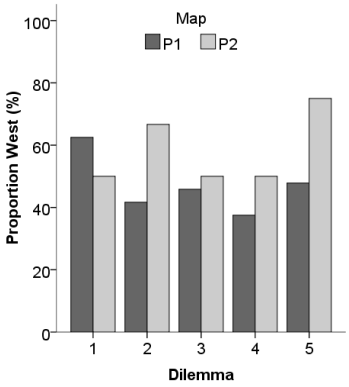

Figure 3d. Proportion western routes per dilemma per map of Pittsburgh

Table 4d. Mean proportions west per dilemma of both maps of Pittsburgh.

Dilemma	Mean proportion west (%)		
	P1	P2	Mean P1-P2
1	62.5	50.0	56.3
2	41.7	66.7	54.2
3	45.5	50.0	47.9
4	37.5	50.0	43.8
5	47.8	75.0	61.4

Discussion

The aim of this study was to examine the southern preference as found by Brunyé et al. (2010). In their research, Brunyé et al. found that when choosing between a northern and a southern route that were of the same length, people prefer the southern route. Brunyé et al. suggested that this bias is caused by the fact that people perceive northern routes as being more strenuous. This study examined this suggestion by using an implicit measure and an explicit measure.

For the implicit measure we hypothesized that participants, who wear a weighted backpack during a route selection task, would show a southern route preference. As previous research showed that physical effort can influence cognition, we expected that variations in physical effort influence route choice: we expected that the bias for a southern route would be significantly stronger for participants who are performing a strenuous activity compared to those who are in a relaxed sitting down position. These results would support Brunyé et al.'s (2010) suggestion that the northern route is perceived as being more strenuous. If the results would not support this hypothesis, this would falsify Brunyé et al.'s suggestion. In line with this, we hypothesized that both strenuous and non-strenuous scenarios during the explicit measure would lead to a southern route preference but that this preference is stronger after hearing the former compared to the latter. This hypothesis is in line with previous explicit measures of Brunyé et al. which showed that calorie consumption ratings and scenic potential ratings of northern routes were higher than those of southern routes.

The results of the implicit and the explicit experiment both showed a preference for the southern route, as found by Brunyé et al. (2010) as well. The results of both experiments did not show significant differences between the eastern and western routes, which supports the hypothesis. However, the experiments did not provide evidence that would be expected given the suggestion that the northern route is perceived as being more strenuous. The implicit measure showed that wearing a weighted backpack did not lead to a stronger southern route preference compared to not wearing a backpack, which contradicts the suggestion of Brunyé et al. The explicit measure did not show differences between route choices after hearing strenuous or non-strenuous scenarios, which does not support the hypothesis that the southern route preference would be stronger after hearing a strenuous scenario compared to a non-strenuous scenario.

Analysis of the individual dilemmas showed that route choice per dilemma often varied as function of the map. For example a southern bias of a dilemma of map Chicago 1,

was a northern bias for the same dilemma of the rotated map, Chicago 2. This implies that for these dilemmas there was a street bias; specific streets seemed to be more logical to choose for the participants (independent of map version). By rotating the map, these preferred streets were directed in the opposite direction. This led to differences in route choice per dilemma between two versions of a map. Research of Sadalla and Staplin (1980) showed a positive relation between the number of intersections along a route and the estimated length of the route. It is plausible that differences in number of intersections between route options have influenced these street biases. However, the results of the four different maps have been averaged; therefore the effect of the street biases has been cancelled out.

As the results of the mean proportion south per dilemma per city show, all north-south dilemmas lead to a proportion south of at least fifty percent. This indicates that the southern route preference is not caused accidentally by only one or a few dilemmas which led to a southern route preference. The mean proportion west per dilemma per city has a larger variance, which indicates that although overall no eastern or western bias has been found, individual dilemmas seem to show some differences. However, all dilemmas have values between circa 40 and 60 percent and no extreme outliers have been found that had a large influence on the mean proportion west.

The results of this study do not support the suggestion that the northern route is perceived to be more strenuous, but one could argue whether the physical effort (wearing a weighted backpack) used in the first experiment is an adequate manipulation for the experiment. Although in previous studies of Bhalla and Proffitt (1999) and Proffitt et al. (2003), the same manipulation has been used successfully, one could argue that for this study it is not appropriate because of the fact that the load for the participants was not static over time. Participants had to wear the backpack continuously, but it might have been the case that in the course of time participants were going to experience the backpack as heavier than in the beginning, which could lead to different results in the end of the experiment compared to the first part of the experiment. However, this turned out to not be the case; the proportions southern route choices in block 1 (63.8%) did not differ significantly from the proportion southern route choices in block 2 (62.5%), $\chi^2(1) < 1$. This shows that there was no influence of the duration the participants wore the backpack. Therefore, the weighted backpack can be seen as a good manipulation.

There are some aspects of this study that may be improved when replicating this experiment. In the second experiment, twenty scenarios were used that were combined with

the twenty route dilemmas developed by Brunyé et al (2010). However, sometimes this led to illogical combinations of the scenarios and the locations, for example: “you have bought many groceries because you will have a party next weekend. Because the car is damaged, you have to carry everything by yourself from the *café* to the *grocery store*”. Some participants mentioned afterwards that these illogical routes (the grocery store as destination for your groceries) confused them; therefore it would be better to take care of good combinations of scenarios and locations.

Many participants indicated that it was quite difficult to perform the second experiment in another way than the first experiment. Although their task during the second experiment was to choose a route based on the scenario they had to listen to, many participants mentioned that they continued to choose the best route, as was asked in the first experiment. This may have reduced the effect of the strenuous and non-strenuous scenarios. Therefore, it would be better to recruit different participants for both experiments.

As the results of this study do not support the suggestion of Brunyé et al. (2010) that northern routes are perceived as being more strenuous than southern routes, and analyses of the dilemmas do not support an explanation in terms of certain trivial street biases, we can speculate on what causes the southern route preference.

One of the possible explanations might be that route choice is influenced by a person’s representation of himself in space, as described in the spatial framework model (e.g. Levelt, 1984; Shepard & Hurwitz, 1984; Talmy, 2000). According to the spatial framework model, people conceptualize space in terms of three axes: one vertical and two horizontal (Franklin and Tversky, 1990). For a standing person, response times of objects on the head/feet (above/below) axis were fastest and for a reclining person, response times of objects on the front/back (in front of/behind) axis were fastest. According to Franklin and Tversky, these fast reaction times for the vertical axis are caused by the body asymmetries and the relation of the body to the world. Because of gravity, an asymmetric force is exerted on the perceptual world which makes it that people perceive the upward parts of most objects different from their downward parts; therefore the vertical axis is a very asymmetric one. As the maps of the cities in this study were presented on a vertical computer screen, one could argue whether it might be the case that the southern route preference as found in this study and previous studies, actually is not a preference for the southern route, but a bias for the downwards routes, caused by the vertical asymmetry in the spatial framework. However, Brunyé et al. (2010) have examined this suggestion already. In an experiment, they let participants choose between two lines that could connect two points. The same

routes as in their previous study were used, but all information other than the dots was removed. In this way, the context of route planning was eliminated. Results of this study showed that participants did not select choose lower line options more often than upper options. Therefore Brunyé et al. stated that the southern route preference is not caused by a preference to select information towards the lower regions of the computer monitor.

Although gravity probably does not influence route choice, it still might be the case that there is an influence of a person's representation of himself in space. Research of Markman and Brendl (2005) showed that when a participant's name was shown on a computer monitor, people were faster to respond to positive words by pulling a lever in the direction of their name than by pushing it in the opposite direction. Participants were faster to respond to negative words by pushing the lever away from their name than by pulling it in the direction of their name. Therefore, this movement-compatibility effect depends on the representation people have of their selves in space, rather than on the physical location of the people.

To control for the possible influence of this asymmetry (for example that people prefer to choose routes that are close to the person's own body), an extra experiment is recommended. In this experiment, the maps which will be used by the participants should be printed on paper and laid in front of the participants on a table. In this way, it can be examined whether participants prefer routes close to themselves. In this experiment, participants should not only describe the best route for themselves, but there should also be a condition in which participants have to choose and describe the best route for another participant, who is located at the other side of the table. In this way, it could be examined whether the bias changes and thus whether a person's representation of itself in space affects route choice.

To expand the understanding of the southern route preference, it would be interesting to replicate the experiment with participants from regions located in the Southern Hemisphere. Brunyé et al. (2010) found the southern route preference within a participant group that lived in a region that is characterized by higher elevations to the north compared to the south. Replications of the experiment in the Netherlands, in which higher elevations can be found in the south, showed a southern route preference as well. Therefore, the influence of these elevations seems to be unlikely. However, participants from present study as well as from the study of Brunyé et al. all lived in geographic regions in the Northern Hemisphere. By replicating the experiment with participants from the Southern Hemisphere, it can be examined whether the southern route preference can be found with participants all

over the world, or that it is a hemisphere-specific bias: a bias which perhaps is caused by the idea that the extreme northern and southern areas of the earth are less passable, which participants transfer to make decisions on small-scale maps.

The goal of this study was to examine the southern route preference. Although Brunyé et al. (2010) suggested that this preference may be grounded in the perception of northern route as being more strenuous, results of this study do not support this suggestion. Although a southern route preference has been found in both experiments, performing physical exertion effort (wearing a weighted backpack) did not lead to a significant change in this preference and no significant differences were found between route choices after hearing a strenuous or a non-strenuous scenario.

In the last decennia, several heuristics that guide route selection have been found. Although these heuristics minimize cognitive effort needed when planning a route, they often lead to impaired judgments and biases. To understand human navigation it is important to have a good understanding of the heuristics that guide this navigation. Having a good understanding of the factors that influence route selection, gives the possibility to predict human navigation. Therefore, other explanations for the southern route preference in route planning should be examined.

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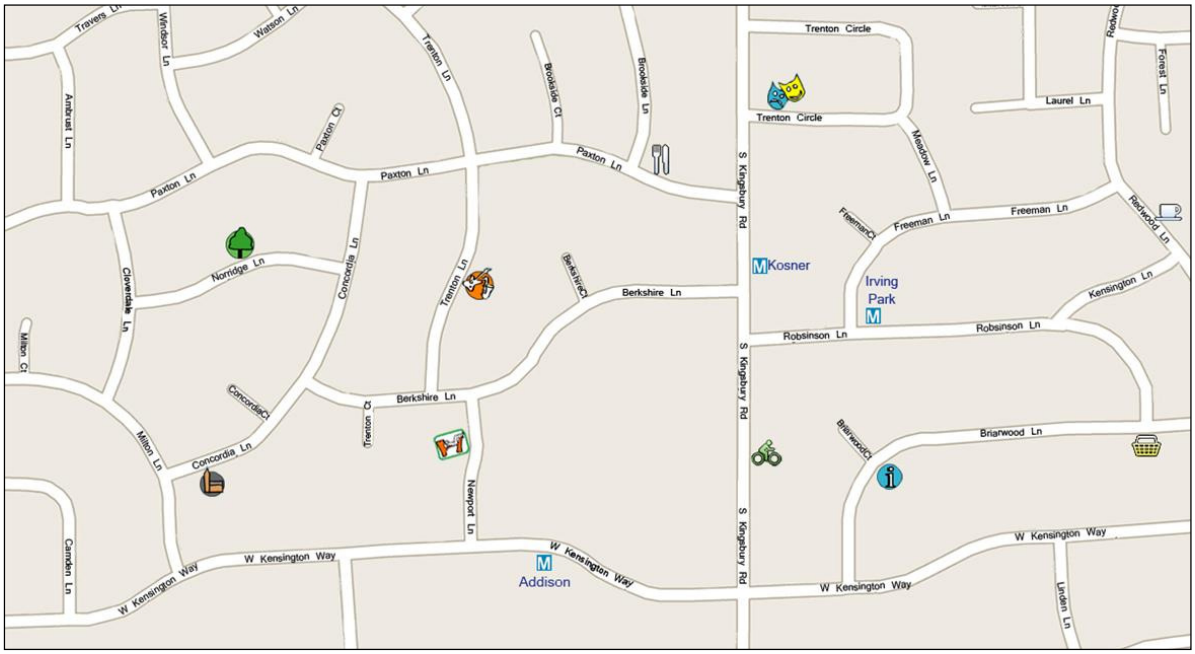
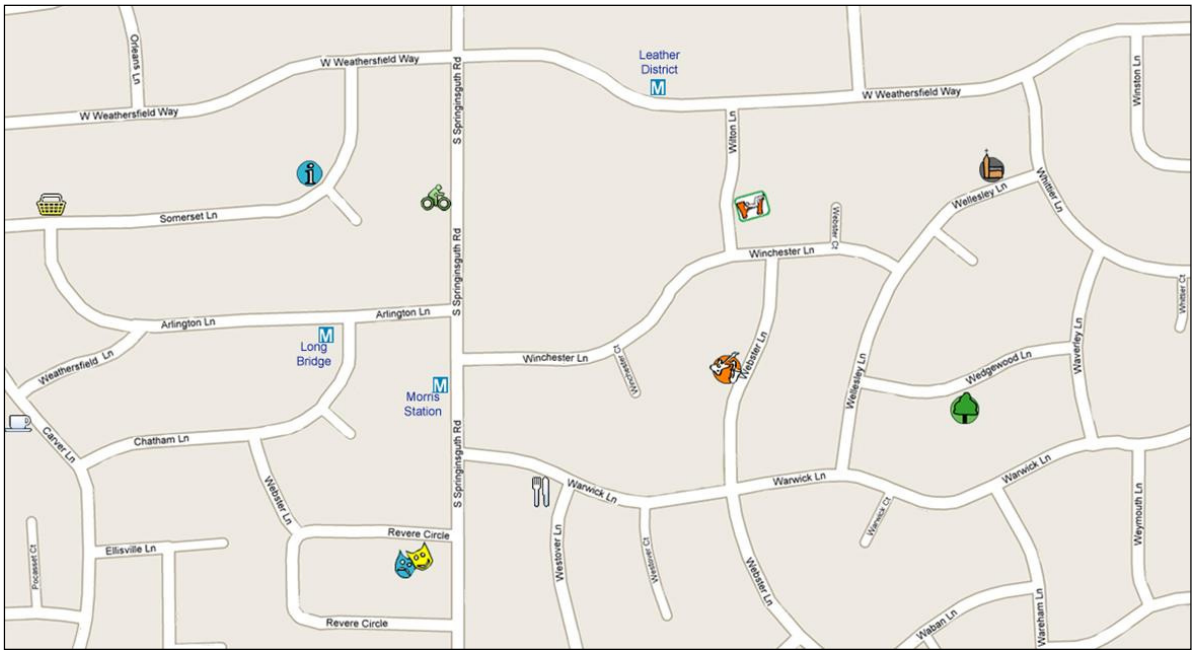
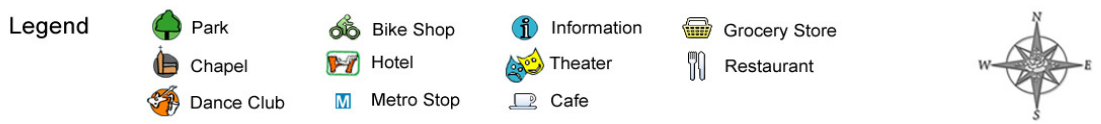
Appendices
Appendix I. Maps

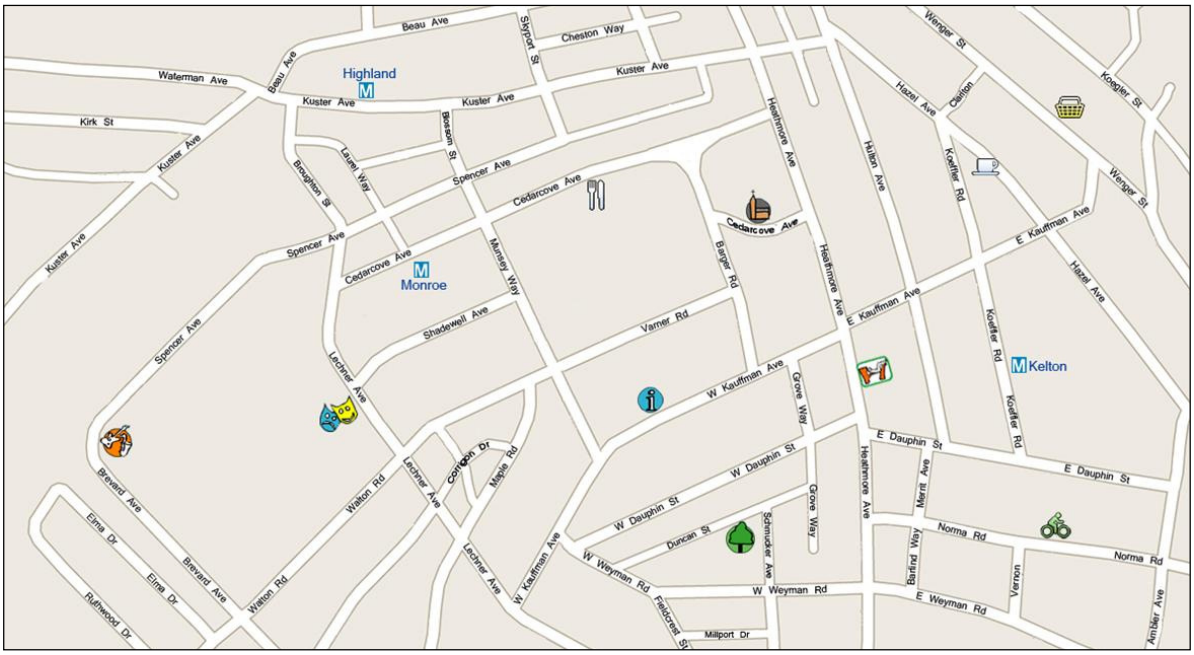


Chicago, Map 1 (C1)

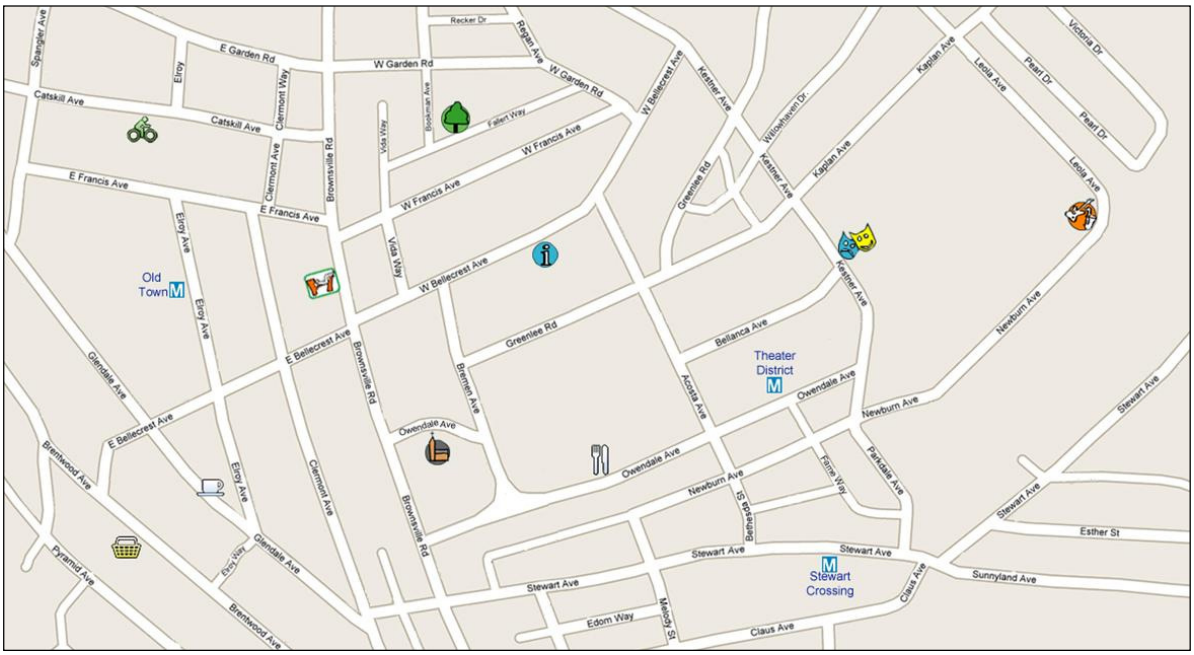


Chicago, Map 2 (C2)





Pittsburgh, Map 1 (P1)



Pittsburgh, Map 2 (P2)

Legend

Park
Chapel
Dance Club
Bike Shop
Hotel
Metro Stop
Information
Theater
Cafe
Grocery Store
Restaurant

N
W
E
S

Appendix II. Dilemmas

Type	Dilem-ma nr.	Map	
		Chicago, map 1	**Chicago, map 2**
East-West	1	Restaurant ↔ Addison Metro	Restaurant ↔LeatherDistrict Metro
East-West	2	Park ↔ Chapel	Park ↔ Chapel
East-West	3	Restaurant ↔ Hotel	Restaurant ↔ Hotel
East-West	4	IrvingPark Metro ↔ Information	LongBridge Metro ↔ Information
East-West	5	Theater ↔ Irving Park Metro	Theater ↔ LongBridge Metro
North-South	1	Grocerystore ↔ Bikeshop	Grocerystore ↔ Bikeshop
North-South	2	Hotel ↔ Bikeshop	Hotel ↔ Bikeshop
North-South	3	IrvingPark Metro ↔ Cafe	Longbridge Metro ↔ Cafe
North-South	4	Kosner Metro ↔ Danceclub	MorrisStation Metro ↔ Danceclub
North-South	5	Park ↔ Danceclub	Park ↔ Danceclub

Type	Dilem-ma nr.	Map	
		Pittsburgh, map 1	**Pittsburg, map 2**
East-West	1	Kelton Metro ↔ Bikeshop	OldTown Metro ↔ Bikeshop
East-West	2	Monroe Metro ↔ Highland Metro	TheaterDistrict Metro ↔ StewartCrossing Metro
East-West	3	Park ↔ Information	Park ↔ Information
East-West	4	Restaurant ↔ Information	Restaurant ↔ Information
East-West	5	Restaurant ↔ Park	Restaurant ↔ Park
North-South	1	Cafe ↔ Chapel	Cafe ↔ Chapel
North-South	2	Grocery Store ↔ Cafe	Grocery Store ↔ Cafe
North-South	3	Grocery Store ↔ Chapel	Grocery Store ↔ Chapel
North-South	4	Theater ↔ Dance Club	Theater ↔ Dance Club
North-South	5	Kelton Metro ↔ Hotel	OldTown Metro ↔ Hotel

Appendix III. Verbs

Verb	Category			Verb	Category		
	A	B	C		A	B	C
Ploeteren	10	0	0	Trippelen	3	3	4
Klimmen	9	1	0	Benen	2	6	2
Sjouwen	9	1	0	Slungelen	2	6	2
Draven	8	2	0	Laveren	2	4	4
Hardlopen	8	2	0	Klossen	2	3	5
Klauteren	8	2	0	Huppelen	2	7	1
Snelwandelen	8	2	0	Sukkelen	2	7	1
Vluchten	8	1	1	Begeven	1	8	1
Een weg banen	7	3	0	Scharrelen	1	8	1
Marcheren	7	3	0	Struinen	1	8	1
Rennen	7	3	0	Talmen	0	1	9
Sprinten	7	3	0	Flaneren	0	4	6
Walsen	7	3	0	Kuieren	0	6	4
Bestijgen	7	2	1	Schrijden	0	6	4
Spurten	6	3	1	Voortbewegen	0	7	3
Strompelen	6	3	1	Drentelen	0	8	2
Trimmen	6	3	1	Wandelen	0	9	1
Hinkelen	6	4	0	Hobbelen	2	8	0
Hollen	6	4	0	Slenteren	2	8	0
Joggen	6	4	0	Schuifelen	1	9	0
Ijsberen	5	4	1	Sjokken	1	9	0
Sluipen	5	4	1	Sloffen	1	9	0
Kruipen	5	3	2	Stappen	1	9	0
Dribbelen	4	4	2	Een ommetje maken	0	10	0
Ijlen	4	0	6	Een wandeling maken	0	10	0
Voortschrijden	3	4	3	Lopen	0	10	0
Huppen	3	3	4				

Categories (English/Dutch):

A. “Uphill, strenuous, difficult, headwind” / “Berg op, inspannend, moeilijk, wind tegen”

B. “Downhill, relaxing, easy, tailwind” / “Berg af, ontspannend, makkelijk, wind mee"

C. “Other” / “Overig”

Underlined words were used for the scenarios.

Appendix IV. Scenarios

Non-Strenuous Scenarios (in Dutch)

Je hebt het werk er op zitten voor vandaag, en je wil wel even naar buiten om wat frisse lucht te krijgen. Op je gemak slof je van __ naar __

Je hebt vandaag je laatste tentamen gemaakt en die ging heel erg goed. Alle eerdere tentamens waren ook al goed gegaan terwijl je er maar weinig tijd in had gestoken. Nu ben je een paar dagen vrij. Op je gemak slof je van de __ naar de __

Je hebt even pauze van het werk en gaat lekker naar buiten. Als je buiten komt waait het heel hard, maar je merkt al snel dat je de wind in de rug hebt. Door de wind stap je heel gemakkelijk van __ naar __

Je zit al de hele dag in een vergadering, en het schiet niet echt op. Gelukkig heb je nu even pauze en ga ze lekker naar buiten. Het is een lekker weertje en je stapt van __ naar __

Wat een lekkere dag! De zon schijnt, lekker weer om naar buiten te gaan. Je besluit om een stukje te gaan lopen van __ naar __

Je hebt nieuwe schoenen gekocht voor een wandelvakantie binnenkort. Om ze goed in te lopen besluit je nu het lekker weer is nog even een stukje te gaan lopen op je nieuwe schoenen. Je loopt van __ naar __

Je hebt zin om te winkelen, maar als je in de stad komt, kom je er achter dat de winkels dicht zijn. Gelukkig valt er in de etalages ook een hoop te bekijken! Op je gemak bekijk je alle etalages op je wandeling van __ naar __

Je hebt vandaag de hele dag lekker op het terras zitten ontspannen met wat vrienden. Op het eind maak je nog even een wandeling van __ naar __

Je hebt vandaag de hele dag vrij, je hoeft niet naar haar college. Dan kan je mooi met de hond een stuk gaan wandelen. Je wandelt met de hond van __ naar __

Je hebt zin om een wandeling te maken op je vrije dag, lekker op je gemak een stukje wandelen buiten. Je wandelt van __ naar __

Strenuous Scenarios (in Dutch)

Je hebt vandaag een vriend geholpen met verhuizen. Dat was een hele klus want er moest een hoop verhuisd worden. De hele dag hebben jullie dozen en meubels gesjouwd. Gelukkig zijn jullie nu bijna klaar, je sjouwt de laatste doos sjouw van __ naar __

Je hebt een hele hoop boodschappen gedaan. Dit weekend geef je een feestje, dus heb je een hoop drank gekocht. Maar helaas moet je dit nu zelf allemaal naar huis dragen. Met alle boodschappen sjouw je van __ naar __

Je bent bijna klaar met het hardlopen van vandaag. Je hebt al meer dan een uur hardgelopen en houd het laatste stukje bijna niet meer vol. Je loopt het laatste stuk hard van __ naar __

Na een lange tijd niet meer te hebben gesport, vond je het wel weer eens tijd om te gaan hardlopen. Je merkt al snel dat je conditie niet meer zo goed was als eerst, het hardlopen valt niet mee! Je loopt hard van __ naar __

Je hebt al een paar dagen ziek op bed gelegen met griep. Je voelt je rillerig en in je benen heb je amper nog kracht. Toch moet je vandaag even naar buiten. Met je zwakke benen klim je van __ naar __

Je hebt net een paar uur in de sportschool doorgebracht. Wat zijn je benen nu moe zeg, het lijkt wel of je een berg op aan het klimmen bent. Je klimt van __ naar __

Het is weer winter en er ligt een dik pak sneeuw op straat. Jammergenoeg kan je niet binnen blijven maar moet je nog naar buiten om iets bij een vriend af te geven. Je ploetert van __ naar __

Het heeft vannacht gesneeuwd, er ligt een dik pak sneeuw op straat en de sneeuw is nog niet aan de kant geschoven. Helaas moet je toch naar college en ploeter je door het dikke pak, van __ naar __

Je hebt haast, je moet je trein halen! Je hebt een hoop tassen bij je dus het lukte je niet om snel een stukje te rennen. Je klautert door de stad van __ naar __

Je moet een stuk lopen, maar bent hartstikke moe, het lijkt wel of je aan het klauteren bent. Je klautert van __ naar __