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On my way to school. Exploring children’s spatial perception and commuting modes through mental sketches

Abstract. The study investigates the relationship between primary school pupils’ modes of transportation and their spatial perception, as expressed through mental sketches of home-to-school routes. Conducted at a small rural school in Karmanowice, Poland, the survey involved pupils from 4th to 8th grades, who were asked to draw sketches of their routes and indicate the means of transportation used. Features depicted in the sketches were classified as natural or anthropogenic. The results indicate a dominance of anthropogenic elements across all transportation modes, with pupils travelling by car or bus generally marking more features, whereas walkers provided more detailed information on near-school infrastructure. The study highlights the influence of distance, individual perception, and the limitations of anonymity on the analysis, including the inability to normalize data by precise distance. Despite the small sample size and underrepresentation of certain villages, the findings provide insights into the interplay between commuting and environmental observation, emphasizing the potential of mental sketches for exploring spatial cognition in children. The paper also outlines methodological considerations for future research, including the benefits and ethical challenges of non-anonymous approaches.

Keywords: commuting, mental map, anthropogenic features, natural features, primary school

1. Introduction

Human beings are spatial creatures. Most of our activities take place within and are inherently connected to space. We live, work and learn in specific locations. We recall both our everyday routine paths and the occasional routes associated with unusual activities. We tend to navigate through our neighbourhoods using landmarks, even in the era of GNSS (Global Navigation Satellite Systems).

We interact with space from early childhood, walking with parents, commuting to school, biking out on our adventures near and far from our houses. In recent decades, we have also embraced virtual realities as spatial entities, which can influence our real-life perception (Polinsky et al., 2023; Subrahmanyam & Greenfield, 1994).

This topic is widely discussed within cognitive psychology, as scientists try to understand our relation to and interaction with space. However, this tête-à-tête is also of particular interest to geographers, who understand that people are integral to the spatial world and seek to explore how human beings conceptualize and organize these spatial relations. This is where mental sketches are often used.

2. Theory

The term mental sketch is often used as a synonym for mental map or cognitive map. These terms may be treated interchangeably (Kitchin, 1994), but many scholars distinguish them, seeing the cognitive map as the psychological outcome of a cognitive process, the mental map as an image of space retained in the

human mind, and the mental sketch as a physical representation (drawing) of the mental map (Hátlová & Hanus, 2020; Krukar et al., 2018; Nieścioruk, 2023; Szombara, 2021). In this paper, the focus is on mental sketches as drawings.

The career of mental sketches in analyses of spatial perception started with an iconic work of Lynch (1960) in the field of urban planning, later followed by (re)risers of applications in geography (Gould, 1966) and cognitive psychology (Stea & Blaut, 1973). Since then, the study of mental maps has remained a consistent theme in scientific discourse. From the perspective of geographers, sketches are a useful tool for examining how people conceptualize spatial phenomena and categories, such as the delineation of regions and countries, the perceived course of a river, the distinction between central and peripheral areas, or the features considered significant within a neighbourhood (Bláha & Nováček, 2016; Didelon-Loiseau et al., 2018; Dragan et al., 2025; Holmén, 2020; Kaisto & Brednikova, 2019; Lehman-Frisch et al., 2012; Nieścioruk, 2019; Zaga & Yaar Waisel, 2023).

There is also an interesting relation of sketches and education. Only a few studies show that anonymous drawings can be used as a teaching tool or as a mechanism for evaluating the effectiveness of education at different levels, from primary school to professional education at universities (Bell & Long, 2009; Castellar & Jordão, 2021; Nieścioruk, 2016, 2023; Swinton et al., 2023). However, many more studies demonstrate the use of mental sketches to (as mentioned above) assess understanding of space, geographic concepts, orienteering and wayfinding skills, and spatial evaluation, among other aspects.

The age of respondents in these studies differs significantly. They can be preschool or early primary school children (Binimelis Sebastián et al., 2023; Bláha & Nováček, 2016; Castellar & Jordão, 2021; Holmén, 2020; Joshi et al., 1999; Nieścioruk, 2019; Ócal, 2011; Pađlo et al., 2021; Rezaei et al., 2020; Šakaja, 2021; Silva et al., 2019; Zaga & Yaar Waisel, 2023), or university students (Costa & Bonetti, 2018; Hagge, 2023; Lee & Shepley, 2020; Nieścioruk, 2016, 2023; Smith & Aranha, 2020). In some studies, even teachers – as people influencing and inspiring students – were tested for spatial

cognition skills (Chiodo, 1993; Gagnier et al., 2021) or for their use of map drawing in classroom instruction (Djadik & Krajiňáková, 2025).

The present research belongs to the former group, evaluating spatial perception and orientation skills through tests conducted with mid- and late primary school pupils. This group is particularly interesting because sketch map tests allow for relatively straightforward observation of knowledge progression from grade to grade, as well as the impact of education on the ability to conceptualize space and articulate it using the language of maps. This is a fact known to researchers and teachers. It enables observing the changes in map design throughout an education process as well as changes in understanding of maps and the potential to conceptualize the space on them (Thommen et al., 2010). Cartographers are aware that the ability to create maps, apply design principles, and use creative resources constitutes an important element of (potential future) map-maker's curriculum (Anderson & Vasconcellos, 1995). Hence, conclusions drawn from such research can help educators refine their teaching approaches and course content.

3. Description of the case study

The study aims to investigate the relationship between pupils' place of residence, their means of transportation, and the types of spatial objects they take cognizance of based on mental sketches gathered during the survey. It took place in the summer semester of 2023 at the Stefan Żeromski Primary School in Karmanowice. It is a small, rural school in the commune of Wąwolnica, Lublin voivodeship in eastern Poland. Pupils attend primarily from Karmanowice and the neighbouring villages of Łopatki, Łopatki-Kolonia, and Celejów, with a few coming from more distant villages, including some outside the commune (Klementowice, Bochothnica). As there is a larger primary school in the commune seat of Wąwolnica, most children from Wąwolnica attend that institution. The location of the school together with the neighbouring villages is presented in Figure 1. The OpenStreetMap (n.d.) service has been used as a basemap – it is a free source of spatial data and (at this scale) standard visualisation's tiles serve as a good depiction of basic topography. The additional layer of



Figure 1. Location of school and villages

boundaries uses official data from the Polish National Geodetic and Cartographic Resource (WMS from Geoportal.gov.pl, n.d.).

Primary school in Poland comprises children aged (in general) 7 to 14–15 and is obligatory for everyone, just as attending school until 18 years of age is. Due to the nature of the Polish education system, with the first three years of primary school being integrated education with no separate courses in the curriculum, only children from grades 4 to 8 were asked to participate in the survey. With the help of the headteacher, a general data pro-

tection form was created to ask parents to provide consent for their children's participation in the research. The ratio of agreement varied across grades (see Table 1). In addition, one grade (6th) was not present in school during the survey week. The numbers are not large, both in terms of the agreement ratio and the absolute number of participants. The purpose of the survey was well-explained to the headmistress and addressed in the note to parents given alongside the agreement forms to fill. It would probably be possible to receive a higher ratio with direct talks with parents during par-

Table 1. Number of pupils and research participants

Grade	Total number of pupils	Number of participants (male / female)	Ratio of agreement
4 th	6	5 (2/3)	83%
5 th	9	8 (5/3)	89%
6 th	5	0 (absent)	0%
7 th	7	3 (2/1)	43%
8 th	18	8 (0/8)	44%
Total	45	24 (9/15)	53%

ents-teacher meeting organised a few times a year. The ratio of around 50% in two grades may be seen as a serious limitation of the reliability of statistics. The fact of low absolute numbers is closely related to the size of the school – it consists of fewer than one hundred pupils, including kindergarten.

The survey was an anonymous “basic sketch map” survey as defined by Kitchin (1994). The participants were given a blank A4 sheet of paper and asked to draw a map of their route from their home to school. They were not instructed how to complete the task, both in terms of content and form of the sketches. As the survey was conducted during lessons, they were equipped with all the typical school accessories, e.g. pens, markers, crayons, etc. They were, however, neither encouraged nor discouraged to use them. Most (but not all) of the pupils produced monochrome sketches, typically drawn with a pen or ballpoint pen. The verso of the sheet contained a questionnaire printed with four questions about place of residence, grade level, and the means of transportation used on the way to school. The last question was divided into “most common” (one answer allowed) and “it happens” (multiple answers allowed). Pupils were offered the following options to choose from: by foot, by school bus, by bicycle, by car or other (with a blank space for specification).

4. Methodology

With the highly variable spatial extent of the sketches, the task of comparing them is difficult. From a statistical point of view, results can easily be summarised using the questionnaire,

showing which villages children were from and the relationship between place of residence and the means of transportation used. A typical solution would involve a diagram as employed in this paper for introductory analysis. However, the paper focuses on testing a methodological approach for assessing the relationship between the means of transportation and the features observed and represented in children’s sketches.

There are several problems and challenges in this kind of research.

1. As the survey was anonymous, no precise pupil addresses were collected. With the wide variation in quality and topographic content of sketches, it is virtually impossible to determine the exact locations of pupils’ homes – the starting points of their routes (and mental images). Hence, the exact distance covered is hard to assess, as is the density of features per distance unit.

2. Moreover, for villages of more dispersed development (e.g. Celejów), with many separate settlement clusters, it would even be impossible to correctly identify a general path (route alignment) of the home-to-school journey.

3. The task of counting individual features on sketches is subject to considerable uncertainty due to the symbolic nature of some images. Elements of sketches may be considered not only as strictly topographic information (for example, individual buildings), but also as symbolic patterns representing broader phenomena (e.g. houses as a built-up area). On many sketches, the individual character of objects is discernible, though this is not always the case.

The first two of these problems may raise questions about the overall usefulness of the research. The final results will be aggregated at the village level (which are not fully comparable) and without a reliable method of normalisation. The author believes the methodology is worth testing even within this more general framework and sees the possibility of performing individualised tests, as described below.

The main task of the research is to investigate the relationship between pupils’ place of residence, their means of transportation, and the types of objects depicted in their sketches. The structure of transportation should be presented at first with a diagram map of villages. Based on the analysis of sketches, object types are categorised. These are divided into

two classes: anthropogenic and natural elements. The former group likely comprises houses and other man-made objects such as shops, industrial facilities, transport and traffic-related features (e.g. bus stops, road signs), orientation landmarks (e.g. electricity poles, wayside shrines), and objects related to agricultural activities. In the latter group, one should expect vegetation (forest, trees used for orientation) as well as water bodies such as rivers and ponds.

As the second task, the number of objects per class (natural vs. anthropogenic) is calculated and presented in absolute and relative values in relation to the means of transport. In the case of relative values, they can be considered either relative within a class (e.g. the percentage of houses within the anthropogenic category), relative per person, or relative to the distance travelled by a child. The second approach (normalisation per person) is the most straightforward, while the third option seems to be highly problematic, as it requires precise distance data. With no addresses gathered in the anonymous survey, the only solution is to use a generalised distance, such as that measured from the centroid of the village. In the case of scattered settlements covering relatively large areas, this approach may be of little use, as already indicated in the problems listed above. The only valuable solution to this problem would be gathering addresses of participants, which is not feasible due to the survey methodology, as well as privacy and data protection concerns.

The additional task of the research is to create an aggregate map showing the most popular elements depicted in the sketches. This is carried out using a quantitative method; a diagram map is therefore the most appropriate tool. The map should present groups of features (types of objects) using cumulative diagrams that show both the frequency of depictions and their structure according to the means of transportation (cumulative structural bar diagrams).

5. The results and their discussion

5.1. Features

The first analysis addressed the general categories of features: natural and anthropogenic objects. The natural category does not consist

solely of natural features but also includes certain human-influenced landscape elements that are biotic and associated with living nature, such as various forms of agricultural activity. Many, but not all, of these require special constructions to be established and are therefore treated here as anthropogenic elements. Hence, the following features were identified on sketches and included in the natural category: forest or groups of trees, ponds, rivers, gullies (including hollow ways in loess, typical of the study area), arable fields, and fruit cultivation (primarily currants). For anthropogenic objects, the list of identified features is longer and consists of: foil tunnels for raspberry cultivation, railroads, roads, bridges, roundabouts or crossroads with traffic islands, road signs, pedestrian crossings, bus stops, train stops, cars denoting traffic, cars denoting parking, parking lots, track roads or paths or pavements, commercial enterprises (shops, factories, etc.), fire stations, significant houses, insignificant houses (used as patterns of built-up areas), street lamps, wayside crosses or shrines, churches, school-related infrastructure, temporary community activities and other landmarks.

The general summary of the structure of the above is that a total of 77 natural and 506.5 (fractions indicate elements that were unclear or fell into more than one category) anthropogenic features were drawn by 24 participants. It formed 13.2% and 86.8% of all objects, respectively. These features were accompanied by non-spatial and non-material elements of a map, such as names and labels (118 were explanations of different objects, 24 were toponyms and 9 indicated directions of roads), legend (3 cases) and, somewhat unexpectedly, a route to school (3.5 cases). While drawing a route was the main task, most pupils did not consider it necessary to mark a linear path – they just drew a road(s) and its vicinity. Moreover, only one child depicted himself drawing a small figure on the way to school, which is an interesting element to analyse while taking a closer look at the form of the sketches.

5.2. Transport

A relation between these two groups of features (natural vs anthropogenic) and the means of transportation is to be analysed, but

first, a summary of participants' responses must be presented, focusing on the primary ("most common") and the secondary ("it happens") way of getting to school. The most frequent answer was travel by car (13 out of 24), while walking received 6, bus – 4, bicycle – 0, and other – 1 (electric scooter). For the secondary means of transportation, it was as follows: bicycle – 12, walking – 10, car – 6, and bus – 3.

A diagram map (Figure 2) presents detailed information on the relationship between trans-

portation mode and the village of residence. The cartographic presentation of these data was done using well-established methods and caused no problems. However, creating two half-pie charts representing primary and secondary means of transport required the use of vector graphics software combined with GIS.

The left diagrams (Figure 2, half pie chart) explain the primary means of transportation, while the right diagrams illustrate the secondary. The total numbers on the left and right are not always equal (the diagrams have different

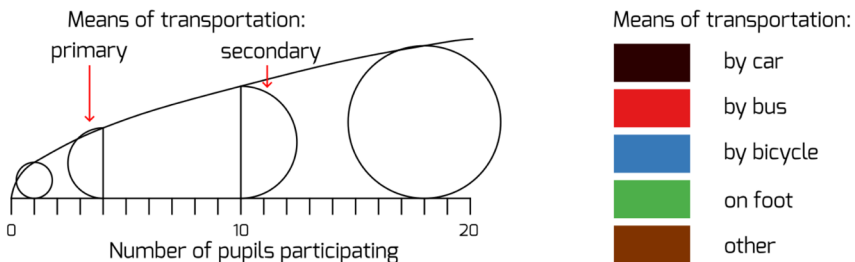
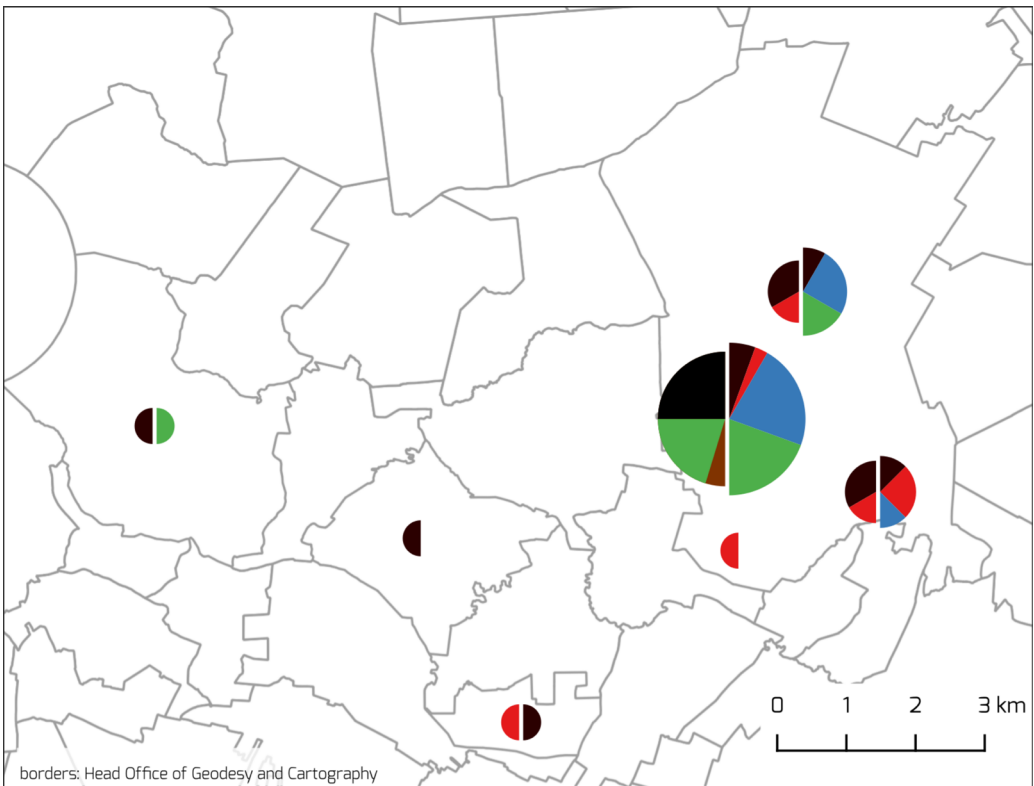


Figure 2. Means of transportation per village

diameters), as for the secondary means pupils could choose multiple answers.

It is easy to notice that the village of Karmanowice, where the school is located, has the highest number of "on foot" responses as the primary means of transportation. Even the single response indicating the use of an electric scooter (other – yellow) can be seen as an "on foot – upgraded" option. These results are no surprise, as walking is an easy and natural choice when the distance to be covered is short. A walking distance may be defined as about 1.5 km (Wilson et al., 2018), depending on the condition and topography. What may be surprising is that no one indicated the bicycle as the main means of transportation, but weather conditions may explain this result, as not every season or condition is favourable for biking. The high share of car use probably results mainly from the fact that the most distant houses in this village are located more than 2 km from the school. However, it is worth noticing the reason for not choosing active school travel (walking, cycling) may include unsafe streets (speeding cars, missing barriers, for examples trees) or lack of companion on journeys (Fusco et al., 2012; Wilson et al., 2018). For other villages, motorized options are considered at first – car or bus, which is understandable given the distances involved. For the secondary choice of transportation, the bicycle and walking are the most popular for Karmanowice and also for Klementowice. It is a very dispersed village (in another commune, which is worth noting), with the nearest houses located about 1.6 km from the school, so walking or biking are feasible options. For the most distant village of Bochotnica, the response "on foot" may seem like a mistake, but it is correct, as the child has family in Karmanowice (not to explain more in order to preserve participants' anonymity).

Knowing the children's responses regarding transportation, the relationship between natural and anthropogenic elements in the sketches and transportation should be analysed. The statistical summary is shown in Table 2.

5.3. Relation of transport to group of features

The overall domination of anthropogenic elements can clearly be seen, with a percentage of over 85 for each type of transport. On this level of detail, no substantial differences were observed between the results for children traveling by car and those traveling by bus – both the percentages and the number of features per person are similar. What may seem surprising is the result of children going to school on foot. This group is similar in numbers to bus commuters (6 to 4 persons), but walkers depicted far more anthropogenic elements as a percentage, so nature constituted only a small fraction of their sketches. It may be contrary to the common-sense expectation that walking allows a person to perceive more of nature, due to the lower speed of travel and greater opportunity to observe the environment. However, it should be kept in mind that for some of these children, the distance to school was very short (in some cases, even less than 100 meters). Consequently, what they mainly encountered and observed on their way were streets to cross, the school gate, pavements, and similar features.

The cartographic visualization of this is shown in Figure 3. Using horizontal instead of vertical bars (additionally segmented into up to 50 observations per bar) solved the problem of large data range. The number of pupils per village was presented with pie charts of the same scale as on the first diagram map. Horizontal orientation of the diagrams also helped to compare anthropogenic (bars growing to the left) and natural (to the right) phenomena. The

Table 2. Natural and man-made objects on sketches

Primary mean of transportation (number of answers)	Natural elements on sketches: number / number per person	Anthropogenic elements on sketches: number / number per person	Percentage of natural and anthropogenic elements
School bus (4)	13 / 3.25	91 / 22.75	12.5 – 87.5
Private car (12)	59.5 / 4.95	347.5 / 28.96	14.6 – 85.4
By foot (6)	2 / 0.33	41 / 6.83	4.7 – 95.3
Other (electric scooter) (1)	2.5 / 2.5	27 / 27	8.5 – 91.5

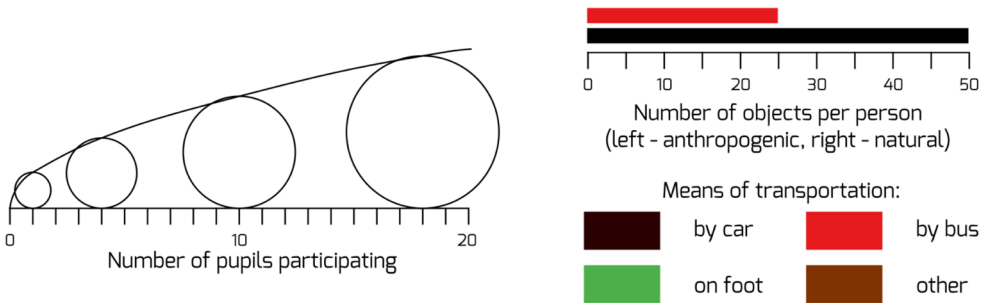
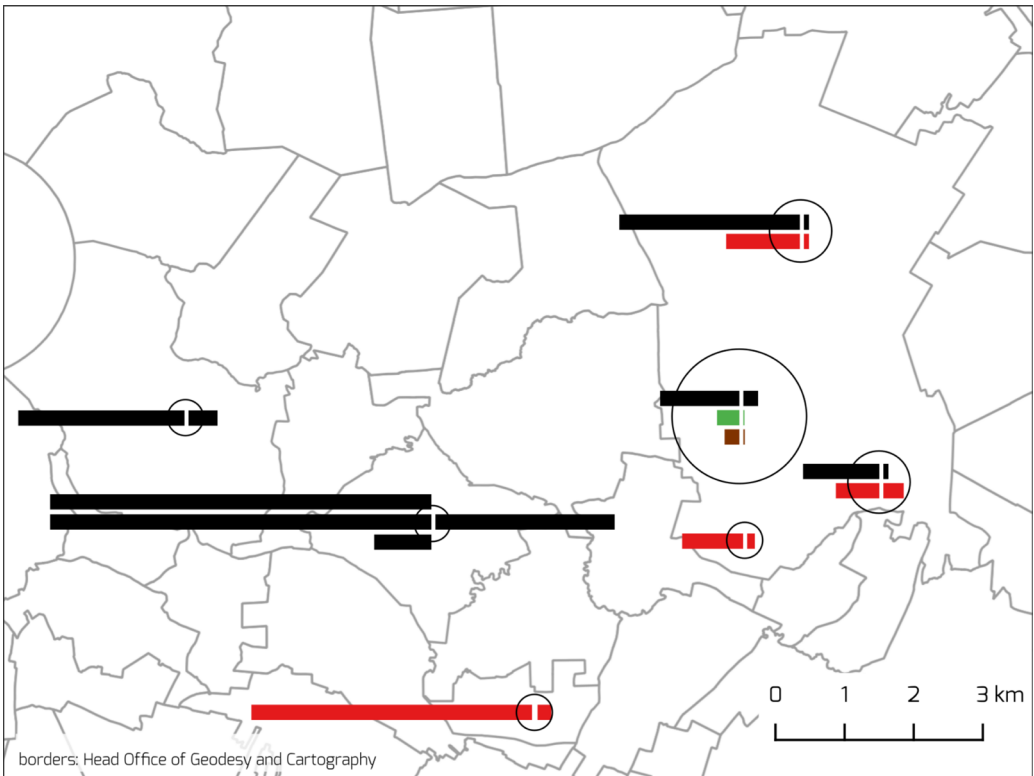


Figure 3. Number of features on sketches

number of anthropogenic features for primary transport are shown as horizontal bars extending to the left, while the number of natural features extend to the right. The values are normalized per person and shown for each means of transportation separately, using the same colours as on the previous map (see Figure 2). The unusual form of the diagrams (horizontal bars of up to 50 occurrences per bar) results from the wide range of data and the need to keep the graphic message clear on the map, as well

as from the intention to present two equivalent phenomena on the same level (left-right instead of the more typical up-down alignment). The conclusions do not differ from those based on the table above – the dominance of anthropogenic elements is significant. What is really striking in this map is the very large number of elements (over one hundred) drawn by one pupil from Witoszyn, reflecting the relatively long distance and two alternative routes marked on the sketch. A similarly high number of features

was marked by pupils from Bochoznica and Grabówki, while lower numbers were recorded for those traveling from villages closer to Karmanowice. It can be explained by a simple and natural relation – the longer the road, the more objects can be observed in total. Additionally, distant villages are represented by single pupils, so normalization per person did not average out the data (the outlines of the pie charts on the map represent the number of children per village). For villages where at least two means of transportation were recorded, natural elements form only a small fraction of all objects. The exception is the case of the bus in Łopatki (two pupils), where natural elements constitute one third of all depicted features, compared to less than 10% in other villages. We have to remember, however, that the results for small groups are heavily influenced by individual preferences, sensitivity to environmental stimuli, and the personalities of pupils, which – in general – are factors that must always be considered in mental mapping research.

The problem mentioned in the methodology section of aggregating data per village and losing precise information about the relationship of features to actual distance is a result of the anonymity of the research. However, in this paper, it was possible to identify one individual and normalize the numbers by distance. That person, living in Karmanowice and walking to school as the primary mode of transport (with car as secondary), marked a shorter walking path and a longer road route. Thus, the content and spatial extent of the sketch are influenced by different means of transport, as it shows two non-adjacent paths. To keep the minimum of anonymity, no distance covered will be given, but for natural elements, the result per 100 metres for this child is 0.23, and for anthropogenic elements, it is 10 per 100 metres. The disproportion of these values is similar to the aggregated and generalized data. With no other individual, non-anonymous results available, no further conclusions can be drawn, but this example shows the approach can be applied when non-anonymized data are available, as explained in the summary.

5.4. Natural vs anthropogenic

A closer look at the detailed content of both groups of features is of interest. Starting with

natural elements and features listed above, a dominance of forests and groups of trees can be observed – they accounted for 34 out of 77 natural objects marked. Trees are often seen on sketches as important features of the landscape – both in the city (Li & Seymour, 2019) and in the village. Besides this, children living in the village positively evaluate the forest and often chose it as their favourite place (Alexander et al., 2015). The neighbourhood is an agricultural area with relatively few forests, but forests are also more important orientation elements than arable fields. However, fields were the third most common, with 15.5 out of 77 objects drawn. The second most numerous natural element was ponds (18 of 77). This is understandable, as children often pay attention to waterbodies (Januškienė & Kamičaitytė, 2024). Also, Karmanowice and its vicinity form a small endorheic basin (Kołodzyńska-Gawrysiak & Chabudziński, 2012), with several small water bodies (ponds and artificial lakes) used for fishing and landscape purposes. These objects were depicted only by children going to school by bus or car, as there are no ponds in the proximity of the school – so they cannot be observed on a walking route. Only one person, traveling to school by car, marked a gully on a sketch, which is somewhat surprising, as the Nałęczów Plateau is characterized by an extremely high density of loess gullies (Maruszczak, 1973). Most of them are natural and covered by forests, but some – as a result of anthropogenic changes – form road gullies (hollow ways), which are elements of the local communication network. The abovementioned person also marked two alternative routes to school, depending on season and weather. Thus, it is quite likely that the hollow way – as a potential linkage between roads – is part of this person's mental image of the area.

The group of anthropogenic features is much more numerous and diverse compared to natural features. The most frequently depicted element was not a unique object – it was a house, treated as a general symbol of built-up area, denoting “here are houses”. These symbols had no individual or significant features; in extreme cases, they were reduced to simple squares, whereas buildings depicted with courtyard elements, stairs, plants, etc., indicated that the child treated them as specific, known buildings (see examples in Figure 4).

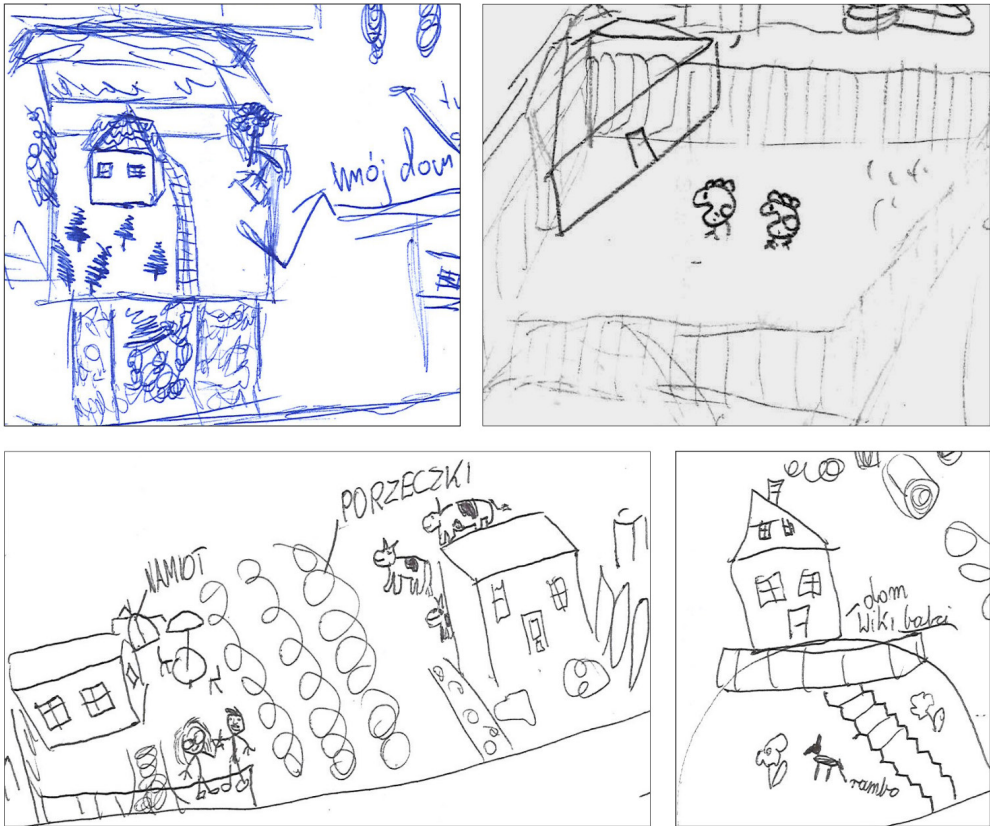


Figure 4. Examples of individualized features of objects and everyday life elements on sketches

There was a total of 236 such symbols (46.6% of all anthropogenic features), but some of them were used more as a pattern to fill an area, making it difficult to consider these numbers as typical or reliable statistics of object occurrences. This approach to the depiction of buildings was observed in similar research, where houses were occasional decorations along streets for children traveling to school by car (García-Mira & Goluboff, 2005). The number of individualised houses was 33 (6.5%). The second most numerous type of feature was the road. Eighty such elements (15.8%) were depicted, plus 15 (3%) cases of demarcated pedestrian pavements and forest paths. The relation of the number of roads to a means of transport is as follows: children travelling to school by car were responsible for 53 of the 80 drawn roads, while those travelling by bus

accounted for 22. As expected, children walking to school depicted fewer roads – they simply had shorter distances to cover; in most cases, only one road (the main road passing through Karmanowice) was shown. There were even sketches with no roads, made by children living immediately next to the school.

Interestingly, of the 15 paths and pavements, four were drawn by one child using an electric scooter, while all children travelling by car marked eight such paths in total. Many other types of transport-related objects were shown on the sketches. A few respondents (7) marked the crossroads of three roads near the school, with a characteristic traffic island (some depicted it even as a roundabout, which was incorrect). Road signs were marked seven times by three children (one of them a pedestrian and cyclist as a second choice), depicting

a speed limit near the school; four children (again, one pedestrian, the same as above) marked a pedestrian crossing; two used cars as a symbol of traffic; four drew parked cars in front of the school, while two used another method to depict parking. Eight bus stops were shown, but only one case was – somewhat surprisingly – a sketch of a commuter (even as a second choice). One child marked two bridges, and another marked a railroad. The same child depicted a railway station. This child travelled to school by bus, which crosses a national rail line, and the local station is located just by the crossing. It is therefore quite likely that the bus sometimes had to stop at the crossing, giving the child an opportunity to observe the station, even though it may have been of no practical use to them.

Children also depicted objects used for orientation purposes, noticeable due to their functions, such as commercial enterprises (shops, industrial buildings). This accounted for 27.5 depictions made by 14 children. Only four children marked a fire depot, despite it being an important object in the rural community. There were five depictions of wayside crosses and shrines. Most children drew elements of infrastructure near the school. A total of 37 such depictions were made, including playgrounds,

individual green spaces and shrubs, sports fields, gates, and even a small safety railing between a gate and a street. Three children enlivened their sketches with scenes of everyday life – people in front of a house, a kid walking with a dog, animals (hens, dogs, cows, Figure 4). This demonstrates that – as mentioned earlier – the form of sketches is also worth investigating.

As the number of respondents was low, and for some villages only one pupil participated, the author decided it was not reliable to show a summary of the above types of objects in classes in a cartographic manner, despite this having been planned and described in the methodology. The high differentiation of answers among individual sketches makes them incomparable statistically. However, it is worth trying to visualise this data in another way for at least one village, to test the approach and examine the data more closely. Figure 5 shows a chart of the number of objects of different types in relation to a means of transport. It was counted for the most diversified (in terms of responses) village, Karmanowice. The striking difference between a car and walking can be observed. As previously analysed and explained, the reason is straightforward – children travelling to school by car cover longer distances and may pass through forested areas and

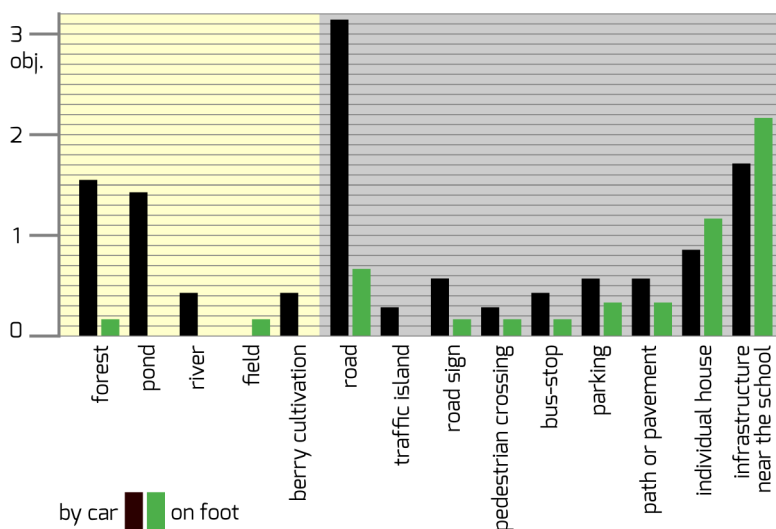


Figure 5. Chart of selected objects per person on sketches (yellow background for natural elements, grey for anthropogenic elements)

ponds. Walkers did not even draw some objects, such as rivers and ponds. The greyish background shows the more numerous anthropogenic objects. This group reveals a few interesting trends. Again, commuters could notice more objects, but for transportation-related features, the difference is substantial. They drew 3.14 objects per person, while walkers marked only 0.67 per person. Other traffic-related objects exhibited a similar trend, especially roundabouts and traffic signs. For crossroads, the difference is much smaller (0.29 vs 0.17 per person), as this element is important for walkers. The opposite trend can be observed for classes more easily noticed by people travelling at lower speeds (individual features of houses) or located near the school and serving walkers (barriers, gates, playgrounds). Individual houses were depicted with a ratio of 0.86 (car) vs 1.17 (walk) per person, while near-school infrastructure was noted at 1.71 and 2.17 per person, respectively. The findings are comparable to what was revealed in previous research, but with some differences. The importance of streets was often similar despite the means of transportation, while pavement played a much more vital role for walkers' image of space (Güroğlu Ağdaş, 2020). The road signs seem to be crucial in urban spaces, where a lot of children pay attention to them (Fusco et al., 2012), contrary to villages with a significantly lower number of signs due to a less dense street network and less organized traffic.

5.5. Additional elements

The elements of sketches that are not directly related to spatial content were not analysed in this paper, but they are worth indicating. One topic is connected to the main task – depicting a route from home to school. Children were not asked directly to draw a route, and only four children did it, which may be somewhat surprising. On the other hand, a very free approach to the task provoked such a solution, with focus on environmental content rather than navigation. One of these children did something quite unique, drawing themselves... twice, at the beginning and at the end of the route, using a static continuous narration to show dynamic phenomena of movement, similar to Renaissance paintings (Andrews, 1994).

The map-reading and orienteering elements of sketches (legend, north arrow) are – as in the case of cartographic design – beyond the scope of this paper, but they are planned to be analysed in further work.

6. Conclusion

As noted in the methodology section, the main problem encountered during the research was the limited number of respondents, resulting in a poor representation of some types, both in terms of means of transport and spatial aspects (the villages they represent). It was partly caused by the small size of the school, but also by refusals to participate in the survey or the absence of children. With a total response ratio of just over 50% in 4th–8th grades, only three villages (Karmanowice, Klementowice, Łopatki) received a more diverse representation, and there was a lack of responses from the village of Celejów, which is close to the school. The other limitation arises from an understandable setting of the survey's environment – the anonymity of answers precludes the collection of precise locations, making it impossible to compare the number of features with the distance travelled on the route to school. The only attempt to do so showed that the idea itself is worth applying and testing more comprehensively, provided data are available.

Having all these considerations in mind, the overall results should be treated as a valuable introduction to the relation between a means of transport and perception of space, confirming common-sense observations, but also revealing less obvious trends worth investigating.

The distance to a school strongly influences the choice of means of transport, which is an obvious observation. However, it is always necessary to analyse the data carefully – the case of the child from the most distant village of Bochoznica marking “walking” as a secondary choice is a good example. The commune-offered school bus is, based on the answers, a valuable addition to the options for reaching the school. The number of “bicycle” responses as a second choice shows that even in a rural area with poor cycling infrastructure, it is a frequently considered option. These answers can support decisions to invest in such infrastructure in villages.

With the second objective planned in this research (the types of objects marked on sketches), the scarcity of data caused more problems. To present the data in a convenient way, normalization per person was used. However, with the distance proportionally influencing the number of observed features, for more remote villages with sole pupils, the disproportion and extent of data remained high and a careful choice of method of presentation was needed. The number of anthropogenic features, in most cases, greatly exceeded natural objects. This was observed even for children travelling on foot to school and those living close to the school, with short distances to cover. It may seem that such a situation would allow them to observe the environment in greater detail. However, those who walk to school use pavements, pass lines of buildings along the road (Karmanowice is a road-aligned village), and have little chance of observing natural elements such as fields or forests. By contrast, those who cover longer distances, for example by car or bus, have more opportunities to observe nature, as they pass through forests and drive past ponds (the case of pupils from Łopatki or Kolonia Karmanowice, a remote part of Karmanowice). There is an interesting example of number of natural features observed by a child from Witoszyn. It is much greater than the normalized number of anthropogenic objects for Karmanowice children, as this child covers (as explained) a much longer route. However, it seems that the child from Witoszyn has an eye for details in general. This observation underlines the typical question raised in research on mental maps – the influence of the individual characteristics of respondents. It is, on the other hand, what we try to discover: is there a pattern in individual characteristics, and what is the “average” person's ability. To do this, a good, diverse, and numerous sample is needed, and this research falls slightly short of this requirement. What is also needed is a methodology for comparing individual data.

The horizontal bar map and analyses in the paper clearly show that the research would

benefit from a non-anonymous approach, with the possibility of using normalization not only per person but also per kilometre. As shown in the sole example using a short distance, knowing the exact location of a respondent's home opens more possibilities. Non-anonymous research causes a few problems. First, the location of a house is vulnerable personal data. Second, it raises an ethical question regarding the gathering, storing, and handling of this information. Third, anonymous answers are often seen as truer and more sincere (Andrà, 2020).

The scarcity of data and the possible underrepresentation of types made it impossible to perform a detailed analysis of individual classes among anthropogenic and natural features. A more detailed look into the information was carried out for one of the most numerous and diverse in terms of responses, the village of Karmanowice. This helped to form a few interesting statements, e.g. the confirmation of the dominance of data coming from car (longer) trips and more detailed information regarding near-school infrastructure provided by walkers. The analysis of classes of objects in the whole survey revealed the high diversity of types, so to draw general conclusions, a more numerous sample is needed to avoid episodic answers and to identify typical cases. The group to test this aspect could also be more homogeneous in terms of spatial origin (children covering more similar routes to school).

The research revealed a few tendencies and helped to raise further questions, with remarks on improving the methodology and the approach to the way the data are gathered. With the general knowledge gained, more detailed, individual-focused information may open more possibilities for understanding the relationship between space perception and the way we commute.

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