# Environment Recognition Using Diagram - as a Practice in Design Education

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## Abstract

Objective of the study is to demonstrate it useful to use diagram in order to designing living environment. We start with defining diagram and outline its general functions in reference to the explanation of its representational structure, which consists of three aspects: (1) Diagram formation, (2) Diagram synthesis or diagram formation on a large unit, (3) Diagram transformation. The usefulness of diagram for observation and representation of environment is explained by introducing perceptual cycle model. Then, we review a case example for design education. A survey of the environment was conducted using diagrams on a trial basis. The survey consists of the following two stages: the first stage for understanding quality of environment as well as discovering underlying problems, and the second stage for evaluating quality and suggesting problems of the environment understood as well as conveying them to others. As a result, we have understood that repeating observation and representation with the use of diagram can facilitate the development of one's recognition and representation as well as the development of diagram itself.

**Keywords:** diagram, design education, design survey, graphic design, semiotic

## 1 Introduction

For the first step of design (i.e. concept design), it is important to reconstruct a designer's concepts about a design object through finding, understanding and enhancing features and characteristics of the object. When students challenge environmental design, understanding the environmental quality, especially experiencing interaction between the environment and themselves would be a good starting point for recognition, revision and revaluation of the environment. In this process, diagram can be a useful tool for students to become aware of the features of the environment and understand them.

Objective of the study is to demonstrate it useful to use diagram in order to designing living environment. The objective contains two elements. One of them is to confirm that, for students who learn design, understanding of living environment can facilitate establishing the basis for designing living environment. The other is to confirm that diagram is useful as a tool for knowledge representation in the process of re-realizing environment, criticizing its designs and discovering underlying problems when we design living environment.

Even though diagram has a long history of its design and study, any fixed definition has not been established yet. Therefore, we define diagram and outline its general functions at first. Then, we review a case example for design education. A survey of the environment was conducted using diagrams on a trial basis for the design education. The environment survey consists of the following two stages: the first stage for understanding quality of the environment as well as for discovering underlying problems and the second stage for evaluating quality of environment understood and suggesting problems as well as for conveying them to others.

## 2 Diagram

Diagram visually displays data which is selected based on the subject. Diagram is a general term for map, pictorial statistics, graph, technical illustration, score, notation, etc. Each of them has its own different history of development.

Map as an expanded form of cartography has been developed in a form of drawing method for two- (or three-) dimensional display of geographical information. In ancient times, there were maps represented in association with human's perspectives of the world and the universe as well, some of which are suitable for a subject of study on anthropology such as those representing outer world knowledge and myths of a particular community. Map came to be called as "atlas" by G. Mercator in 16th century. In 19th century, a French engineer C. Minard exercised his ingenuity for adding various topographical data on maps as visual statistics paving the way for usage of maps as explanatory materials of history as well as documents and schematic drawings of city planning. With more important information included in addition to its original function to show spatial positional relations, a map created by C. Minard was expanded to something suitable to be called as diagram. It has become a tool for current city planning and its design has been sophisticated. Today, usage of atlas has been further expanded to various fields, for example from atlas of anatomy, historical atlas and linguistic atlas to meteorological atlas, atlas of cloud and brain atlas.

Visual statistics based on pictogram was attempted by Otto Neurath in Vienna in 1920's. In order for citizens to be able to understand the situation of the contemporary world, such exhibition as different from display of objects was tried. Drastically sophisticated explanatory panels with words and visual displays of data and

explanation were arranged, which enhanced understanding of the subjects. Inspired by the exhibition, rules for usage of pictogram were set up and a concept to understand society and the world by displaying objective data based on these rules has spread across Europe including the Soviet Union, where the concept was used for information and promotion of five-year plans. The attempt by Otto Neurath was initially called as Vienna method and subsequently it was developed to ISOTYPE (International System of Typographic Picture Education) and used widely for atlas etc. as well as in exhibition.

Recently, diagram has been widely used not only in exhibition space but also for daily life including various instructions and guidance and on websites. Further, in scientific visualization integrated with simulation and big data analysis, diagram has been applied for wide range of fields.

## 3 Functions of Diagram and Its Representational Structure

Explanation about Principle of Graphical Excellence by E.R. Tafte is helpful to understand functions of diagram [1].

Graphical Excellence is the well-designed presentation of interesting data – a matter of substance, of statistics, and of design.

Graphical Excellence consists of complex ideas communicated with clarity, precision, and efficiency.

Graphical Excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink and the smallest space.

Representational structure for realizing functions of diagram may be sorted out into the following three aspects:

(1) Diagram formation

For example, people can understand data from a graph as long as information is displayed according to the rules for graph generation. Graph, reference chart, and map have their respective formation rules.

(2) Diagram synthesis or diagram formation on a large unit

For example, formation of population map in combination with data of population density.

(3) Diagram transformation

For example, network diagram can be topologically transformed in order to emphasize specific items and relationships. Correlation can be understood by comparing distribution of height with that of weight. Such diagrams generated in association with (2) are intended for viewers to understand narratives there, to lead them to discover or notice implications [2] [1,2].

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1: E.R.Tufte has sorted out items from (1) to (3) into micro structure and macro structure of diagram.

2: J. Bertin has suggested problem resolution based on diagram.

## 4 Understanding of living environment based on diagram

We have taken up Tamagawa-josui as an example case for understanding living environment by diagram. Tamagawa-josui has a role of water channel for transporting drinking water from suburban to urban area of Tokyo as well as a role of walking trail developed along the water channel. Without any artificial structures ever built in the area except for fences, the wooded area has been conserved. Residents make use of the area for commuting, going to school and other leisure time such as walking. The survey is conducted on the 300 m-long part of it located at Kodaira city in Tokyo.

Tamagawa-josui is surrounded by greenery providing citizens with a comfortable environment. The task is to represent reasons for the amenity based on observation of its spatial form, temporal form, sequence, visibility, and ambient qualities. It is required to observe not only objective information but subjective (mental) responses and represent them in order to accomplish the task. We expected to develop such diagram as to cope with observing and representing environmental features.

We have suggested diagram of K. Lynch as a reference example for observing and representing the environment [3]. The diagram represents both environmental attributes and mental responses to the environment without distinguishing them. K. Lynch has also emphasized that it is important not to conduct comprehensive survey at initial stage using traditional planning model and survey model but to figure out a practical measure for each challenge in each case.

Students are not supposed to understand the environment immediately. They learn a perspective against environment with the help of several suggested diagrams at first. Subsequently, they achieve such diagram that is capable of displaying environmental characteristics while repeating observation and representation and revising or modifying diagrams. In order to facilitate the process, it is preferable to suggest such diagrams at first that admit later revision and modification.

**Fig. 1 Tamagawa-josui (promenade)**

## 5 Diagram as a tool for recognition and representation

There are several advantages in using diagram for observation and representation. In environmental surveys, spatial data is easier to represent on a map, whereas such data that is obtained by experiencing environments over time is easier to represent in notation. These representations are part of diagram. With the excellent visibility at a glance, use of multiple (subjects of) diagrams is suitable for classification, comparison and ranking.

When students observe environments, result of the observation may be intensely affected by what kind of diagram they adopt. This is because by using diagram with consciousness of its rules for forming or transforming representations, they can repeat more constructive representation and observation than by depending on words that are often used unconsciously. It is also important for them to be conscious of diagram as a framework of their observation and representation. With its flexibility for synthesis and transformation, diagram is capable of building up representations appropriate for observed environments [4].

Perceptual cycle model of Neisser is helpful from a perspective of knowledge representation, in order to consider effects of diagram on recognition and representation of environments.

Perceptual cycle of diagram consists of diagram, behavior such as observation and representation, and object that is environment here. Diagram provides a framework and perspective for behaviors such as observation and representation. Behavior conducts observation and representation of environments based on the diagram. Through such behaviors, various aspects of environments such as visual acoustic environments and light environment at night are turned into subjects of diagram and objects of behaviors.

In a circular relationship between diagram, behavior and object, diagram offers directions for behavior, and behavior extracts information from object (i.e. environment) and object conducts revision and amendment of diagram.

## 6 Trial of observation and representation of environment by diagram

Observation and representation of environment by diagram was carried out in two stages as shown in **Figures 2** and **3**. The first stage was started by preparing data of five senses of a person who is in contact with Tamagawa-josui based on a suggested diagram of K. Lynch at first. Being unable to use the original diagram of K. Lynch for this purpose, it was required to make some twist for the observation and representation.

The following matters were discovered and confirmed at this stage:

(1) A lot of subjects were found as sensory data based on human's five senses against the environment and diagrams for representing these subjects could be generated.

(2) Not all of five senses data against the environment were observed actually. It was difficult to obtain data of tactile and taste senses excluding thermal sensing.

(3) In some cases, subjective measurement was conducted in order to observe personal impressions of an observer. In observations, we considered the meaning of recordings one's subjective impressions and tried to find the possibility to substitute them by numerical or objective (e.g. photos, voice recorder, etc. ) data.

The diagrams in **Figure 2** are the sketches, not objective data, of the student's subjective impressions over the environmental qualities. The sketches of (a) to (g) concern the elements that are supposed to have influence on the environment. By reconsidering the sketches, he can find what features correlate and help form the environment there as a whole. For example, the walking line recorded in (b) is twisted avoiding tree trunks and roots, which determines visibility (c) and perceptual range of sunshine (f) so that the overall view along the trail is somewhat complicated. The greeneries mostly take up visual areas for him in daytime, but at night, lights of the houses along the trail play a significant role in determining his sight. Abundant greeneries are comfortable for a daytime walker, but when it gets dark too much of them are inconvenient because they utterly block out outside light.

The main purpose of this step is to encourage the observer to find himself what makes up the environmental quality and to know the importance of correlating multiple data. The experience of this task may help him determine what kind of data will be needed for further recognition of the environmental quality.

**Figure 3** was prepared for the next stage by making revisions. Based on evaluation of contents in **Figure 2** including both important and unimportant, the data was sorted out in **Figure 3**.

(1) Diagrams shown in **Figure 2** were prepared separately for each subject. Some consideration was made in Figure 3 for these diagrams to be able to associate with each other and revised them by providing each a common format.

(2) As many diagrams were unable to be understood without explanation in **Figure 2**, the format was improved in **Figure 3** so as for us to be able to understand even without explanation while contriving ways to provide legends.

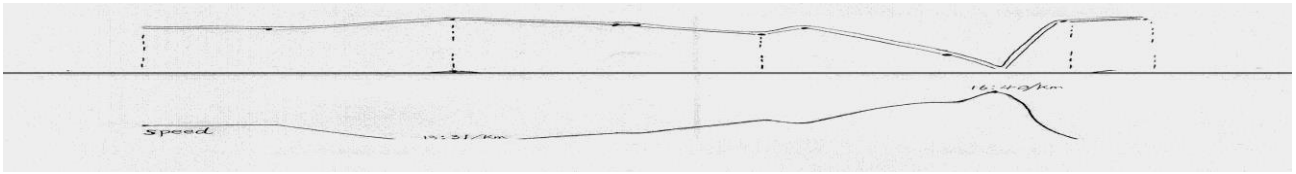
(3) Recording device and analysis software were utilized in recording sensory data. For example, it has been proved by analyzing audio recording data that singing of insects were observed in the whole area of Tamagawa-josui, while only a few singing could be recognized by human's ear.

## 7 Conclusions

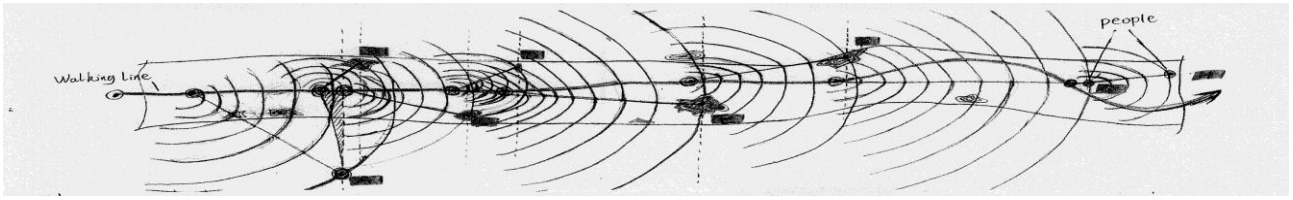
We have tried in this study to demonstrate the use of diagram as a tool for recognizing our living environment.

First of all, we confirmed that diagram visually displays data which is selected based on the subject. Taking it into account, we surveyed how diagram has come to be as it is today and how it affects recent visualization.

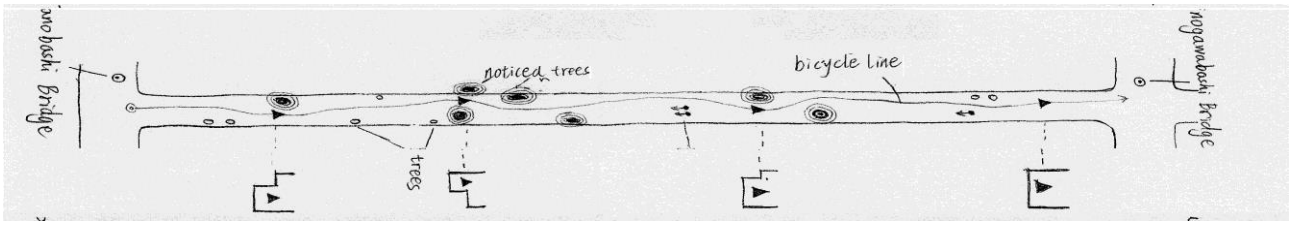
In addition, we sorted out representational structure for realizing functions of diagram into three aspects: (1) Diagram formation, (2) Diagram synthesis or diagram formation on a large unit, (3) Diagram transformation.



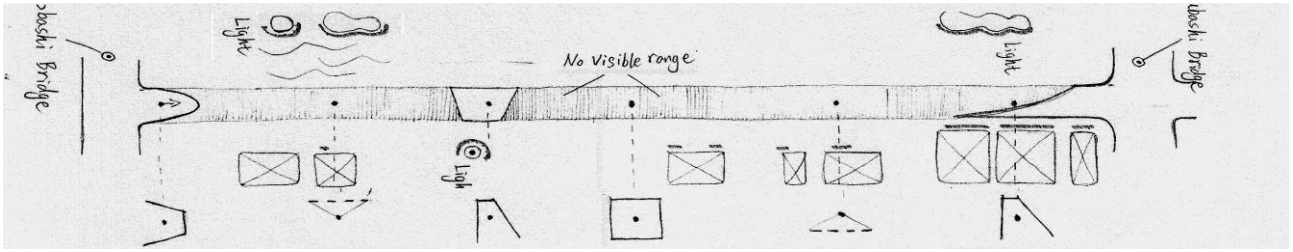

**(a) The obstacle against moving (the number of pedestrians)(the lower) and moving speed (bicycle) (the upper)**



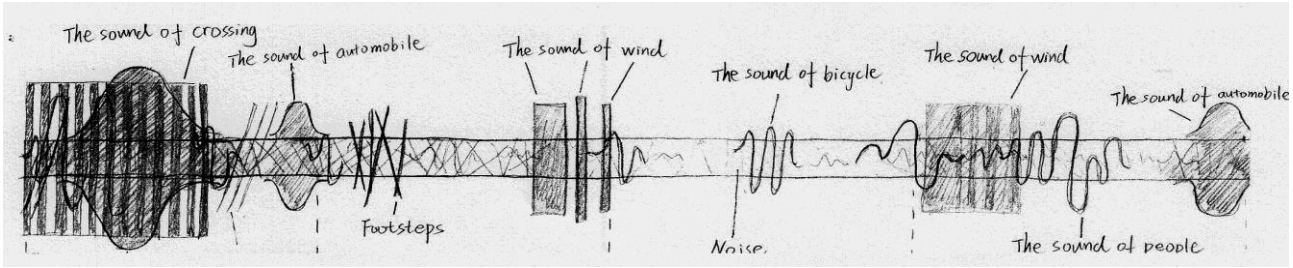

**(b) Walking line and inside/outside view (trees, people, outside objects)**



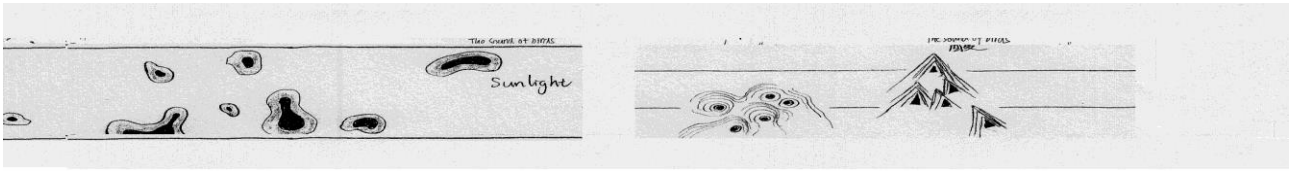

**(c) Visible range at 10:30 (right, left, forward, backward)**




**(d) Visible range at 19:30 (right, left, forward, backward, outside light)**




**(e) Sound or noise (of conversation, car, train, bicycle, wind, footstep,,,)**




**(f) Warmth of light through the trees (a part) (g) Smell (of surroundings, for example, of restaurants) (a part)**

**Fig. 2 Sketches of sensory data**

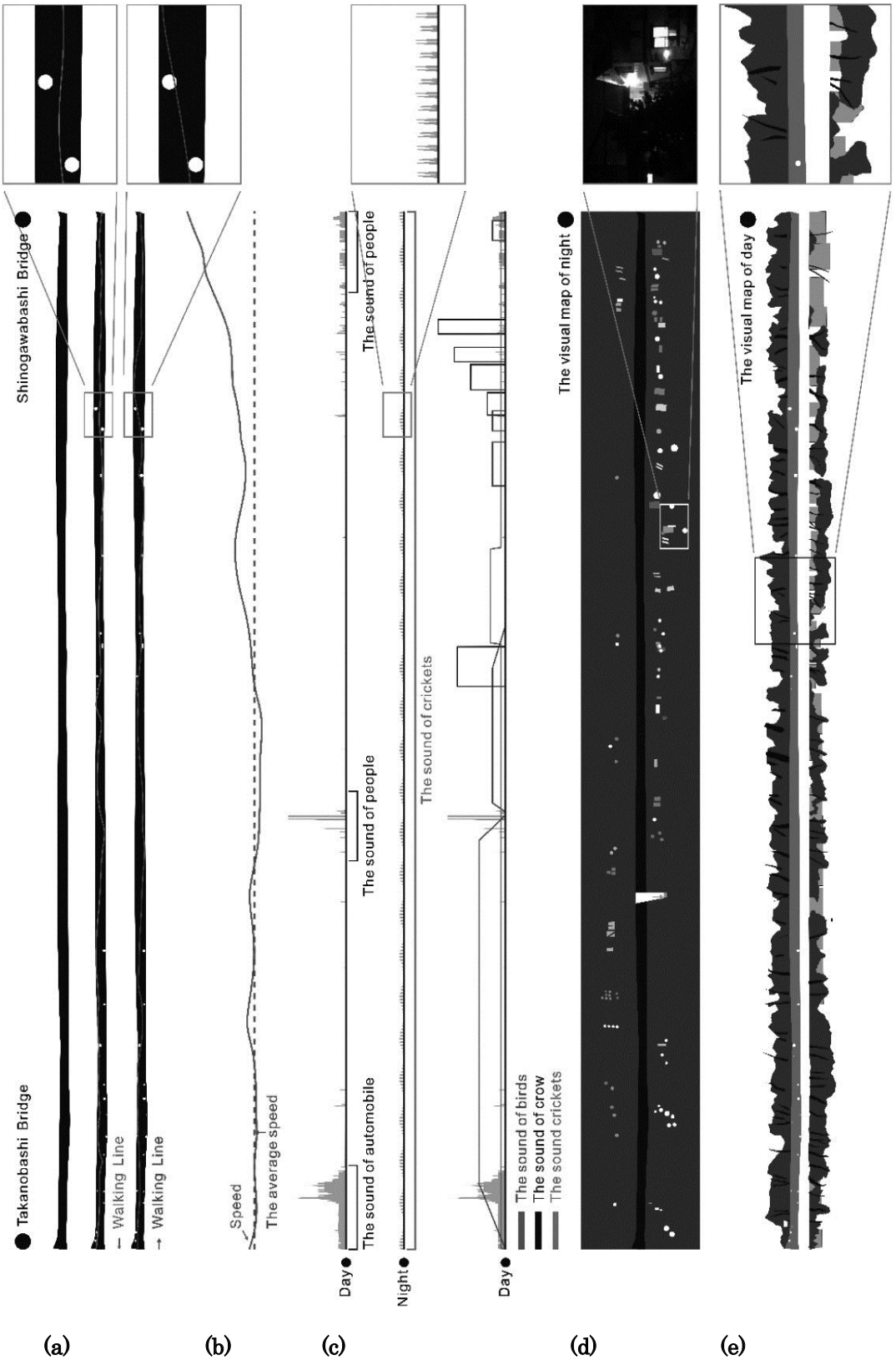



**Fig.3 Sensory data**

**(a) Width of the road, walking line (to and from) and wood (b) Walking speed (c) Sound or noise (of conversation, car, cricket in the night, birds) (d) Visual map of night (outside light visible through woods, recorded at 19:30) (e) Visual map of day (recorded at 10:30)**

Finally, a concept of perceptual cycle model was very useful for explaining diagram's significance as a framework in the course of observation and representation.

The case example of this study is a trial for further educational practice. We confirmed that repeating observation and representation with the use of diagram can facilitate the development of one's recognition and representation as well as the development of diagram itself. Diagram can be utilized not only to assemble objective data but also to observe and represent sensory data that have been regarded as un-measurable. On that point we have put emphasis in this study because we think it is one of the most important challenges for design to recognize and visually represent what is un-measurable as well as measurable matters. Our living environment is full of rich contexts for design, full of resources of design ideas.

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