

## Users' Cognition according to the Types of Illustration in Linear Graph

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### 1. Background and purpose

In the era of “Big data”, there has been growing interests over the effective means of the transmission of huge amounts of information. Even in Infographics, illustration has been recognized as an effective tool for the transmission of information, and the application of the illustration in Infographics has been continuously increased. Therefore, it would be necessary to investigate the influence of the illustration over users' recognition in order to employ it in more effective methods. Therefore the purpose of this study is to classify illustration used in linear graphs and to find out influence of each type of illustration on types over the recognition process.

### 2. The types of linear graph according to attributes of information

Robert L. Harris defines a graph as “a chart that graphically displays quantitative relationships between two or more groups of information” in *Information Graphics*[1] and classified graphs by format and data arrangement into 13 types including ‘Point graph’, ‘Line graph’, ‘Area graph’, etc. Based on this classification, linear graph were defined as graphs having data plotted on form of line. And linear graph are classified into a point graph as a graph plotting data in lines, which are consisted with dots, a line graph as a graph plotting data in open-end lines, and a column and bar graph as a graph having the areas of data graphics do not meaning. As for this study, the linear graph of ‘Information Graphics’ was classified into two types of the relation information and 8 characteristics were deducted. Out of those 8 characteristics, information qualities of the type showing the ‘Relation by Difference’ are ‘Comparison’, ‘Hierarchy’, ‘Deviation’, and ‘Emphasis’, and of the type showing the ‘Relation by Flow’ includes ‘Trend’, ‘Pattern’, ‘Projection’, and ‘Cumulation’. The analysis was done for emphasizing the linear graph with the characteristics of ‘Comparison’, which took the largest percent.

Types	Comparison	Relation by Difference				Relation by Flow		
		Hierarchy	Deviation	Emphasis	Trend	Pattern	Projection	Cumulation
Natures	Relation with difference among data	Relation with difference between rankings		Differentiation of specific data or portions	Fluctuation of value according to sequence	Style of value according to sequence	Forecast and plan of future data based on past or present	Total value sum of from initial value for certain period of time
Explanation		Relation with difference between rankings		Differentiation of specific data or portions	Fluctuation of value according to sequence	Style of value according to sequence	Forecast and plan of future data based on past or present	Total value sum of from initial value for certain period of time
Examples		Relation with difference between rankings		Differentiation of specific data or portions	Fluctuation of value according to sequence	Style of value according to sequence	Forecast and plan of future data based on past or present	Total value sum of from initial value for certain period of time

Figure 1. The types and characteristics of linear graph

### 3. The 5 types of application of illustration in linear graph

In general, the illustration was defined as “visualization or a depiction made by an artist, such as a drawing, sketch, painting, photograph, or other kind of image of things seen, remembered or imagined, using a graphical representation”. In other words, it was considered that the illustration has two objectives. And the first objective is to depict and describe a thing and the second one is to lead the visual access to such thing. Based on these objectives of the illustration, this study assumed the objectives of illustration of a linear graph as a visual mean for description and a device for leading the visual access. For determining the standards of types of the illustration application from the latter aspect, ‘card sorting’ was gone along for revealing relationships between linear graphs and data graphic with 200 linear graphs from INFOGRAPHICS (<http://inside.chosun.com/>) and Samsung Tomorrow (<http://samsungtomorrow.com/>). As a result, it was concluded that the linear graph can be classified into 5 types including ‘Separateness’, ‘Legend’, ‘Overlay’, ‘Alternative’, and ‘Figure’. The ‘Separateness’ exists separately from data graphic for a decorative purpose and it is mainly used for supporting the understanding of a main theme rather than the description of information. ‘Legend’ is a type used the illustration as a label and it helps to identify data variables. ‘Overlay’ is the one which overlapped the illustration with data graphic. Even if the illustration is deleted, still it is possible to recognize its data, but the overlaying of the illustration and data graphic heightens the recognition effect. ‘Alternative’ is a type of the illustration, which substitutes the data graphic of a graph. Since the illustration is the data graphic itself, a graph would be no longer valid if the illustration is deleted. ‘Figure’ is a type of which a set of data graphic is expressed in a single illustration. (Indeed, the ‘Figure’ type was excluded in this study since it is hard to clearly separate it from illustration).

#### 4. Interrelation between the types of application of illustration and attributes of high-quality in recognition process

To understand the correlation between the illustration and information properties, 5 previous studies on high-quality information characteristics were classified by properties with the same meanings. This classification revealed that major properties coincide with ‘Perception’, ‘Attention’, ‘Cognition’, and ‘Implementation’, stages of the recognition process, as shown in the table 1, and ‘Conciseness’, ‘Attractiveness’, ‘Understandable’, and ‘Functionality’ set properties for each of stages.

[Table 1] Categorization of attributes of high-quality according to recognition process

Process of Cognition	Advanced research Wang, Richard Y., Strong, Diane M. “Attributes of 14 High quality information”	Alberto Cairo The Functional Art “Visual Wheel”[2]	Jason Lankow Infographics : The Power of Visual Storytelling	Randy Krum	Lee hyun-ju and et al 2 Aha! Infographic
<b>Perception</b>	<b>Conciseness</b> / Completeness	Density / Lightness	Solidity	Be concise	
<b>Attention</b>	<b>Attractiveness</b>	Originality / Decoration	Beautifulness	Be attractive / Be different / Be creative	Interesting / Aesthetic
<b>Cognition</b>	<b>Understandable</b> / Accessibility / Interpretability	Familiarity		Be smarter	Eidetic / Rapid
<b>Implementation</b>	Errorless / Timeliness	<b>Functionality</b>	Usefulness	Be accurate	Effective

By testing and interviewing 5 males and 5 females in 20~40s with linear graphs with illustration and no illustration (‘Non’) based on the information characteristics of the table 1, it was found out that the illustration application type has relative influence over a user’s recognition process. Even though when a graph with ‘Separateness’ didn’t to make graph to be concise, it still intrigued users’ interest, but it did not have significant influence over degree of understanding. ‘Legend’ intrigued users’ interest by a high degree and helped users’ understanding of the graph. Especially, ‘Alternative’ expressed information in a simple manner and intrigued users’ interest the most and had a positive influence over every stage of the recognition process. However, in case of ‘Overlay’, the illustration application rather made a graph more complicated, in turn lowering ‘Attractiveness’ and interrupting the understanding of the graph. The following table 2 shows examples of graphs with each type of the illustration and the results of the test and interview.

[Table 2] Attributes of information according to application of illustration

‘Separateness’	‘Legend’	‘Overlay’	‘Alternative’
Conciseness 1 2 3 4 5 6 7 Attractiveness Understandable Functionality	Conciseness 1 2 3 4 5 6 7 Attractiveness Understandable Functionality	Conciseness 1 2 3 4 5 6 7 Attractiveness Understandable Functionality	Conciseness 1 2 3 4 5 6 7 Attractiveness Understandable Functionality
..... Non —— With illustration	..... Non —— With illustration	..... Non —— With illustration	..... Non —— With illustration

#### 5. Conclusion

With the study on influence of the illustration of a linear graph on users’ recognition, it was concluded as the following. First, the illustration application can be classified into 5 types, based on relationships between graphs and data graphics. Second, it was shown that the influence of the illustration over the recognition process is varied with the illustration application type. In case of ‘Separateness’ and ‘Legend’, they raised ‘Attractiveness’ at the stage of ‘Attention’, and ‘Alternative’ exerted a positive influence over every stage of the recognition process. On the other hand, it was found out that ‘Overlay’ type makes the graph complicate and interrupts with a user’s information recognition the most out of 4 illustration application types that had been tested. This conclusion supports the necessity of the study on the illustration expressions. It was not up to the mark that the graph analyzed in this study did not. In the future, it would be necessary to widen the scope of study subjects rather than linear graphs in order to suggest a proper illustration expression type for Infographics to minimize the errors in the users’ recognition process, which may arise in connection with the illustration.

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#### 6. References

[1] Robert L. Harris, Information Graphics : A Comprehensive Illustrated Reference, OXFORD, 1999.  
 [2] Alberto Cairo, The Functional Art: An introduction to information graphics and visualization, wikibooks, 2013.