

# Perception Enhancements Using Visual Attributes in Sequence Motif Visualization

Kok Weiyang

Faculty of Cognitive Sciences & Human Development  
Universiti Malaysia Sarawak  
Kota Samarahan, Sarawak  
Email: wyingkok89@gmail.com

Oon Yin Bee\*

Faculty of Cognitive Sciences & Human Development  
Universiti Malaysia Sarawak  
Kota Samarahan, Sarawak  
Email: yinbee@fcs.unimas.my

Lee Nung Kion\*

Faculty of Cognitive Sciences & Human Development  
Universiti Malaysia Sarawak  
Kota Samarahan, Sarawak  
Email: nklee@fcs.unimas.my

**Abstract**— Human factor theories are always being neglected especially in the design of biological tools. This problem was found in sequence logo which is used to visualize the conservation characteristics of the biological sequence motifs. Previous studies have found some limitations in the graphical representation which cause biasness and misinterpretation of the results in sequence logo. Therefore, the aim of this study is to investigate on the visual attributes performance in helping viewers to perceive and interpret the information based the preattentive theories and Gestalt principles of perception. A survey was carried out to gather user's opinion. The results showed some limitations in the use of colour, negative space, size and arrangement of the nucleotides and the lack of information and interactivity in the sequence logo. Therefore, improvements in standardizing the colour, graphical representation of the nucleotides and interactivity of the tool are needed to solve the problems of biasness and misinterpretation of the results in sequence logo visualization.

**Keywords** - visual attributes; sequence logo; Gestalt perception;

## I. INTRODUCTION

Visualization tools are important in providing valuable information for molecular biologist or bioinformatician to derive scientific insight from a large scale of biological data. In the past decades, new biological data and discovery of new algorithms has extended our ability to interrogate the biological process in many levels and the visualization methods have advanced greatly from hand drawn pictures to computer based visualization tool. A good visualization tool can helps to support three activities: the exploratory analysis, the confirmatory analysis and the presentation of data [1]. Besides containing the design of techniques and tools for browsing, formulating and displaying the predicted outcomes or complex database queries, data visualization also contain the automated description and validation of data analysis outcomes [2].

Information visualization can be viewed as a channel for communication from a dataset to the centre of cognitive

processing in user. Hence, human factor plays an important role in designing and developing suitable tools for data analysis and visualization. The power and usefulness of visualization in representing the information of scientific data is largely due to the strength of human perception. One of the well-known theories in perception which has been used in many areas is the Gestalt theory proposed by German psychologists Max Wertheimer, Kurt Koffka and Wolfgang Köhler in 1920s. This theory is used to explain how humans tend to visually assemble individual visual element into groups or 'unified wholes' [3]. The use of visual attributes such as colours, symbols, shape, sizes and etc. are all dealing with how well the information can be represent in order for user to perceive while visualizing an object. Thus, understanding the human visual system and perception mechanism are very important in improving the quality and quantity of information displayed in visualization tools.

With the increase of new visualization methods and tools, information visualization has suffers from not being based on a clearly defined underlying theory which makes the tools that are produced difficult to validate and defend [4]. The greatest challenge most researchers faced while designing visual tool is to decide on the graphical representation. Researchers are always concerned with algorithms to transform data into a graphical representation especially in scientific data visualization such as how the data are encoded into colours and shapes or transform into different scales. However, when it comes to deciding the best form of representation, models and principles on human factors are always being neglected and are mostly resort to their own aesthetic judgment.

In this study, we will focus on the problems found in the design of sequence logo and propose some possible improvements in the graphical representation that can help viewers to enhance the perception and interpretation of the results. Sequence logo is a visualization method introduce by Schneider and Stephens (1990) to visualize the conservation characteristics of the biological sequence motifs of DNA, RNA