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STRUCTURING THE PERCEPTION OF COMPLEX MESSAGES THROUGH VISUAL MOTION

Tkachenko Pavlo
Motion Designer, Creative Director,
ORCID: https://orcid.org/0009-0004-6003-578X
Crisp Motion, Inc., 327 Degraw St., Brooklyn, NY 11231, United States

Abstract. This study examines the cognitive and communicative principles underlying the structuring of the perception of complex messages through the use of visual motion. It substantiates that visual motion functions as a key factor in attention organization, segmentation of information flow, and reduction of cognitive load during the processing of multicomponent messages. A conceptual approach is proposed for employing dynamic visual elements as a tool for information hierarchization, temporal

organization, and semantic emphasis, which enhances interpretive accuracy and communication effectiveness under conditions of informational complexity.

Introduction. The perception of complex messages within a communication environment is increasingly complicated by the growing volume of information, multichannel modes of presentation, and a high density of semantic elements. Under such conditions, static visual structures often fail to ensure an adequate level of cognitive organization, leading to fragmented comprehension, loss of logical connections, and overload of the recipient's attention.

Overcoming these limitations requires the use of dynamic mechanisms for information structuring, particularly visual motion, which is capable of guiding perceptual direction, sequencing the processing of elements, and shaping semantic priorities. By integrating spatial and temporal parameters, visual motion enables the consolidation of individual message components into a coherent cognitive model. However, the absence of a systematized approach to its application limits its effectiveness in scientific, educational, and media communication.

The purpose of this study is to substantiate and develop an approach to structuring the perception of complex messages based on the use of visual motion as a tool of cognitive organization and semantic navigation.

To achieve this purpose, the following objectives are addressed:

1. To determine the role of visual motion in processes of attention, segmentation, and hierarchization of complex informational messages.
2. To analyze the key parameters of visual motion, including direction, tempo, rhythm, and sequence, in terms of their influence on cognitive information processing.
3. To identify ways of applying visual motion to optimize the perception and interpretation of multicomponent information.

Literature Review. The issue of enhancing the effectiveness of perceiving complex messages through dynamic visual elements has evolved within the context of cognitive optimization of information flows and visual interface design. The study by S. Hu, O. Jiang, J. Riedmiller, and C. X. Bearfield [1] examines the use of motion-based visual encoding for representing time series, demonstrating improved accuracy and speed in the perception of dynamic information. In the research by A. Srinivasan, J. Ellemose, P. W. S. Butcher, P. D. Ritsos, and N. Elmqvist [2], emphasis is placed on adaptive visualizations that track user attention in real time and adjust visual elements to optimize the interpretation of complex data. A. Arunkumar, L. Padilla, and C. Bryan [3] analyze the impact of cognitive attention fluctuations, or mind wandering, on the perception of dynamic visualizations, highlighting the importance of integrating behavioral user metrics to enhance visual communication effectiveness. In their study, D. Petrescu, P. A. Warren, and Z. Montazeri [4] investigate the interaction between eye movements, user motion, and dynamic visual scenes in virtual environments. The results demonstrate that synchronizing user movement with visual elements increases the accuracy and speed of information processing. Y. Zhang, Z. Wang, J. Zhang, G. Shan, and D. Tian [5] provide a systematic review of immersive visualizations with a focus on perception and interaction, emphasizing the role of dynamics as a key mechanism for structuring complex information. H. Pei, D. Hu, and L. Dong [6] compare the effects of static and dynamic images on user cognitive experience using eye-tracking methods, with findings confirming that dynamic elements enable faster orientation within multicomponent messages. J. Liu and F. Zeng [7] examine the neural mechanisms underlying the integration of visual and vestibular information in motion perception, underscoring the need to account for natural cognitive processes in the design of dynamic visualizations.

Methodology. The research methodology is based on integrating cognitive analysis of perceptual processes with methods of visual semiotics and multimodal communication theory. The study employs an analytical comparison of static and dynamic modes of information presentation, focusing on the influence of visual motion parameters on attention, processing sequence, and semantic integration of multicomponent messages. A structural and functional approach is applied to identify the role of motion in shaping element hierarchies and causal relationships among them, alongside interpretive analysis to assess changes in the accuracy and completeness of content comprehension. The methodological framework is oriented toward identifying not isolated visual effects, but stable patterns that optimize cognitive information processing under conditions of increased message complexity.

Results. Information environments are characterized by a high level of complexity and multicomponent message structures, which complicates their effective perception by users. Dynamic visual elements that implement motion-based codes and variations in spatial and temporal parameters increase the speed and accuracy of cognitive information processing. Despite the active application of such approaches in data visualization and interactive systems, systematic studies of mechanisms for optimizing the perception of complex messages through the targeted use of visual motion remain limited. This determines the need to develop methodological approaches that integrate principles of cognitive psychology and interface design in order to enhance the effectiveness of interpreting dynamic information.

Visual motion functions as a key mechanism for structuring complex messages, as it enables the prioritization of elements, emphasizes relationships among data, and supports the construction of cognitive maps of information flows. The use of dynamics in visualizations facilitates memorization and simplifies the interpretation of multicomponent messages. In addition, motion-based elements can adapt to user attention, providing flexible data representation in real time [1-2].

Different types of motion elements in visualizations affect information perception in distinct ways. Linear motion enables rapid tracking of changes in time series and highlights critical trends, whereas nonlinear and sinusoidal trajectories enhance the memorization of complex structural relationships among elements. The parallel use of multiple motion codes, such as combining color change with object movement, increases the accuracy of interpreting multicomponent messages and reduces user cognitive load. The effectiveness of visual motion depends on the context of information presentation, its density, and the interactive capabilities of the system [3-4].

The classification of motion element types is performed with consideration of their influence on perception speed and accuracy, prioritization of key components, and memorization of multicomponent information. Table 1 presents motion parameters, associated cognitive effects, and recommendations for their application in interactive and dynamic visualizations, enabling the correlation of specific motion characteristics with user information processing outcomes.

Table 1 Impact of Types of Visual Motion on the Perception of Complex Messages

Type of Motion	Primary Perceptual Effect	Cognitive Outcome	Recommendations for Use
Linear motion	Tracking changes in time series	Rapid identification of trends	Use for data with clearly defined trends
Nonlinear motion	Visualization of complex relationships between elements	Facilitated memorization	Use for structured or hierarchical data
Sinusoidal motion	Emphasis on cyclic or periodic processes	Improved pattern recognition	Recommended for repetitive processes or signals
Combined motion (color + movement)	Highlighting priority elements and integrating multiple parameters	Increased interpretive accuracy and reduced cognitive load	Use for multicomponent messages with large data volumes
Adaptive motion	Adjustment of display based on user attention	Optimization of real-time interpretation	Apply in interactive systems and immersive environments

Source: author's development

Analysis of Table 1 indicates that linear motion is effective for tracking changes in time series and rapidly identifying critical trends, whereas nonlinear and sinusoidal motion enhance the memorization of structural relationships and patterns. Combined motion codes, which integrate color changes with object movement, enable precise interpretation of multicomponent messages while reducing cognitive load. Adaptive motion elements allow the display to adjust to the user's attention level, increasing the effectiveness of interactive and immersive visualizations.

The results demonstrate that the selection of motion type should align with the characteristics of the information and the user's tasks to ensure optimal perception. Enhancing the perception of complex messages requires attention not only to the presence of motion elements but also to their specific characteristics. The direction of motion determines how users orient themselves within the information space and highlights key components requiring priority attention. Motion tempo regulates data processing speed and influences attentional focus: an optimal balance between speed and message complexity reduces cognitive overload. Rhythmic patterns shape user expectations, simplifying the identification of structural relationships among elements. Motion sequence establishes a logical order of interaction between message components, improving the accuracy and coherence of interpretation. Analysis of these parameters enables the identification of motion code combinations that maximize the speed and accuracy of cognitive processing for multicomponent information [5-7].

To compare the impact of visual motion parameters, they were systematically categorized by direction, tempo, rhythm, and sequence, and their effects on attention, accuracy, and information processing speed were assessed. Table 2 presents motion characteristics that enhance the perception of multicomponent messages, along with recommendations for optimizing visualization structure in accordance with users' cognitive characteristics.

Table 2 Impact of Visual Motion Parameters on Cognitive Information Processing

Motion Parameter	Primary Cognitive Effect	Influence on Perception	Recommendations for Use
Direction	Orientation within the information space, highlighting key elements	Accelerates identification of priority components	Use for structured and multi-level messages
Tempo	Regulation of processing speed and attentional focus	Optimizes perception speed and accuracy	Adjust according to information complexity; avoid excessively fast motion
Rhythm	Formation of expectations, simplifying pattern detection	Facilitates recognition of structural relationships	Use for repetitive or cyclical data
Sequence	Logical order of element interaction	Enhances accuracy and coherence of interpretation	Apply to multicomponent messages with sequential structure
Combined parameters (direction + tempo + rhythm)	Integration of multiple effects simultaneously	Reduces cognitive load and increases interpretive accuracy	Use for complex and large-scale information sets

Source: author's development

Analysis of the systematized data indicates that motion direction determines perceptual priority and provides spatial orientation for users within multicomponent messages. Motion tempo correlates with attentional focus: an optimal speed enhances processing accuracy, whereas an inappropriate tempo may lead to cognitive overload. Rhythmic motion patterns support information structuring and facilitate the detection of recurring patterns. Motion sequence ensures a logical order for integrating elements and maintains the coherence of interpretation. The combined use of motion parameters simultaneously enhances speed, accuracy, and memorization of information, which is particularly effective in complex or dynamic visualizations.

In practical applications, visual motion can be employed in informational and analytical systems to improve the accuracy and speed of perceiving multicomponent messages. In dynamic visualizations, it enables the highlighting of priority elements, structuring of information flows, and support for logical interactions among data. Motion elements can serve as a mechanism for adapting displays to the user's attention level, optimizing information processing, and reducing cognitive load. Integrating motion parameters into message design provides a foundation for informed decision-making, rapid data analysis, and effective interpretation of complex information structures.

Conclusions. This study analyzed the impact of visual motion on the perception and interpretation of multicomponent messages. It was determined that the direction, tempo, rhythm, and sequence of motion elements influence information processing speed, the accuracy of prioritizing components, and cognitive integration of data. Linear motion facilitates tracking changes in time series, while nonlinear and sinusoidal motion enhance the memorization of structural relationships. Combined motion parameters reduce cognitive load and improve interpretive accuracy.

In practical terms, the findings can be applied in interactive and analytical systems, immersive environments, and information platforms to enhance the accuracy, speed, and effectiveness of interpreting complex messages. Implementing recommendations regarding motion parameters and their combinations provides a foundation for optimizing cognitive information processing and supporting informed decision-making across various domains.

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