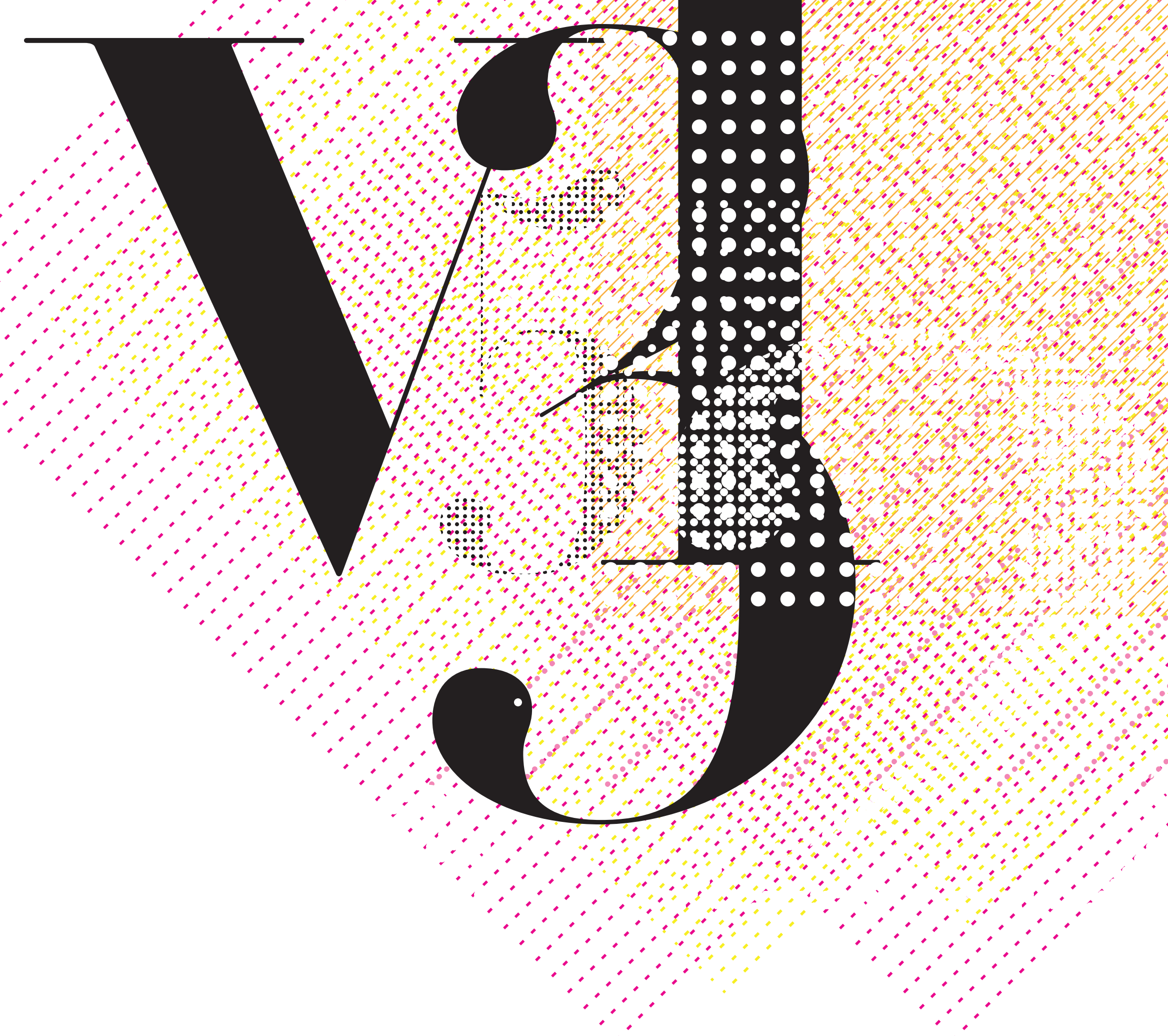
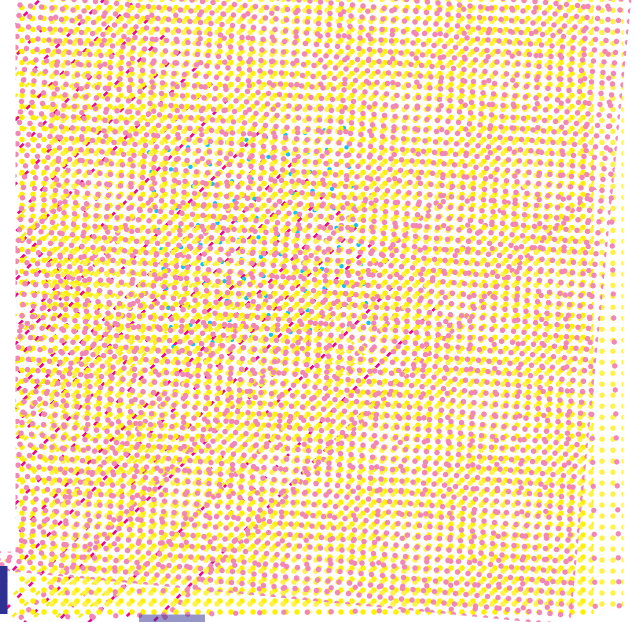
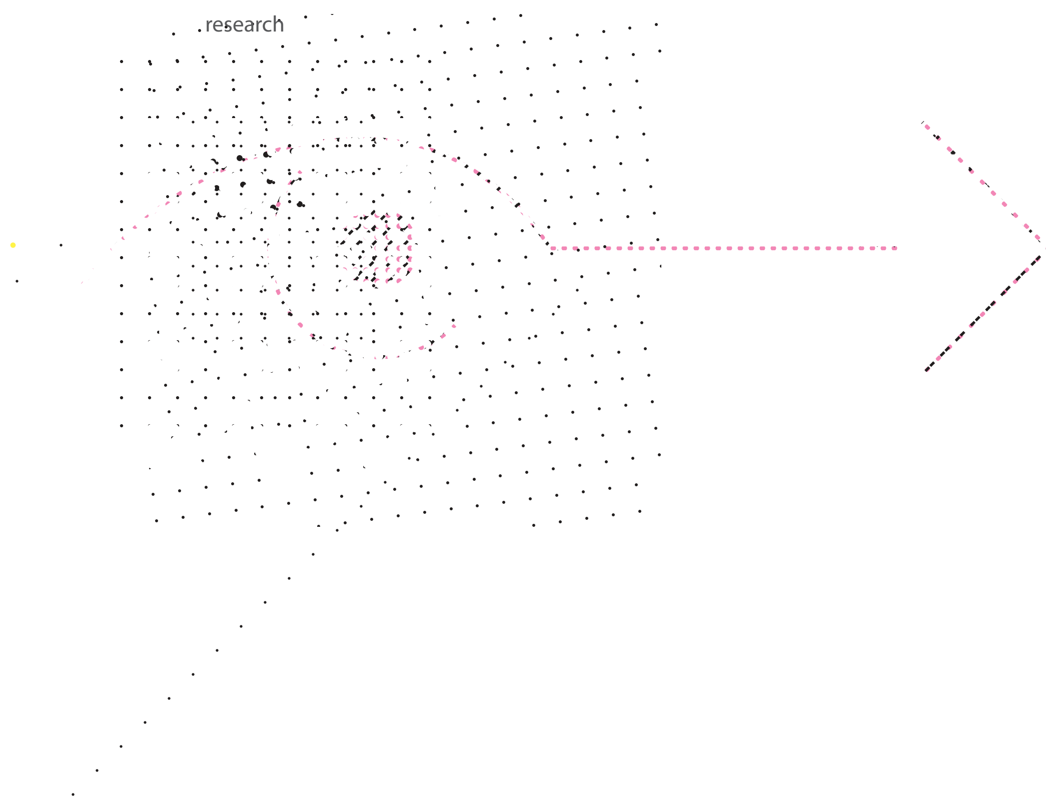




53 . 2

Visible Language

the journal of
visual communication
research

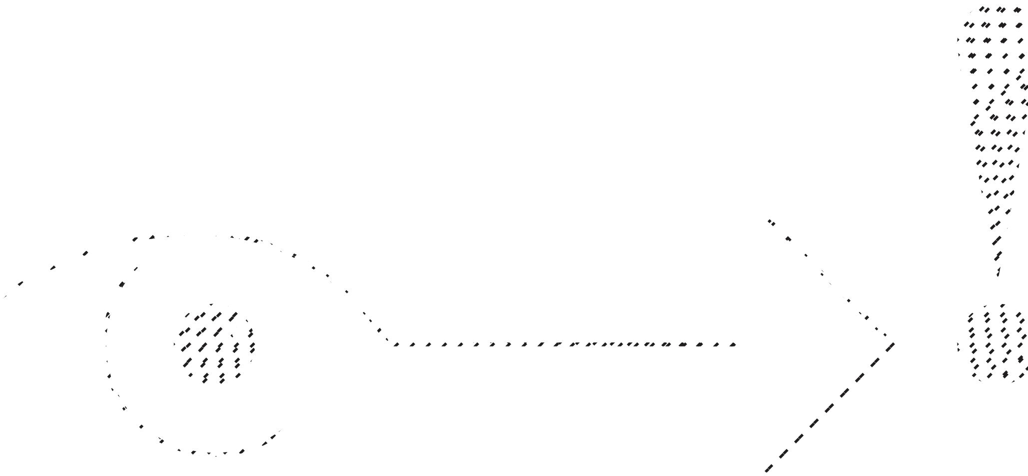


august 2019

Visible Language
53 . 2
the journal of visual communication research
august 2019

ISSN 0022-2224

Published continuously
since 1967.



Before there was reading there was seeing.

Visible Language has been concerned with ideas that help define the unique role and properties of visual communication. A basic premise of the journal has been that created visual form is an autonomous system of expression that must be defined and explored on its own terms. Today more than ever people navigate the world and probe life's meaning through visual language. This journal is devoted to enhancing people's experience through the advancement of research and practice of visual communication.

Published tri-annually in April, August, and December

w e b s i t e :

http://visiblelanguagejournal.com

s e n d   c o r r e s p o n d e n c e   t o :

Mike Zender, *Editor*
College of Design, Architecture, Art, and Planning
University of Cincinnati
PO Box 210016
Cincinnati, OH 45221-0016

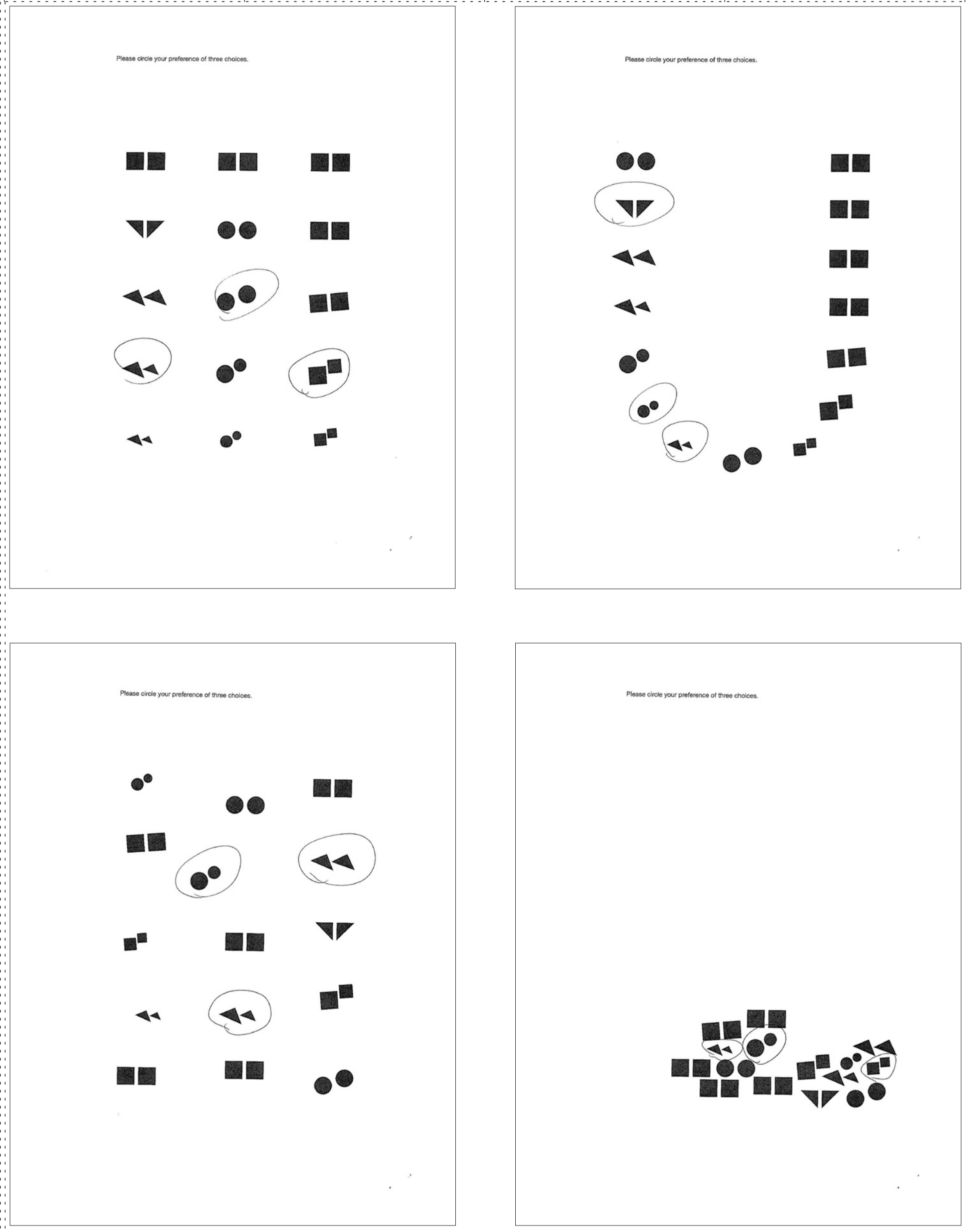
the journal of
visual communication
research

August 2019

Advisory Board

Visible Language

Contents



For Visual Attention, are there any Tendencies in Form Interpretation?

Jinsook Kim, PhD[1]
Michael H. Fritsch, MD[2]

We examined if there is any intrinsically "hard-wired" tendency in the subject's Visual Attention. When asked to spontaneously decide preferences for shape or grouping of shapes, distinct patterns of preference in human test subjects were found. These preferences were consistent among ages older than 20 years adulthood and both genders. These findings could result in broad practical applications ranging from interface designs to visual alerts.

Keywords:

Gestalt Grouping;
Common-fate;
Visual Rhythm;
Visual Hierarchy;
User Interface

[1] Georgian Court University, 900 Lakewood Ave., Lakewood, NJ, USA

jkim@georgian.edu

[2] Indiana University, 9002 N Meridian St., Indianapolis, IN, USA

mfritschmd@gmail.com

1. Background

The information we receive at every moment of our life's interactions is overwhelming. Perspectives, interfaces, and artifacts surround our everyday visual interactions. Symbols and icons are pervasive. This research attempts to determine if there is visual bias, which plays a role in Visual Attention regarding user interface and interactions.

Attention is related to perception, context, interest, and even surprise (p. 30, Poggenpohl, 2018). From a visual perception or scientific point of view, Attention is related to grouping principles and segmentation (Kootstra, 2011), and figure–ground perception for gestalts (Leeuwen, 2011). As it happens, Attention, gestalt grouping, and figure-ground perception share common mechanisms (Dodd, 2005; Kootstra, 2011; Leeuwen, 2011).

For example, common-fate, one of the gestalt grouping principles, is explained as the viewer's tendency to visually group when the individual and/or different stimuli have the same visual destination. Imagine ocean waves, a school of fish, or a flock of birds moving together with a variety of distances each to another. We group all individual fish or birds moving together concurrently, although their individual angles or directions when moving are all slightly different. Our Attention goes to seeing or understanding the entire figure group of waves, fish, or birds, also separating the group from the background – sea, sky, or nature by the combination of the principles of similarity and common-fate.

Based on the relationship between perception and visual imagery processes (Kosslyn, 2005), the process of the "visual image" builds sequentially over time (p. 338). For example, imagine a star created by the overlaps of two triangles. It is a hexagon surrounded by six triangles to present a 'star'. Once each part (a triangle) is generated, it begins to fade and move to the next expectation (another triangle) – the parts (bottom up inputs) cohere as separate units (Kosslyn, 2006, p.150). For perception, the imagery is depictive based on what is "stored" (top down inputs) in the brain. Based on Kosslyn, perception and imagery processes share underlying neural processes; however, are not necessarily the same.

Based on Treisman (1988), "pop-out" occurs when the target has a unique feature for the properties of the object, which is coded early in perceptual processing (p. 40). Thus, the image builds continuously until a certain threshold is reached and the image is recognized.

Our research investigates what image components people naturally choose first when trying to build an image. The research hypothesizes that common-fate is superior to proximity and/or similarity.

Of interest is that in our natural world, where these groupings or visual hierarchies evolved, there are sequences which connect the visual stimulus to the subject (see *Figure 1*.). We see a moth, its symmetric shape, then its four "eyes". We distinguish the moth from its background either by a contrast of colors or by a contrast of shapes between figure and ground.

In our modern everyday world, non-natural visual stimuli are presented such as buildings and taxicabs (Figure 2) or combinations – houses and flowers (Figure 3). What do you see first? Buildings? Taxicabs?

Figure 1. Moth

Figure 2. Taxicabs and Buildings

Figure 3. Houses and Flowers

Which one first, or both? Do people identify the center or periphery first? For example, in Figure 3, which flower caught your eyes first? Did you have any preference in selecting your flower from the figure – by brightness, by shape, by size, or by more personal familiarity? Is there any intrinsic bias of size—i.e., smallness or largeness? In the figure, are there any significant differences between geometric shapes and organic shapes or nature to prejudice human Attention?

Regarding the viewer's representation of what they see/saw, Attention can also be associated with the concept of "affordance" (Gibson, 1979) to consider the "context" or "environment" of the viewer. Baylis (1992) claimed that Visual Attention is not based directly on the information itself. As Gibson mentioned, "An affordance is an invariant combination of variables, and one might guess that it is easier to perceive such an invariant unit than it is to perceive all the variables separately. It is never necessary to distinguish all the features of an object and, in fact, it would be impossible to do so. Perception is economical" (p. 134).

As an example of affordance, right now, my computer screen cursor is constantly blinking at regular intervals, to show where to type letters. This very small, thin, blinking cursor is catching my Attention to communicate that it lets me successfully type, and I am typing. Design makes the connection between the user's goal and the artifacts used. The users are active human beings, seeking to achieve their goals, using what they see/saw to achieve the goal successfully. People "adapt" in every action, and their perception or Attention is "economical".

2. Materials & Method

2.1 Research Question

Is there any hard-wired tendency for Visual Attention to basic shapes or visual groupings in which the tendency can be characterized?

2.2 Experiment Constructions

2.2.1. Components: Perceptual Attributes

Grouping principles – proximity, similarity, and common-fate – are engaged with six arbitrary squares arranged with the same spacing (Figure 4). Degrees of common-fate are tested by adding features to the six squares. As a degree 1, the squares are paired creating distance between the groups (gr1), (gr2), and (gr3), or alternately interpreted as closeness between a and b, c and d, and e and f. As a degree 2, the grouping from degree 1 is fostered by presenting different shapes – the groupings (or separations from each group) are stronger than that of only proximity. As a degree 3, common-fate is added to see if any stronger associations if each element is angulated in a shared direction. Finally, as a degree 4, depth, one visual technique was applied by reducing the size of the second element from each pair to create three-dimensional depth to see if there are any stronger associations that each pair presents in terms of visual technique. See Table 1.

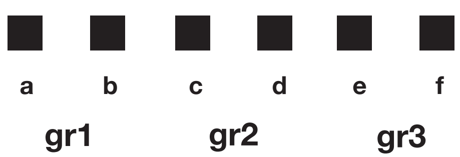


Figure 4.

Six squares without any stimulations or emphases

TABLE 1.

Six random squares are paired to create three groups. Using proximity, a number of individual shapes were grouped based on distance closeness. Using a similarity, the group from proximity was fostered. For example, gr1b, gr2b, and gr3b of gr-b present clearer separations from each other than that of gr1a, gr2a, and gr3a. Using common-fate, the group from both proximity and similarity was further shaped to create orientation identity. For example, when comparing gr2b and gr2c or gr2d, then gr2d was presented with angulation and depth to create the same destiny for the group between c21 and d22 (i.e., a diagonal).

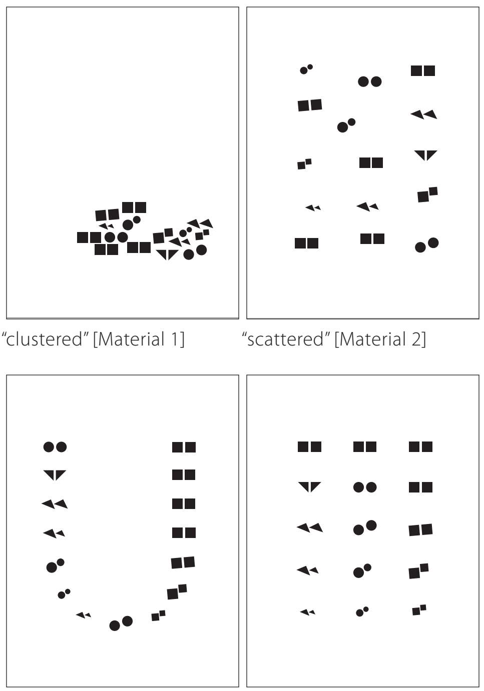
	Visual Stimuli gr1, 2 & 3			Grouping principles applied to gr1, gr2 & gr3							
gr-a	a01 b02 gr1a	c03 d04 gr2a	e05 f06 gr3a	Proximity	O	Similarity	X	Common - Fate	X	Depth	X
gr-b	a07 b08 gr1b	c09 d10 gr2b	e11 f12 gr3b	Proximity	O	Similarity	O	Common - Fate	X	Depth	X
gr-c	a13 b14 gr1c	c15 d16 gr2c	e17 f18 gr3c	Proximity	O	Similarity	O	Common - Fate	O	Depth	X
gr-d	a19 b20 gr1d	c21 d22 gr2d	e23 f24 gr3d	Proximity	O	Similarity	O	Common - Fate	O	Depth	O

2.2.2 Compositions/ Materials: Conceptual Attributes

The pairs in Table 1 are then intermingled contributing to "the perception-conception relation" (Reed & Friedman, 1973, p. 157), mimicking or abstracting some situations for interface – the merging processes between the artifact's attributes and the subject's cognitive and experiential learning or understanding – for example (Figure 5): "clustered" [Material 1], "scattered" [Material 2], "shaped" [Material 3], and "aligned" [Material 4].

Figure 5.

Schematic Material 1, 2, 3, and 4



"clustered" [Material 1] "scattered" [Material 2]

"shaped" [Material 3] "aligned" [Material 4]

In Figure 5 Material 1, a proximity algorithm, all stimuli were located in the right lower corner of the page; the components were arranged with minimum distance from each other. In this material, closer distance was emphasized to see how the viewers distinguish and choose each pair from the algorithm. In Material 2, a randomness algorithm, the stimuli were scattered without parameters. In this material, unordered pairs were emphasized to see how the viewers distinguish and choose each pair from the algorithm. In Material 3, an identification algorithm, the stimuli were arranged based on a certain shape. In this material, shape dominance was emphasized to see how the viewers distinguish and choose each pair from the algorithm. In Material 4, an alignment algorithm, the stimuli were aligned based on rows and columns. In this material, linear alignment was emphasized to see how the viewers distinguish and choose each pair from the algorithm.

2.3 Participants and Protocols

There were 55 participants in the experiment. The ethnicity and gender distribution were 51% white Americans and 49% Asians, all with normal vision, and 51% women and 49% men. The participants' academic backgrounds included medicine, nursing, education, business, and law. All were over 20 years of age. The participants were directed with the question: "Please circle your preference of three choices." in each of the four series of experiment stimuli sheets of paper. The series were given in the same order for all participants (Material 4–3–2–1). The time given to complete participant answers were five minutes or less.

3. Results

The highest population rate was 45% (25/55) on a particular pair, gr2d (compared to 12.5% random selection of 8 options). Figure 6 shows the top five popular figures in the color of black and gray, the rate from 31% (17/55 answers) to 45% (24/55 answers). For Material 1, participants were still able to distinguish each pair such as gr1, gr2, and gr3 without difficulty, although the group and each component were considerably close to each other. The most popular two groups selected were gr2d (circles) at 45% and gr1b (triangles) at 40%. In Material 2, the most popular two groups selected were gr3b (squares) at 44% and gr2d (circles) at 42%. In Material 3, the most popular two groups selected were gr1c (triangles) at 38% and gr2c (circles) and gr2d (circles) at 36% for both. In Material 4, the most popular two groups selected were gr1b (triangles) at 44% and gr2b (circles) at 35% (see *Figure 6-1*).

Figure 6.

Top three ones are marked with black. The fourth & fifth ones are marked with gray.

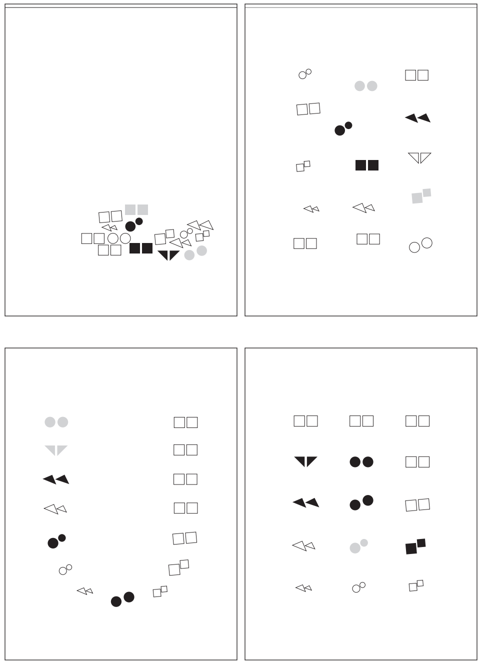
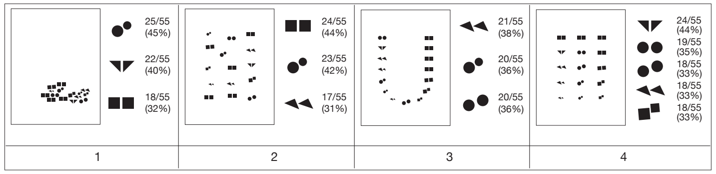


Figure 6-1.

Top three preferences shown with percentages for Material 1, 2, 3, & 4



Overall, the pair of circles' rate is 43%; 84% of the circles chosen were with an angulation configuration. The pair of triangles rate is 36%; 60% of the triangles chosen were with angulation. The pair of squares rate is 21%, and 33% of the squares chosen were with angulation. As a whole, 64% of the shapes selected were engaged with angulation. (See Table 2.) Table 3 shows the most popular three pairs (67%) of the selected. The group of gr-a (the pairs of squares) had been repetitively used; however, those were not dominant by the viewers. Similarly, the smallness of the pairs was not selected neither. Comparatively, the choices from Material 3 "shaped" were regular – circles and triangles only with angulation for all. See 3 in Figure 6-1.

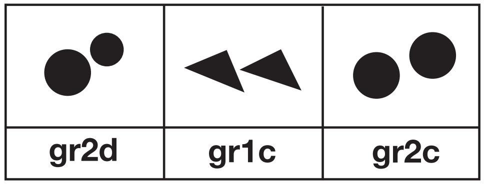
TABLE 2.

Results. The highest rates are highlighted.

Shape tendencies	Populations
The pairs with shifting	64 % (9/14)
The pair of circle <1>	43 % (6/14)
The pair of triangle <2>	36 % (5/14)
The pair of square <3>	21 % (3/14)
<1> with shifting	84 % (5/6)
<2> with shifting	60% (3/5)
<3> with shifting	33 % (1/3)

TABLE 3.

The most popular three pairs from the materials are presented.



4. Discussion

Generally, the most popular three pairs are all engaged with angulation – common-fate. "What is the concept of angulation, or what is the concept of common-fate in relation to Visual Attention?" Attention, conventionally, is known to be controlled by two factors (Zhao et al., 2013): It is driven by salient external stimuli, and by internal goals or task rules. However, Zhao (2013) argued that "regularities" bias spatial and feature Attention and that structured sources of information receive Attention priority over noisier sources of information. Is angulation showing any sort of structured source? Is common-fate showing any tendency of regularities? What is "regularity"?

Regularity is the quality of being regular, belonging to an important order, and can be related to unity. For example, Wiese (2017) discussed visual regularity: "The camera only recorded the motion of the point-lights, so the resulting movies displayed a number of moving dots. Although the information about the moving bodies was sparse, subjects who viewed the movies were able to distinguish whether a person was walking or running and could also identify the person's gender" (p. 260). Wiese also discussed predictability and auditory regularity: "When we hear a familiar scale, the first and second notes are predictive of the third note ("predictive" in the atemporal sense that uncertainty about the first note is reduced, because a correlation exists.) The predictability arises because of a regularity (harmony), which makes it more likely that some notes constitute a sequence and less likely that others do. The example emphasizes that regularities are tracked over time: not only the pitch of individual notes, but also their time of occurrence is predictable" (p. 260).

Can common-fate be understood like a melody or rhythm in music? Common-fate is generally thought to have the status of a connected configuration when visual elements appear to move together. Wertheimer (1923) used "uniform destiny" as an expression for common-fate. According to Auditory Scene Analysis (Bregman, 1990), supporting Weise's auditory regularity, unclear and complex sounds at different pitches can be harmonized by their patterns of fluctuation as a grouping in music. Angulation is not necessarily itself only to execute; the research carefully hypothesizes that the phenomenon from angulation in order to Attention can be an example of belongingness for a visual melody or a visual rhythm, more naturally engaging the viewer.

See Figure 7. Wertheimer's original description on common-fate (1923) for a "shift" (angulation) is that visual orientation dominates over proximity (e.g. "m n o" or "p q r") and similarity (e.g. "n & s") to see the entire

row of dots as a slightly upward line from "m" to "x". The figure (from "m" to "x") with a "shift" makes the associations of dots fostered in such a way that the dialogue between dots affects the viewer's Attention. Now, do you still associate "o" and "p" and "r" and "s" in Figure 8 as much as you did in Figure 7? Imagine, "s, t, u" is missing in both Figure 7 and 8. For example, which way (between 7 and 8) will emphasize the connection more between "p, q, r" and "v, w, x" (See Figure 9.)

Figure 7.

A row of dots in common-fate (Figure adapted from Wertheimer, *Laws of Organization in Perceptual Forms*, 1923)

Figure 8.

A row of dots

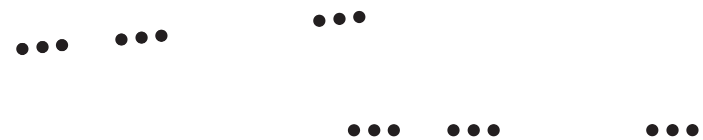


Figure 9.

Rows of dots by authors with discontinuation, top with angulation, bottom without angulation

There is an inherent tendency in Visual Attention to create visual patterns. Viewers show a tendency toward Attention in common-fate for regularity and predictability. Aspects such as melodic or rhythmic for belongingness rather than the baseline accelerate viewers' preferences.

As a further note, the squares were preferred as #3 in Material 1, but #1 in Material 2; this gives rise to a question of why? Is there a change from ground to figure if these are seen with more space between objects in the looser proximity? This changing of priority in Attention of the same shape runs counter to Gibson (1979).

"Seeing" seems subjective, but the subjective is based on objective bias; when visual stimuli are intermingled, they are understood based on a visual hierarchy. The subject's testing is an abstraction to confirm the correlation of "common-fate" and "Attention" to describe this phenomena.

Our findings on Attention seem to indicate that certain features have a higher psychological importance when trying to build on image. In a certain hierarchical sequence, subjects predictively choose certain image features. Presumably, this hierarchy, that seems consistent for test subjects, helps to accelerate image building by recognizing the most important features first. As the algorithm for image recognition proceeds, a certain accumulation of information will suddenly reach a threshold of understanding, and at that moment, the image is recognized. These findings are consistent with the "bottom up-top down" and "pop-out" ideas of Kosslyn and Treisman.

5. Conclusion

This research attempts to explore whether there are specific reactions to visual questions that are common to subjects and may indicate a human pre-set behavior. Early indications from the research are that this happens across a number of test subjects. This may mean that there is an intrinsically hard-wired visual ordering that human subjects use to identify and interact with visual stimuli. This investigation sets: 1) There is an inherent tendency in Visual Attention to create visual patterns. 2) There is the correlation of "common-fate" and "Attention". 3) Melodic or rhythmic patterns for belongingness accelerate viewer's preferences.

References

Baylis, Gordon, Driver, Jon. (1992). Visual Parsing and Response Competition: The effect of Grouping Factors. *Perception & Psychophysics*. 51(2), 145-162.

Bregman, Albert. (1999). *Auditory Scene Analysis: The Perceptual Organization of Sound*: The MIT Press.

Dodd, Michael, Pratt, Jay. (2005). Allocating Visual Attention to Grouped Objects. *European Journal of Cognitive Science*. 17(4), 481-497.

Gibson, J. James. (2015). *The Ecological Approach to Visual Perception*: Houghton Mifflin (1979): Psychology Press: Taylor & Francis, New York & London.

Kootstra, Gert, Bergstrom, Niklas, & Danica Kragic. (2011). Gestalt Principles for Attention and Segmentation in Natural and Artificial Vision Systems. Semantic Perception, Mapping & Exploration (SPEM), ICRA 2011 Workshop.

Kosslyn, M. Stephen (2005). Mental Images and the Brain. *Cognitive Neuropsychology*. 22(3/4), 333-347.

Kosslyn, M. Stephen, Thompson, L. William & Giorgio Ganis (2006). *The Case of Mental Imagery.* Oxford University Press. Chapter 5.

Leeuwen, Cees et al. (2011). Gestalt has no Notion of Attention. But does it need One? *Humana Mente Journal of Philosophical Studies*. 17, 35–68.

Poggenpohl, Sharon. (2018). *Design Theory to Go*: Ligature Press. Estes Park, CO.

Reed, Stephen, Friedman, Morton. (1973). Perceptual vs. Conceptual Categorization. *Memory and Cognition*. 1(2), 157-163.

Treisman, Anne & Stephen Gormican. (1988). Feature Analysis in Early Vision: Evidence from Search Asymmetries. *Psychological Review*. Vol. 95, No. 1, 15-48.

Zhao, Jiaying, Al-Aidroos, Naseem & Nicholas B. Turk-Browne. (2013). Attention is Spontaneously Biased toward Regularities. *Psychol Sci*. 24(5), 667-677.

Wertheimer, Max. (1923). Laws of Organization in Perceptual Forms. *Psycologische Forschung*. 4, 301-350.

Wiese, Wanja. (2017). *Experienced Wholeness: Integrating Insights from Gestalt Theory, Cognitive Neuroscience, and Predictive Processing*: The MIT Press, pg 260.

Authors

Jinsook Kim, PhD, Assistant Professor, has worked as a communication design specialist for over 20 years. For her research, she is interested in visual perception problems for both print and screen based media regarding design practices and theories. She is interested in translating and extending two-dimensional visual literacy into 'time' for new media. Dr. Kim developed an applied theory, Motion Gestalt. Her research interests include gestalts, gestalts motion, attention and interaction, visual dominance, design research methods, and communication design for social and community issues. She received her PhD in Design from the Institute of Design at Illinois Institute of Technology in Chicago. Currently, she is an Assistant Professor of Graphic Design & Multimedia at Georgian Court University in New Jersey.

Michael H. Fritsch, MD, Professor, has been interested in hearing, psychoacoustics, and sensory perception during his career in medicine. He is currently a practicing surgeon physician and researcher located in Indianapolis, Indiana. Dr. Fritsch is interested in hearing and perception of sound in patients with hearing loss and deafness through hearing aids and the "bionic ear" cochlear implants, in addition to visual perception and artistic design.

Subscription Rates

United States	Individual	Institutional
1 year	$35.00	$65.00
2 year	$65.00	$124.00

Canadian*	Individual	Institutional
1 year	$44.00	$ 74.00
2 year	$83.00	$142.00

Foreign**	Individual	Institutional
1 year	$ 56.00	$ 86.00
2 year	$107.00	$166.00

Prepayment is required. Make checks payable to University of Cincinnati *Visible Language* in U.S. currency only, foreign banks need a U.S. correspondent bank.

* Canadian subscriptions include additional postage ($9.00 per year).
**Foreign subscriptions include additional postage ($21.00 per year).

ISSN 0022-2224
Published continuously since 1967.

Back Copies

A limited number of nearly all back numbers is available. The journal website at http://visiblelanguagejournal.com is searchable and lists all issues, past article PDFs, contents, and abstracts.

Copyright Information

UNIVERSITY OF Cincinnati