

A CONCEPTUAL FRAMEWORK TO INVESTIGATE PERCEPTUAL DOMINANCE REGARDING MOTION CLOSURE FOR SCREEN DESIGN

Jinsook Kim, Ph.D.

The International Academy of Design and Technology, Chicago, Illinois, The USA, jinsook@id.iit.edu

ABSTRACT:

This research suggests a guideline for a framework to investigate perceptual dominance on visual motion regarding Motion Closure. Dual concepts for motion behaviors with minimal representations are designed and tested with four subjects as a pilot study for the research. Qualitative analyses are examined for representations of the experiments data. This research motivates the developments of motion interpretation whose affine is justified with human judgment moving into reasonability to read the motion with regard to Motion Closure. The hypotheses are: 1) Position discrimination characterized by changing from discrete elements of the motion objects influences the connotation for Motion Closure 2) Sequence identity characterized by changing from intervening or tuning points of the sequence (identifiable or vague) influences the connotation for Motion Closure, and 3) Quantification characterized by changing from quantification for

evolution (growth or reduction) of the motion objects influences the connotation for Motion Closure. This research expects to guide clearer representations of movement for screen design involving visual motion.

I. INTRODUCTION

Key assumptions of Gestalt in psychology indicate that the experience of seeing is a reasoning process that moves toward meaningfulness for the object rather than a mere summation of elements or quantities. The notion of gestalt is extended to visual motion as Motion Gestalt. Motion Gestalt on screen is elucidated with six grouping principles; Motion Proximity, Motion Similarity, Motion Common-fate, Motion Good-continuation and Motion Closure (Kim, 2007).

Among the principles, Motion Closure is defined by abbreviated passages led by the viewer's interpretation resulting from semantic summarization of the motion event—the conformity of motion behavior in which a unity of arrangement and inter-arrangement of parts form a harmony of behaviors—thus it produces a result that overcomes internal invariance, consequently the motion is specifically interpreted. Accordingly, the question, “What can be the reasonability for interpretation of motion?” is answered: we can forgive individual idiosyncratic or not perfect motions using group-wise definition or holistic understanding such that the comprehension becomes more meaningful (Kim and Poggenpohl, 2005).

This paper discusses what can be the properties to transform the motion for the semantics of motion as Motion Closure that supports a shift toward advanced grouping or interpretation. Ramscar mentioned in *Time, Motion and Meaning - the Experiential Basis of Abstract Thought* (in press), “People's everyday endeavors constantly require them to conceptualize and describe things that they cannot directly perceive or manipulate.” In this regard, what do we naturally select or group when we see motion? And, what does Motion Closure conceptualize?

The questions of perception and cognition of phenomena especially on an object as it is apprehended by the human senses including visual motion are principally discussed in the area of psychology, neuroscience, cognitive science and vision science. For example, Levi and Stanley (2002, p.46) mentioned, “Classification images provide an important new method for learning about which parts of the stimulus are used to make perceptual decisions... the classification images for detection in both foveal and parafoveal vision resemble the discrete frequency patterns (DFP) test stimulus, but are considerably broader in spatial frequency tuning than the ideal observer”. In addition, in the area of brain and cognitive science, McDermott and Edward

(<http://koffka.mit.edu/~kanile/master.html>) mentioned, “Like many aspects of vision, motion perception begins with a massive array of local measurements performed by neurons in area V1. Each receptive field covers a small piece of the visual world, and as a result suffers from an ambiguity known as the aperture problem”.

While those investigations are informative for basic knowledge of motion and motion interpretation for vision and cognitive science, the results of those investigations have necessitated further research in terms of more precise clarification of schemes of motion regarding screen design. In particular, for visual communication design, practitioners concerns ‘answers’ from viewers about ‘what they see (saw)’ rather than ‘what the brain processes for the vision’ for example. This paper presents perceptual dominance in terms of connotations—the set of characteristics that makes up the meaning of terms—as up-to-date study of Motion Gestalt regarding the viewers’ interpretations on visual motion based on experiments to approach viewers’ natural selection. The data from the experiments were analyzed throughout qualitative research methods. The research expects to help to establish visual motion literacy, which is demanding regarding design activities for motion as well as any further investigation for practical understanding of visual motion and application to the design.

2. METHODS

2.1. RESEARCH QUESTION

This research is to describe constructive qualities of visual motion behaviors for perceptual dominance in connotation regarding Motion Closure, for visual motion design, based on participants’ natural responses on motion on screen. The research question is: Is there any fundamental measure to support a shift toward advanced grouping or interpretation to influence of viewers’ connotation regarding Motion Closure?

2.2. EXPERIMENTS

2.2.1. SUBJECTS AND PROTOCOL

The research reported is a pilot study that investigates relating to or affecting the underlying principle or structure of Motion Closure as up-to-date study of Motion Gestalt. Four experimentally naïve people with respect to the goal and design of the experiment were involved. Ethnicity was reported three Americans and one African having normal English skills and vision. Gender distribution was two males and two females. Participants’ academic backgrounds included philosophy, nursing and business. The age was over 20.

The experiment was carried out on a Macintosh iBook G4. Macromedia Flash version 8 was used to create the movie, and Quick Time Player was used to play the movie. The entire experiment lasted about 15 minutes for each participant. Open-ended questions were asked to capture intuitive response to motion. Subjects were asked to watch the movie clips one by one, and every time after each movie was over, they answered for the question “What is going on?” inviting verbal captures on the scene, and “What does it look like?” inviting a story as an analogical description. Each movie lasted 4.1 seconds, and 12 movie clips were given to each participant. The sequence of 12 movies was different for each of the four participants.

MOVIE CONSTRUCTION AND ANALYSIS METHODS

2.2.2. MOVIE CONSTRUCTION

In this study of the framework for perceptual dominance in visual motion regarding viewers' interpretation based on the theory of Motion Gestalt, the motion events are created as minimal as possible to diminish complications of the movement; therefore, competing concepts of each movement can be maximized. It has only spatial localization and direction under critically descriptive conditions, and to test its analyzability (Dimmick, 1920, p.317). An alternate way of extracting conceptual motion for the experiment is to combine the ambiguous information from different localization, transposition of the same object. Each movie embeds dual concepts such as ‘to progress’ and ‘to disappear’ within the minimal representation. In creating the appearance of stimuli, three regular black squares are equally applied for twelve movies in terms of shape, color, size and texture.

Two similarly directed, but seemingly different representations of movie clips based on the basic context described above are paired to be analyzed for interpretation in which the participant's answers are based. Four sets of movie clips are arranged for the experiments, and the results were analyzed for the research. Descriptions on the movie clips include screen captures, graphs, stimuli factors, movement descriptions and objectives of the event. 12 movie clips tested for the experiments, and 8 movies — more comparable in terms of distinction for comparison were selected for analyses. Scenes from screen captures and representation of graphs for the scenes follow. The description of each movie clip discussed in Analyses. See Figure 1.

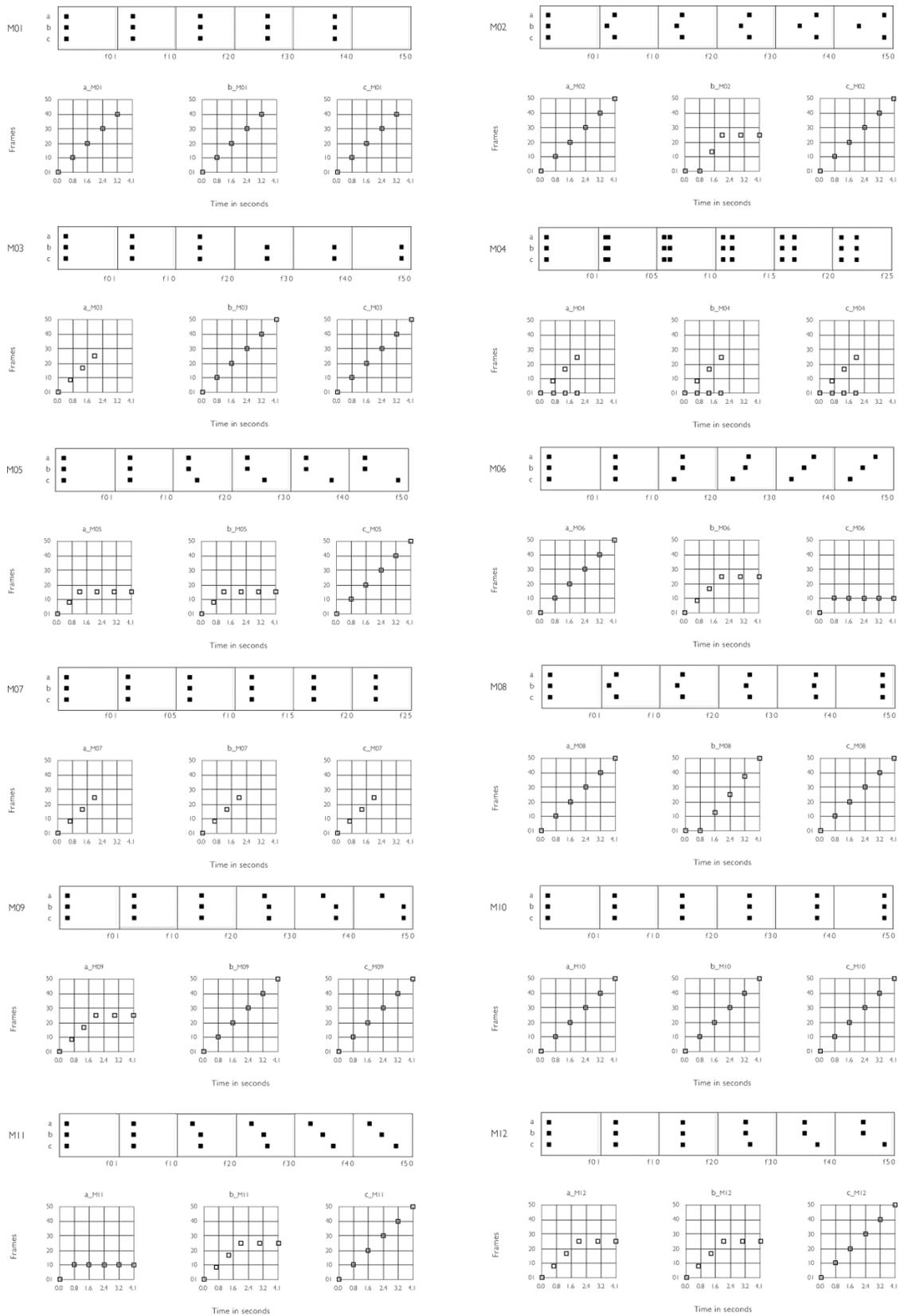


Figure 1: Screen captures from the twelve movie clips and graphs to represent the relationship between Time and Movement

2.2.3. ANALYSIS METHODS

Analyses invited Grounded Theory based on three stages.

Stage 1. Open coding: Participants' responses are categorized by analytic procedures regarding open coding concerned with identifying and categorizing from text transcriptions of participant response. Initiative and Description are labeled as main categories for analyses. Those main categories are divided into two sub-categories. The expressions that appear in each cell are what the participants exactly expressed. For example:

MOVIE 01					MOVIE 02						
		Subject (S)		S1		S2		S3		S4	
Analytic Categories		What Is Going On?/ What Does It Look Like?									
INITIATIVE	Action Accomplished	three squares moves across the screen and disappear	three squares started again from the left side	everybody just left	left to right movement	two dots are moving	the middle square draws back, and catching up again	two of them just disagree with one moving all the way to the right	top and bottom were moving faster than the middle one		
	Action Followed		moved across a line, vertically lined to the right side, when reached right frame, they disappeared			one dot is pushing the other dots	the middle square just stopped, and top and bottom square progress	one stays in the back, almost middle			
DESCRIPTION	Narrative	the end of the book /three people were moving in the same kind of path	the frame is now blank/ empty or blank/ a monitor/ TV screen/ TV turned off	it's blank now/ everybody is gone /strange		psychology experiments	competition/ two eyes and a mouth	three people are trying to agree with sth./ waiting ideas	to show adult how children progress sth.		
	Repetitive Mention		blank	everybody is gone			progressed right side of frame	disagree			

Figure 2: Participants' verbatim answers were categorized by an analytical scheme.

Stage 2. Axial coding: This is consistence of Stage 1. Participants' answers based on the categorization described above are re-categorized by the process of linking properties for which, Speed and Direction as basic characteristics of visual motion defined (Kim and Poggenpohl, 2004) as x axis crosses Connotative, "as of mental content in general, invokes the metaphor of mind as container" (Nolan, 2004), and Descriptive, as a discursive account, as y axis. See the following figure.

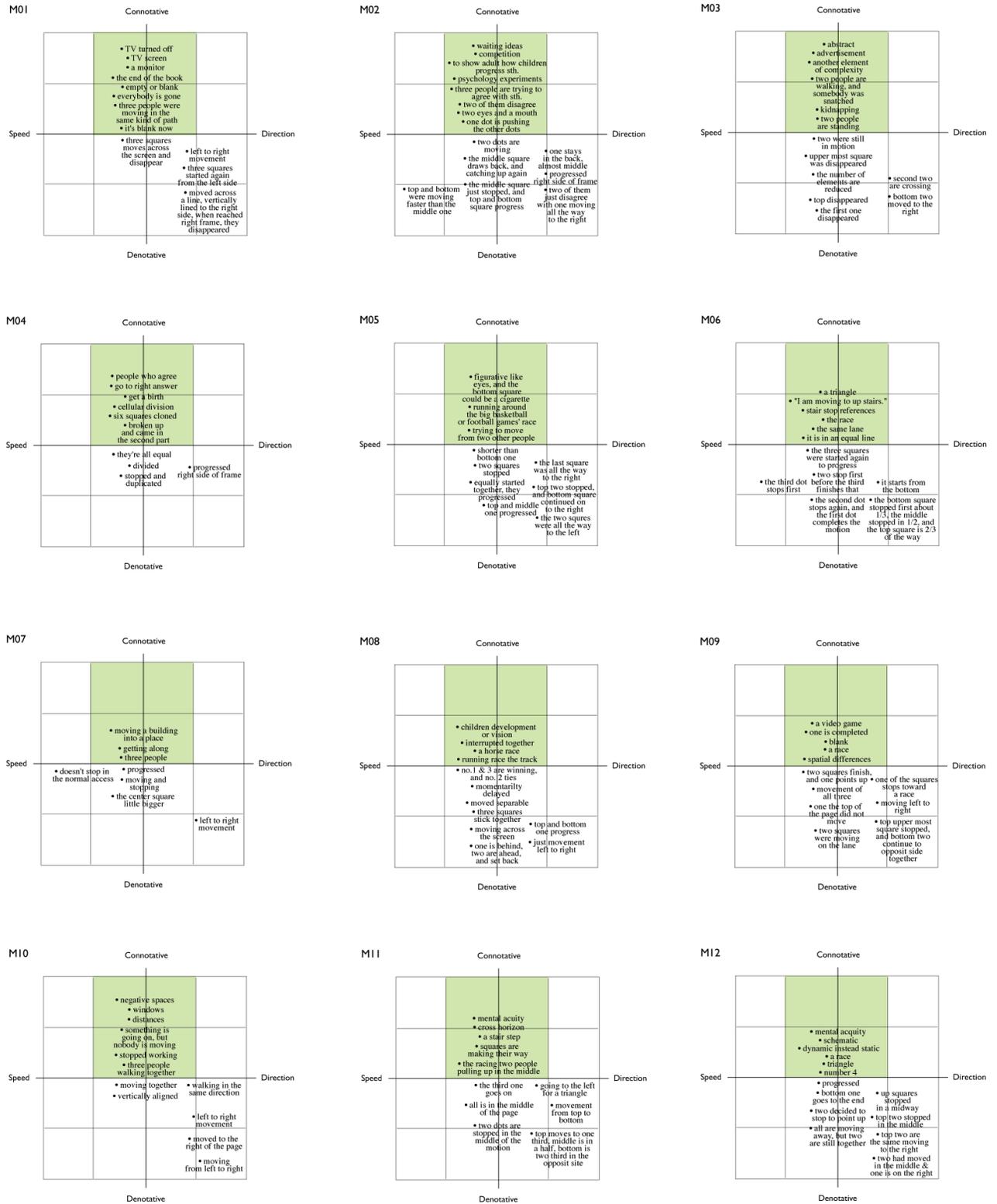


Figure 3: Participants' verbatim answers were re-categorized by another analytical scheme based on two axes.

Stage 3. Selective coding: This is a core category of the research. The reading of data from Stage 2 is re-opened to match with the objects found from the participants' answers in which the relationship of grouping among the objects and the connotation from the participants' response are revealed. See Figure 4 for example.

Analysis Category	Movie 02						Movie 09					
	"Stop and go": A. Middle or top											
Scenes												
Objects mentioned from the connotative coloration		a	b	c				a	b	c		
	• waiting ideas											
	• competition											
	• to show adult how children											
	• psychology experiments											
	• three people are trying to...		●	●	●							
	• two eyes and a mouth		●	●	●							
• two of them disagree		●		●								
• one dot is pushing the other		○	●	○								
Objects mentioned from the dennotative coloration												
	• two dots are moving		●		●			●	●	●		
	• middle square draws back...			●				●	●	●		
	• ... middle... top and bottom...		●	●	●			●	●	●		
Objects mentioned for direction												
	• one stays in the back...			●				●				
	• progressed right side of...							●				
Objects mentioned for speed												
	• top & bottom... faster... mid		●	○	●							
Objects mainly mentioned	all	7 1/2	6 1/2	7 1/2		a	7	3	4			

Figure 4: An example chart re-organizing participants' answer for combination with the objects in movement

3. ANALYSES

This research regards the integrity of characterizing concepts from conceptual categories and engages a means of constructing the subtle qualities and distinction.

3.1. CONCEPTUAL CATEGORY I: Position discrimination

Stimuli and Scene Descriptions

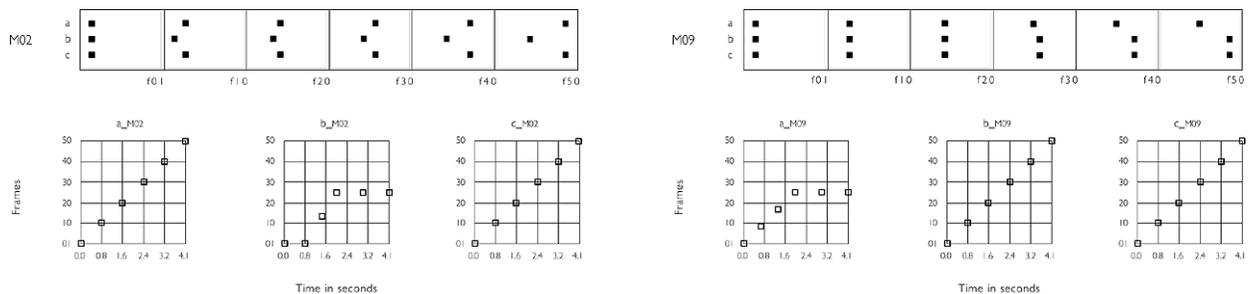


Figure 5: Screen captures by every 0.5 seconds and graphs representing relationship between Time in second (x) and Frames (y) of each square for M02 (Left) and M09 (Right)

Stimuli. All stimulus configurations were series of perfect black squares. The movie lasted 4.1 seconds. A frame per second (fps) was 12.0, and the total number of frames was 50 for both M02 and m09.

Movement. Three vertically aligned squares (a, b and c. See screen captures in Figure 5) are moving from the left side to the right side for both M02 (Left) and M09 (Right). The second object from the top, Square b stopped in the middle of the process in M02 while the first object, Square a stopped in the middle of the process in M09. The two positions where the two objects stopped are the same. Or, the first and third objects are moving to the end of the movie in M02 while the second and the third objects from the top are moving to the end of the movie in M09. All of the objects are the same in speed. See b_M02 and a_M09 in the graphs in Figure 5.

Objectives. The motivation of this conceptual category is to see any influence for further interpretation of a motion event by different localization of any one of the parameters required to define the certain motion.

Results.

- Objects mainly mentioned: Participants' description on M02 includes most of objects a, b and c while M09 mainly includes object a for the description.
- Connotative coloration: The scenes reported by the participants for M02 and M09 were fairly different. For example, M02 is reported as "waiting ideas", "competition" or "one dot is pushing the other." M09 is reported as "blank", "a race" or "spatial differences". There were no data regarding speed in M09, but it was mentioned once for M02. See Figure 6.

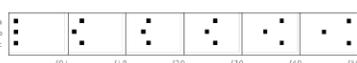
Conceptual Analysis Category	Movie 02	"Stop and go": A. Middle or top			Movie 09			
Scenes								
Objects mentioned from the connotative coloration		a	b	c		a	b	c
	• waiting ideas				• a video game			
	• competition				• blank			
	• to show adult how children				• a race			
	• psychology experiments				• spatial differences			
	• three people are trying to...	•	•	•	• one is completed	•		
	• two eyes and a mouth	•	•	•				
	• two of them disagree	•		•				
	• one dot is pushing the other	○	•	○				
Objects mentioned from the dennotative coloration								
	• two dots are moving	•	•	•	• two squares finish, and one...	•	•	•
	• middle square draws back...		•		• movement of all three	•	•	•
	• ... middle... top and bottom...	•	•	•	• one the top of the page...	•		
					• two squares were moving...	•		•
Objects mentioned for direction								
	• one stays in the back...		•		• one of ... stopped toward...	•		
	• progressed right side of...				• moving left to right			
	• two of them... to the right	•		•	• top... bottom two opposit...	•	•	•
Objects mentioned for speed								
	• top & bottom... faster... mid	•	○	•				
Objects mainly mentioned	all	7 1/2	6 1/2	7 1/2	a	7	3	4

Figure 6: Participants' answers are combined with the motion object.

Conclusion. It is assumed that position discrimination in the movement controls the presence of a motion phase in interpretation. The result is suggestive for motion in design that discriminates meaning by different positioning, but more study is required to establish a definitive answer.

3.2. CONCEPTUAL CATEGORY II: Sequence identity

Stimuli and Scene Descriptions

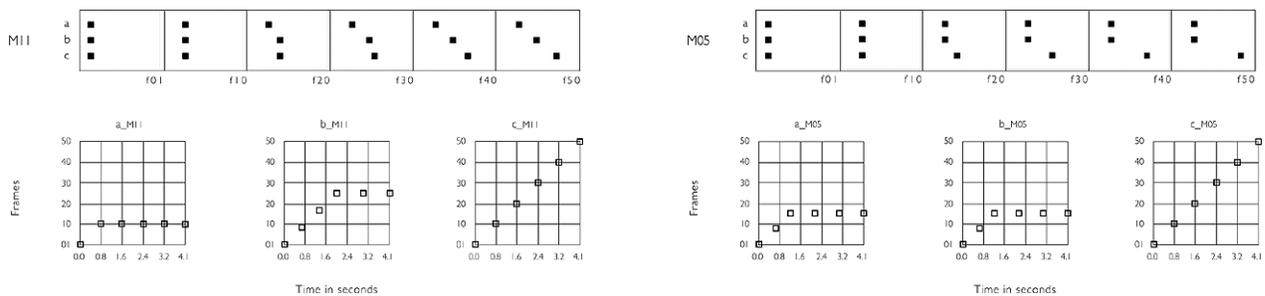


Figure 7: Screen captures by every 0.8 seconds and graphs representing relationship between Time in second (x) and Frames (y) of each square for M11 (Left) and M05 (Right)

Stimuli. All stimulus configurations were series of perfect black squares. The movie lasted 4.1 seconds. A frame per second (fps) was 12.0, and the total number of frames was 50 for both M11 and M05.

Movement. Three vertically aligned squares are moving from the left side to the right side for both M11 (Left) and M05 (Right). The squares in M11 stop one by one in the order of the top, middle and bottom, or a, b and c. The two squares from the top in M05 stop simultaneously at the point of one third of the sequence, which is a similar position where the first object stopped for M11.

Objectives. The motivation of this conceptual category is to see any influence by a sequence identity — identifiable (M11 for example) or vague (M05 for example).

Result.

- Objects mainly mentioned: Participants' description on M11 includes most of the objects, a, b and c while M05 mainly includes object a and b.
- Connotative coloration: The scenes reported by the participants for M11 and M05 were fairly different. For example, M02 is reported as "cross horizon", "a stair step" or "the racing two people." M05 is reported as "eyes and a cigarette", "running around the big basketball" or "trying to move from two other people". There were no data regarding speed for both M11 and M05. See Figure 8.

Conceptual Analysis Category	Movie 11			Movie 05		
	"Stop and go": B. 3 steps or 2 steps					
Scenes						
Objects mentioned from the connotative coloration	• mental acuity				• running around... basketball	
	• cross horizon				• ...eyes, and the bottom...	•
	• a stair step				• ... to move from two other	○
	• squares are making their...					
	• ...two... pulling up in the middle		•	•		
Objects mentioned from the dennotative coloration	• all is in the middle of...				• shorter than bottom one	•
	• the third one goes on			•	• two squares stopped	•
	• two dots are stopped...	•	•		• equally started... progressed	
					• top and middle... progressed	•
Objects mentioned for direction	• going to the left for...					
	• movement from top to...					
	• top... middle... bottom...	•	•	•		
Objects mentioned for speed						
Objects mainly mentioned	all	2	3	3	a, b	4 1/2, 4 1/2, 2 2/1

Figure 8: Participants' answers are combined with the motion object.

Conclusion. It is assumed that the elements for a sequence identity, i.e., the characteristics of intervals (identifiable or vague for example) for interferences or tunings control the presence of a motion phase in interpretation. The result is suggestive for motion in design that constructs grouping different phases by chronological access (or identifiable intervals) for each phase, but more study is required to establish a definitive answer.

3.3. CONCEPTUAL CATEGORY III: The length of linear motion and attention

Stimuli and Scene Descriptions

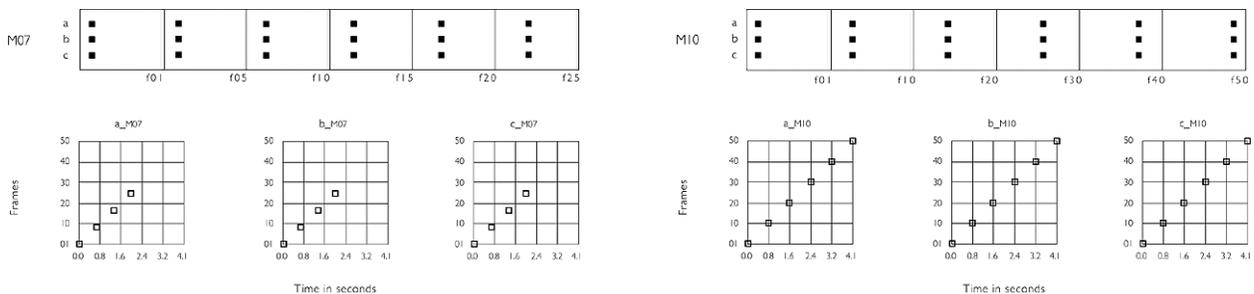


Figure 9: Screen captures by every 0.8 seconds and graphs representing relationship between Time in second (x) and Frames (y) of each square for M07 (Left) and M10 (Right)

Stimuli. All stimulus configurations were series of perfect black squares. The movie lasted 4.1 seconds. A frame per second (fps) was 12.0, and the total number of frames was 50 for M07. The movie lasted 2.0 seconds, and a frame per second (fps) was 12.0, and the total number of frame was 25 for M10.

Movement. Three vertically aligned squares are moving from the left side to the right side for both M07 (Left) and M10 (Right). Squares in M07 stopped at the point of near a half of the frame while the squares in M10 were lengthier for the movement. See the graphs in Figure 9.

Objectives. The motivation of this conceptual category is to see any influence by a shorter length and a longer length of a linear motion in terms of attention.

Result.

- Objects mainly mentioned: Participants' description is not specified with any particular object or group to mention the movement for both M07 and M10.
- Connotative coloration: Participants' interpretation of the two movies is twofold. For example, M07 is reported as “three people”, “getting along” or “progressed”. M10 is reported as “three people working together” or “moving together”, these represent joint ideas between M07 and N10. On the other hand, participants' interpretation for M10 includes complexity for the movement such as “negative spaces” or “distances”. Speed was mentioned for M07 only. See Figure 10.

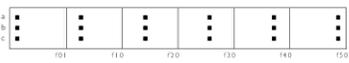
Conceptual Analysis Category	Movie 07	"Stop and go": C. Short or long			Movie 10			
		a	b	c		a	b	c
Scenes								
Objects mentioned from the connotative coloration	• moving a building into...				• negative spaces			
	• getting along				• windows			
	• three people	•	•	•	• distances			
					• something is going on, but...			
					• stopped working			
Objects mentioned from the denotative coloration	• progressed				• moving together			
	• moving and stopping				• vertically aligned			
	• ...center square little bigger		•					
Objects mentioned for direction	• left to right movement				• walking... the same direction			
					• left to right movement			
					• moved to the right of the pg			
Objects mentioned for speed	• doesn't stop... normal access							
Objects mainly mentioned	n/a	1	2	1	n/a	1	1	1

Figure 10: Participants' answers are combined with the motion object.

Conclusion. It is assumed that the matter of length in a linear motion does not essentially control the presence of a motion phase in interpretation. The finding is suggestive for motion in design that compensates spatial limitation for linear paths in motion, but more study is required to establish a definitive answer.

3.4. CONCEPTUAL CATEGORY IV: Quantification by deposition or disappearance

Stimuli and Scene Descriptions

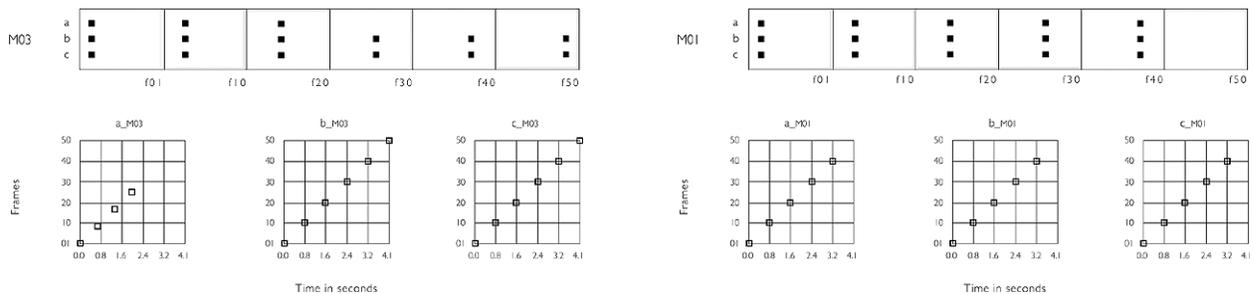


Figure 11: Screen captures by every 0.8 seconds and graphs representing relationship between Time in second (x) and Frames (y) of each square for M03 (Left) and M01 (Right)

Stimuli. All stimulus configurations were series of perfect black squares. The movie lasted 4.1 seconds. A frame per second (fps) was 12.0, and the total number of frames was 50 for both M03 and M01.

Movement. Three vertically aligned squares are moving from the left side to the right side for both M03 (Left) and M01 (Right). All of squares in M01 disappeared at the same time at the end of the movement (See a_M01, b_M01 and c_M01 in Figure 11) while only one square, Square a in M03 disappeared in the middle of the process. See a_M03 in Figure 11.

Objectives. The motivation of this conceptual category is to see any influence by quantification based on deposition or disappearance.

Result.

- Objects mainly mentioned: Participants' description includes all three squares for both M03 and M01.
- Connotative coloration: The scenes reported by the participants for M03 and M01 were fairly different. For example, M03 is reported as “another element of complexity”, “somebody was snatched” or “two people are standing”, and M01 is reported as “TV screen”, “the end of the book” or “empty.” Speed was not mentioned for both M03 and M01. See Figure 12.

Analysis Category	Conceptual Category		Movie 03			Movie 01			
	"Stop and go": D. Some or all								
Scenes									
Objects mentioned from the connotative coloration	• abstract		a	b	c	• TV turned off			
	• advertisement					• TV screen			
	• ...element of complexity					• a monitor			
	• kidnapping					• the end of the book			
	• two... walking ...somebody... snatched	•	•	•		• empty or blank			
	• two people are standing		•	•		• everybody is gone			
Objects mentioned from the dennotative coloration	• two were still in motion		•	•		• three... moves... and disappear	•	•	•
	• upper most... disappeared	•							
	• ...elements are reduced								
	• top disappeared	•							
Objects mentioned for direction	• the first one disappeared	•							
	• second two are crossing		•	•		• left to right movement			
	• bottom two ...to the right		•	•		• three squares from the left...	•	•	•
Objects mentioned for speed					• ...vertically lined to the right...				
Objects mainly mentioned	all	4	5	5	all	3	3	3	

Figure 12: Participants' answers are combined with the motion object.

Conclusion. It is assumed that any way of quantification, i.e., deposition or disappearance controls the presence of a motion phase in interpretation. The finding is suggestive for motion in design that comprises diverse attention by quantification, but more study is required to establish a definitive answer.

4. DISCUSSIONS

Closure in motion for design is defined as a process aiming for connotation by more referential evidence from the representations. It allows rebuilding a system of movement in the form of semantic summarization (Kim, 2007). "Something" gets "captured" by "something" in visual motion — reformulation through stronger attribute. This pilot study proposes an experimental guideline for the attributes of Motion Closure based on the participants' natural selection as interpretation on motion stimuli. The attributes, as it were, behavioral, constructive characteristics of movement in motion events "by viewers" for dominance aiming connotation are investigated as a research framework in which to study transformational properties to unfold relationship between denotative properties of visual motion and connotative aspects on the motion — how close or separable, regarding motion design.

Nolan (1994, p.225) discussed, "a perceptual category cannot be "manufactured" (as it were) by humans merely as the output of sensation, we have been amply assured by the history of failures of sense datum theories; it is the categoriality of the category dog that escapes such theories. A perceptual category (such as animal) may then be subject to transformation during the course of development to yield a conceptual

category (such as mammal), perhaps together with a replacement prototype as its correlative perceptual category. Prototypes can thus be understood as perceptual categories, even in the absence of semantic, conceptual understanding of the related concept." Four conceptual categories considering "integrity" of the perception world are examined, and the research finds out the idea of the experimental basis of abstract concepts as a system framework for the attributes regarding Motion Closure. In summary, the attributes of interpretation of visual motion regarding Motion Closure include:

1. **Position discrimination characterized by changing from discrete components of the motion objects.**
2. **Sequence identity characterized by changing from intervening or tuning points of the sequence (identifiable or vague).**
3. **Quantification characterized by changing from quantification for evolution (growth or reduction) of the motion objects.**

Perceiving moving objects is so involved and hugely complex in terms of its dependency on the context. However, the human behaviors on visual stimuli including motion are actively involved with categorization by interpretation or dominance. The contribution of this research is twofold:

1. Approaching three conceptual definitions regarding dominance for motion interpretation, corresponding to the notion of "analogical extensions from richer, more experience-based domains" as one of answers on organizing knowledge for motion perception (Ramscar, Lera and Teenie, in press).
2. Methodological suggestion representing conceptual categories on motion events for reasons of interpretation, corresponding to the notion of "some conceptual categories have noteworthy relations to perceptual categories" (Nolan, 1994, p. 230).

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