

THE ANALYSIS OF DESIGNERS' ON-LINE RETRIEVING AND REFERRING BEHAVIOR

Pei-Jung Cheng¹ and Li-Hao Chen²

¹Department of Media Design, Tatung University, Taipei, Taiwan, admufy@gmail.com;

²Department of Applied Arts, Fu Jen Catholic University, New Taipei City, Taiwan, aha055@gmail.com

ABSTRACT:

The purpose of the study is to explore the characters while designers are experiencing a brainstorming session and thinking of the keywords for retrieving relevant information on-line. Based on the purpose, the study conducted the observations and retrospective interviews with 24 design students to understand their on-line retrieving and referring behavior during the early design. Besides, we further analyzed the relationship between the designers' retrieving behavior and other behaviors for understanding designers' design procedure. The results of the study are: 1) the study found seven external behavioral codes for planning a useful creativity support system in the future; 2) the alternating of the RI behavior and CNS behavior makes their progress towards the outcome; 3) the three behaviors, RI, CNS and LRI, have showed the stronger relationship than the links among other behaviors.

Keywords: Ideation, Design behavior, Retrieving behavior

1. INTRODUCTION

The behavioral change caused by the development of Internet has not only happened on our daily life but also on designers' ideation process. Lang et al. (2001) argue that designers spent a great deal of time on searching for relevant information or knowledge to solving their design problems. Cheng (2010) has found from the interviews of her research that the design practitioners are getting used to 'inputting search keywords in a search engine on-line' for referring to some relevant information or images while they were generating the ideas. 'Words' become a powerful tool for designers, as well as for us, to communicate with the search engine and their brain. That is, the tool helps designers talking to themselves for their reflective process in the ideation and talking to a search engine to get references or stimulus for their ideation. As Jonson (2005) has proposed that verbalization was the major conceptual tool for getting start in designers' ideation process, Segers (2004) argues that words are constantly instilled with different meanings and changing interpretations during ideation process. The behavior of thinking about the search keywords and inputting the keywords in a search engine for inspiring design thinking that designers have become

accustomed in the digital age definitely supports the Segers (2004) and Jonson's (2005) argument.

Besides, Segers et al. (2005) think that words and their related associations helped in both diverging and converging ideas in the ideation process. It may indicate that 'words' play a useful role to lead designers going through their ideation. Therefore, the main questions in the study are: first, how the keyword based on-line referring behavior presents in designers' ideation process? Second, how the designers' on-line referring behavior connect with other behaviors in the ideation?

Based on the above questions, the study started with observing designers' on-line retrieving and referring behavior to figure out its influence on designers' ideation process. Moreover, we further analyzed the relationship between the designers' retrieving behavior and other behaviors for understanding designers' design habit and procedure.

2. METHOD

Based on the purpose of the study, the observations were conducted during the period of May to November in 2012. The observations focused on the designers' behaviors, the referred information and the completed idea sketches. The details are explained and described as section 2.1 and 2.2.

2. 1. OBSERVATIONS

For the observations, we recruited 24 design students, 14 males and 10 females, as the subjects for the experiment. The participants were third year and fourth year undergraduate students from the Media Design Department or Industrial Design Department, Tatung University in Taiwan. Each participant was asked to carry out a laboratory experiment under observation and recording in the Design Creativity and Cognition Lab. A personal computer with wireless was set up and several A4 sheets of paper were put on an office table in the laboratory for the participants to take an assigned task. In this stage, the study set up two cameras with two arranged angles that took from the right back side and the left front of the participant while they were taking the experiment. Besides, the study recorded the participants' on-line retrieving and referring procedure by screen record software, Camtasia Studio 7.0.1. The illustration of our videoing method is showed as Figure 1.

The observational experiment was explained as follows: 1) the graphic design task was given to the participants on a written instruction sheet accompanied by a brief oral explanation (to design a logo for a coffee shop, named 'At coffee'), 2) there was no time constrain for participants to perform the task by hand on the A4 size white paper or draw the computerized sketches by a graphic design software. Besides, participants were free to use the personal computer to search for any reference they need while taking the assigned task, 3) researchers in the study started to record each participant's ideation process after he/she completely prepared to take the task. Then, the observing and recording process should be

stopped whenever the participants thought that have given a great idea sketch for the graphic design task and have completed their work, 4) Finally, the participants were asked to take part in a retrospective interview after they completed their task for confirming the observed result.

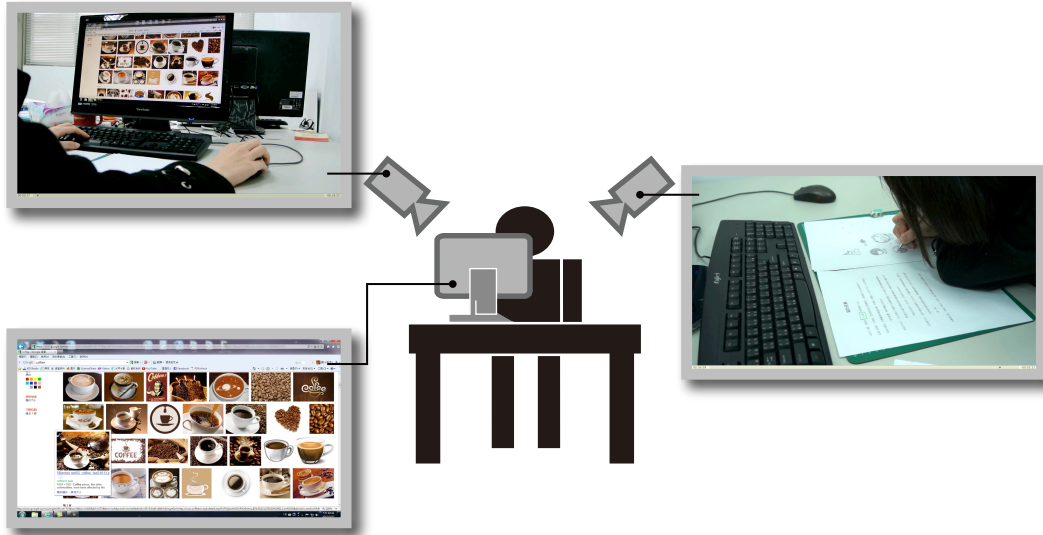


Figure 1: Videoing method during the observations in the study.

2. 2. DATA ANALYSIS

In the analytic process, the study adopted the technology of data triangulation and investigator triangulation, which means using multiple data sources and recruiting more than two researchers in data analyzing stage (Hussein, 2009). So that, after the observational stage, the study invited three researchers as the coders in the data analytic process for confirmation purpose. The three researchers are graduate students in design area at Tatung University in Taiwan. They conducted the data analysis with the researcher of the study during the period of December 2012 to January 2013. Besides, for data triangulation, the study also used multiple data source, including the video data from two camera shot angles and a screen recorder, for validation purpose.

The sequence of the analytic process is: 1) the researcher recorded participants' every behavioral segment and its time slot according to the judgment of different behaviors and each change point in the video. Moreover, researcher captured a picture from each segment of the video to represent a behavior and listed the pictures on A4 size white paper for being the reference of coding procedure, 2) three coders individually looked at the captured pictures of the 24 participants and wrote simple behavior description below each picture, 3) the researcher named different behaviors and checked the internal consistency of the three coders on the description of each behavior, 4) the researcher transcribed the record of all participants' retrospective interview word by word to confirm the observational result.



Figure 3. Three coders' coding and analyzing process.

3. RESULTS AND DISCUSSIONS

3. 1. DESCRIPTION OF DESIGN BEHAVIORS AND THE BEHAVIORAL CODES IN DESIGNERS' IDEATION

By reviewing and analyzing the video data, the average time of all participants spent on taking the assigned graphic design task is 26'27". Among all participants, participant E took the least amount of time (09'06") on the task but participant F took the most amount of time (55'06") on it. There are 373 behavioral segments cut as the experimental data to be coded in the analysis process.

The study found seven kinds of external behaviors during the student designer' ideation process according to the three researchers' (coders) analysis. The seven kinds of external behaviors are: 1) writing down ideas, 2) retrieving information, 3) looking at relevant information, 4) looking at own sketches, 5) referring to the saved data, 6) creating new sketches and 7) continuing to sketch. The definition and the behavioral code of the seven behaviors are shown in Table 1 and explained as follows:

The seven external behaviors are recorded and identified by researchers through observing designers' task taking process. That is, the seven kinds of design behavior are definitely different from each other. First of all, the major difference between WI and RI is the designers generating the ideas on paper and a search engine on-line. The behavior of WI means that designers write down their ideas as written keywords on the paper for recording the design concept but RI means that designers input their ideas as search keywords in a search engine on-line for retrieving the inspirational images or information. Secondly, the behavior of LRI means that designers are looking at relevant information, which includes computerized data, printed data and the written ideas made themselves. However, the behavior of LOS shows that designers are looking at their own idea sketches either on the paper or on the computer screen (if a designer drawn idea sketches by graphic design software).

Thirdly, the behavior of RSD shows that the designers refer to the computerized files they have saved while they were retrieving information on-line, such as some pictures related to task topic. The designers mostly present the RSD behavior for inspiring themselves. Finally, the behaviors of CNS and CS both related to the designers' visualizing process. The major concern on distinguishing the two behaviors is to recognize whether the drawing sketch is existed or not in advance. That is, the behavior of CNS means the designers are making a new idea sketch but CS means they are continuing working on an existed one.

Behavior (code)	Definition
Writing down ideas (WI)	Writing down keywords as the ideas they generated to be used later; listing, adding or adjusting different alternatives; looking at the written ideas.
Retrieving information (RI)	Retrieving information on-line for capturing ideas, sketching or drawing; saving the retrieved information in the hard disc to be the reference later.
Looking at relevant information (LRI)	Looking at the information they have retrieved on-line in advance, in which the retrieving action is not included.
Looking at own sketches (LOS)	Looking at the sketches they have drawn in advance.
Referring to the saved data (RSD)	Referring to some saved data that have been retrieved on-line by them in advance.
Creating new sketches (CNS)	Creating the new shapes, labels or arrows.
Continuing to sketch (CS)	Continuing to work on a sketch they have drawn

Table 1: The definition and the behavioral code of each behavior.

3. 2. THE BEHAVIORAL FLOW OF EVERY DESIGNER DURING THE TASK

Figure 4 shows the behavioral order of each designer's ideation while he/she was taking the assigned task. The direction of arrow indicates the order of each designer's behaviors, and the words within the black arrows represent the behavioral codes (refer to Table 1).

Among the seven behaviors, we found that there are 19 out of the 24 participants exhibited the behavior of retrieving information on-line (RI) in the beginning of their ideation except participant B, G, H, T and V, who were creating new sketches (CNS) or writing down keywords as the ideas (WI) as the first behavior of their ideation. Moreover, based on the presenting time of all participants' each behavior (refer to Table 2), the participants spent most of their ideation time on creating new sketches (CNS), which occupied 42.2% of the total time. Then the behavior they spent much time on is retrieving information on-line (RI), which occupied 29.4%. After that, the behavior of continuing to work on a sketch (CS) is took them much time, which occupied 15% of the total time.

By checking the frequency of each behavior that all participants presented during the ideation (see Table 2), we found that the most frequently exhibited behavior is creating new sketches (CNS), and then is looking at relevant information (LRI), after that is the behavior of retrieving information on-line.

A	RI	CNS	LRI	CS	CNS	CS	CNS	CS	RI	CNS	LRI	CNS	CS
	00'00"-01'58"	01'59"-05'32"	05'33"-05'38"	05'39"-10'38"	10'39"-12'10"	12'11"-15'21"	15'22"-16'06"	16'07"-19'22"	19'23"-19'37"	19'38"-25'00"	25'01"-25'20"	25'21"-26'47"	26'48"-28'26"
B	CNS	CS	CNS	CS	RI	CS							
	00'00"-02'03"	02'04"-03'45"	03'46"-06'58"	06'59"-10'02"	10'03"-12'58"	12'59"-19'18"							
C	RI	CNS	LRI	CNS	LRI	RI	CNS	RI	CNS	CS			
	00'00"-07'15"	07'16"-11'03"	11'04"-13'00"	13'02"-13'16"	13'17"-14'28"	14'29"-15'13"	15'14"-22'10"	22'11"-24'12"	24'13"-27'26"	27'27"-37'38"			
D	RI	WI	CNS	LRI	RI	CNS	LRI	RI	CNS	LRI	CNS	CS	
	00'00"-00'41"	00'42"-02'32"	02'33"-06'40"	06'41"-06'46"	06'47"-07'23"	07'24"-09'19"	09'20"-09'58"	09'59"-10'42"	10'43"-11'25"	11'26"-11'31"	11'32"-15'55"	15'56"-18'58"	
E	RI	CNS	LRI	RI	CNS	CS							
	00'00"-02'52"	02'53"-03'42"	03'43"-04'06"	04'07"-04'57"	04'58"-06'26"	06'27"-09'06"							
	RI	LRI	RI	LRI	RI	CNS	LRI	RI	CNS	CS	LRI	CNS	LRI
	00'00"-01'02"	01'03"-02'06"	02'07"-02'29"	02'30"-03'34"	03'35"-04'38"	04'39"-08'56"	08'57"-09'26"	09'27"-09'51"	09'58"-16'22"	16'23"-27'30"	27'33"-29'34"	29'36"-37'37"	37'39"-37'50"
F	RSD	CS	LRI	CS									
	37'51"-37'56"	38'02"-44'32"	44'33"-44'46"	44'47"-55'06"									
	CNS	RI	CNS	LRI	RI	CNS	LRI	CS	LRI	CNS	LRI	CNS	LRI
	00'00"-01'59"	02'00"-02'56"	02'57"-03'48"	03'50"-04'46"	04'47"-05'28"	05'29"-07'09"	07'11"-07'27"	07'28"-07'48"	07'50"-07'57"	07'58"-08'56"	08'57"-09'25"	09'26"-10'38"	10'40"-12'25"
G	RI	CS	LRI	CNS	LRI	CNS	LRI	CNS	LRI	CS	LRI	RI	CS
	12'26"-13'53"	13'55"-14'44"	14'45"-15'07"	15'08"-15'49"	15'52"-16'12"	16'14"-16'49"	16'52"-18'52"	18'55"-19'19"	19'22"-20'03"	20'04"-20'16"	20'18"-20'58"	21'00"-22'05"	22'06"-22'28"
	WI	RI	WI	LRI	RI	LRI	RI	CNS	RI	CNS	LRI	CNS	RI
	00'00"-01'57"	02'00"-02'29"	02'30"-02'44"	02'47"-03'06"	03'07"-07'59"	08'00"-08'35"	08'36"-10'44"	10'46"-12'30"	12'32"-13'20"	13'22"-15'51"	15'53"-16'01"	16'02"-18'19"	18'20"-18'30"
H	CS	LRI	CNS	LRI	CNS	RI	CNS	LRI	RI	CS			
	18'31"-19'50"	19'51"-20'35"	20'37"-21'51"	21'52"-22'30"	22'32"-26'07"	26'08"-28'06"	28'07"-28'15"	28'17"-29'52"	29'58"-31'32"	31'34"-33'20"			
I	RI	CNS	LRI	CNS	LRI	CS	LRI	CS					
	00'00"-06'02"	06'08"-12'02"	12'04"-13'04"	13'05"-13'27"	13'28"-14'34"	14'35"-15'18"	15'19"-17'24"	17'26"-23'17"					
J	RI	CNS	RI	CNS	LRI	CNS							
	00'00"-01'02"	01'04"-07'26"	07'27"-11'30"	11'32"-18'40"	18'42"-20'30"	20'31"-22'35"							
	RI	CNS	LRI	CNS	LRI	CNS	LRI	CNS	LRI	CNS	LRI	CNS	LRI
	00'00"-04'21"	04'23"-05'27"	05'29"-05'37"	05'38"-06'06"	06'08"-06'15"	06'16"-06'54"	06'57"-07'11"	07'13"-09'10"	09'12"-10'06"	10'07"-11'00"	11'02"-11'09"	11'11"-11'48"	11'50"-12'00"
K	CNS	LRI	CNS	LRI	CS								
	12'12"-12'48"	12'50"-13'05"	13'07"-21'14"	21'15"-21'30"	21'33"-29'45"								
	RI	CNS	LRI	LOS	LRI	RI	CNS	LRI	CNS	LRI	CS	LRI	CNS
	00'00"-02'40"	02'44"-05'36"	05'38"-06'13"	06'14"-06'19"	06'20"-06'34"	06'35"-07'21"	07'23"-09'00"	09'02"-09'20"	09'21"-11'48"	11'50"-12'08"	12'10"-13'07"	13'08"-13'45"	13'47"-14'27"
L	LRI	CNS	LRI	CNS	LRI	CNS	LRI	CNS	LRI	CNS	LRI	CS	
	14'28"-14'57"	14'59"-15'53"	15'56"-16'15"	16'16"-17'56"	17'57"-18'08"	18'10"-18'44"	18'45"-18'57"	18'58"-19'48"	19'50"-20'20"	20'22"-20'27"	20'29"-20'33"	20'35"-20'50"	
M	RI	CNS	LRI	CNS	LRI	CNS	LRI	CS					
	00'00"-01'38"	01'40"-11'15"	11'16"-16'53"	16'55"-20'42"	20'43"-24'03"	24'05"-24'42"	24'44"-25'52"	25'53"-26'53"					
	RI	CNS	LRI	CNS	LRI	CS	LRI	CNS	LRI	CNS	LRI	CS	LRI
	00'00"-01'24"	01'26"-05'58"	06'00"-06'09"	06'10"-08'01"	08'03"-08'22"	08'24"-08'38"	08'39"-09'32"	09'34"-11'55"	11'57"-12'08"	12'10"-12'44"	12'45"-12'48"	12'50"-14'11"	14'12"-14'17"
N	CS	RI	CS	LRI	CNS								
	14'18"-20'50"	20'52"-21'31"	21'33"-21'45"	21'46"-21'56"	21'57"-24'59"								
O	RI	CNS	LRI	RI	CNS	LRI	CNS	LRI	CNS	RI	CNS	RI	CS
	00'00"-05'01"	05'05"-07'24"	07'25"-07'30"	07'31"-09'24"	09'26"-12'39"	12'40"-14'03"	14'05"-16'51"	16'53"-18'06"	18'10"-24'40"	24'42"-26'51"	26'53"-28'24"	28'30"-32'48"	32'50"-33'55"
P	RI	CNS	LRI	CNS	RI	CS	LRI	WI	CS	RI	CS		
	00'00"-00'16"	00'17"-01'24"	01'25"-02'56"	02'57"-03'38"	03'39"-03'54"	03'56"-04'27"	04'28"-04'35"	04'36"-11'40"	11'42"-12'20"	12'21"-23'33"	23'35"-31'59"		
Q	RI	CNS	LRI	RI	CNS	RI	CNS	LRI	CS	LRI	CS		
	00'00"-00'10"	00'12"-01'46"	01'48"-04'25"	04'26"-05'22"	05'23"-06'28"	06'29"-13'00"	13'02"-13'50"	13'51"-14'22"	14'24"-14'39"	14'40"-18'22"	18'23"-18'50"		
R	RI	CNS	LRI	RI	CNS	LRI	RI	LRI	CS	LRI	CS		
	00'00"-02'33"	02'35"-02'56"	02'58"-04'35"	04'36"-08'25"	08'26"-19'41"	19'43"-24'15"	24'16"-25'18"	25'19"-28'45"	28'46"-28'55"	28'56"-37'17"	37'18"-37'23"		
S	RI	CNS	WI	CNS	LRI	CNS	LRI	RI	CNS	CS	LOS		
	00'00"-08'06"	08'07"-09'19"	09'20"-09'58"	09'59"-10'02"	10'03"-14'28"	14'29"-15'18"	15'20"-15'38"	15'40"-16'18"	16'19"-16'58"	16'59"-19'58"	20'00"-20'16"		



Figure 4: The behavioral flow of each designer during the first observational experiment.

	RI	WI	RSD	LRI	LOS	CS	CNS	Total
sec.	14882	913	229	5555	90	7559	21318	50546
%	29.4	1.8	0.5	10.9	0.2	15.0	42.2	
frq.	63	13	4	108	5	51	110	354
%	17.8	3.7	1.1	30.5	1.4	14.4	31.1	

Table 2: The time amount and frequency of each behavior that the participants exhibited.

The result shows that RI behavior (retrieving information on-line) is significant and necessary to the student designers despite the analysis of the exhibited order, time spent and frequency of each behavior during the ideation. Besides, the alternating of the RI behavior and CNS behavior makes those student designers' progress towards their outcome.

3. 3. THE LINKS BETWEEN THE DESIGNERS' RETRIEVING BEHAVIOR (RI) AND OTHER BEHAVIORS

Table 3 shows the links among all behaviors, as well as shows the linked order between two behaviors. For instance, the '4' showed in the second row of the table means that RI behavior exhibited before WI behavior 4 times totally; the '5' showed in the first row and second column means that WI behavior exhibited before RI behavior 5 times totally. According to the analysis, RI behavior frequently been presented before CNS behavior (47 times), but mostly exhibited after LRI behavior (26 times). However, RI behavior never been

presented after LOS behavior and RSD behavior. Besides, LRI behavior and CNS behavior showed the stronger connection than the links between other behaviors.

The result shows that those design students like to retrieve some information on-line (RI), and then to create new sketches (CNS). Moreover, they also tend to look at relevant information (LRI), and then to create new sketches (CNS); or create new sketches (CNS) before looking at relevant information (LRI). Therefore, the three behaviors, RI, CNS and LRI, have showed the stronger relationship than other behaviors.

	WI	RI	LRI	LOS	RSD	CNS	CS
WI		5	4			14	1
RI	4		5	1	1	47	10
LRI	3	26		1	2	55	24
LOS			2				2
RSD			1				3
CNS	13	15	78	2			12
CS		4	18	1	1	4	

Table 3: The links between the designers' retrieving behavior (RI) and other behaviors.

4. CONCLUSIONS

The study conducted two experiments and the retrospective interviews individually with 24 design students to explore designers' retrieving and referring behavior in the ideation while they are doing a brainstorming procedure. Based on the results, we found seven important behavioral codes and behavioral chains can be analyzed deeply for planning a useful creativity support system. The study also found that RI behavior (retrieving information on-line) is significant and necessary to the student designers' ideation. Besides, the alternating of the RI behavior and CNS behavior makes their progress towards the outcome. Finally, the three behaviors, RI, CNS and LRI, have showed the stronger relationship than the links among other behaviors.

5. ACKNOWLEDGMENT

The authors would like to gratefully thank the financial support of this study by the Ministry of Science and Technology in Taiwan, under the grant MOST 103-2410-H-036-008, and the Tatung University of Taiwan, under the grant B100-V06-066.

REFERENCES:

- Ahmed (2005) Encouraging reuse of design knowledge: a method to index knowledge, *Design Studies*, 26(6), 565-592.
- Cardella, Atman and Adams (2006) Mapping between design activities and external representations for engineering student designers, *Design Studies*, 27(1), 5-24.
- Cheng (2010) A study on Designers' Searching-retrieving Behavior in the Ideation Process, Unpublished doctoral dissertation, National Yunlin University of Science & Technology, Yunlin, Taiwan.

Cheng, Hu, and Chen (2012) The Considerations in Using a Mind Mapping APP, 3rd International Conference on Engineering Industry, Seoul, Korea, pp.1260-1263, Dec. 3-5.

Hussein (2009) The use of Triangulation in Social Sciences Research: Can qualitative and quantitative methods be combined? *Journal of Comparative Social Work*, 1, 1-12.

Jin and Chusilp (2006) Study of mental iteration in different design situations, *Design Studies*, 27(1), 25-55.

Jonson (2005) Design ideation: the conceptual sketch in the digital age, *Design Studies*, 26(6), 613-624.

Lang, Dickinson, and Buchal (2001) An overview of cognitive factors in distributed design, the Sixth International Conference on Computer Supported Cooperative Work in Design, London, Ont., Canada, July 12-14.

Segers (2004) Computational representations of words and associations in architectural design-development of a system supporting creative design, Technische Universiteit Eindhoven, the Netherlands.

Segers, de Vries, and Achten (2005) Do word graphs stimulate design? *Design Studies*, 26(6), 625-647.