Evaluating Effects of Background Stories on Graph Perception

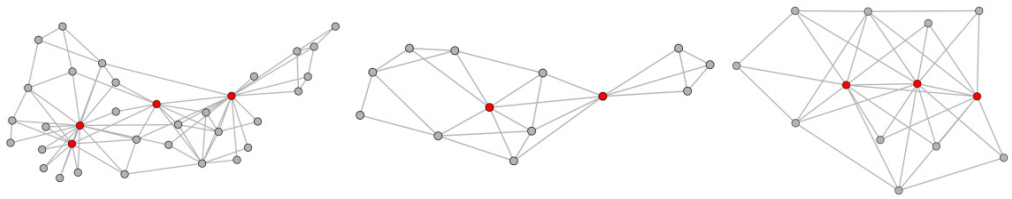
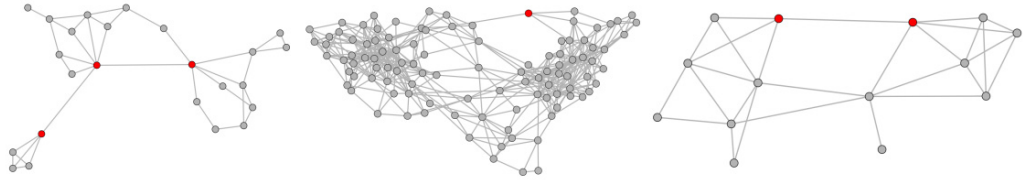
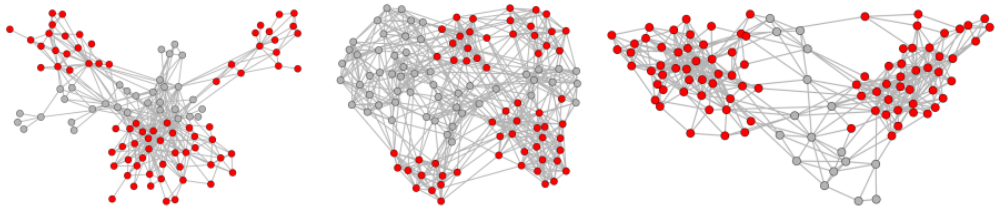
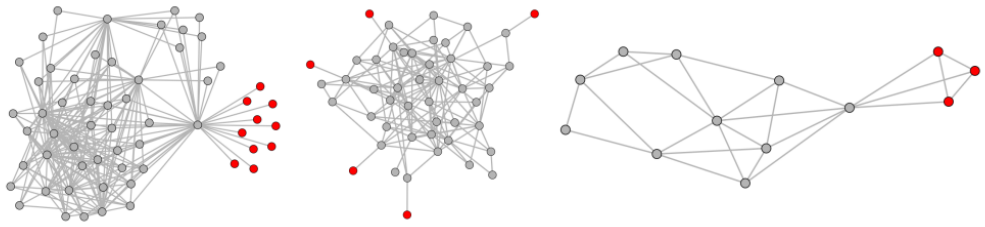
Supplementary Material: Supporting Information for the Experiments

1 Supporting Information for Ex1

1.1 Cases of the Four Types of Graph Structures in Ex1

In Ex1, we categorized the areas of interest (AOIs) selected by the FBSers and UBSers into four types of graph structures. Table 1 shows some cases of the four types of graph structures. In each case, several representatives of the corresponding structure type are highlighted with colors.

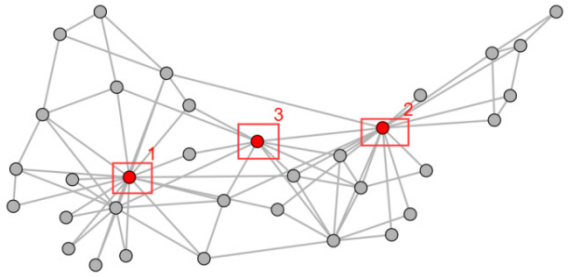
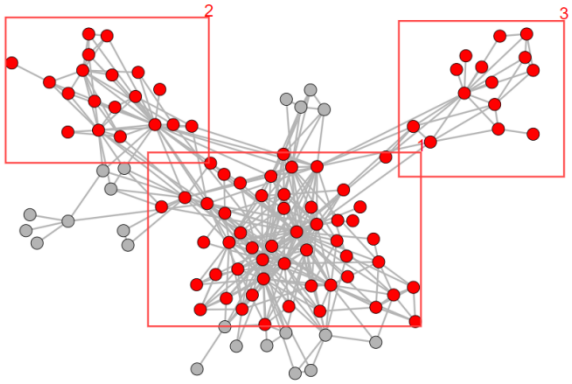
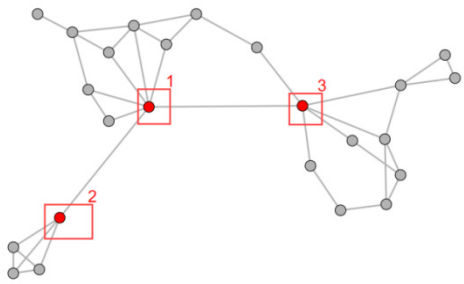
Table 1. Cases of the four types of graph structures selected by the participants.

Structure Types	Cases
High degree structures	
Bridge structures	
Community structures	
Other structures	

1.2 Cases of the AOI Selections and Feedback of the Participants in Ex1

In Ex1, we asked the participants to select any AOIs in each graph. In the interviews of Ex1, all participants were allowed to review their selection results and were encouraged to state their thoughts. In order to facilitate readers to understand the results of Ex1, we provide some cases and feedback from the FBSers (Table 2) and UBSers (Table 3).

Table 2. Cases of the AOI selections and feedback from the FBSers in Ex1.

Illustrations	Interviews
GD3: Friendship network of members of the Zachary's Karate Club (selected by FBSer-3) 	*Q: Why do you select these structures?* A: 1 and 2 are high degree nodes which represent the club instructor and the club president. 3 represents the person who connects the two groups. *Q: Comment on your selection order.* A: According to the background story, I select the important persons at first (Based on visual perception, 1 is more obvious than 2), and I guess there should be a person who acts as a communicator; therefore, I select 3. *Q: What information in the background story affects your choice, and Why?* A: The club instructor has a conflict with the president. I try to match the conflict with the structure of the graph, which makes me focus on these two high degree structures.
GD4: Relationship network of characters in Game of Thrones (selected by FBSer-29) 	*Q: Why do you select these structures?* A: Several houses are introduced in the background story. 1, 2 and 3 are obviously the houses. *Q: Comment on your selection order.* A: The background story mentions several houses. I select 1 at first, which is near the center of the graph. I think it corresponds to the honorable Stark family. Then, I select 2 and 3 respectively, because they are far away from the center of the graph. *Q: What information in the background story guides your choice?* A: Some adjectives including "honorable", "pompous", "slighted", and "exiled" give me guidance. According to these adjectives, I construct a community structure diagram in my mind, which is similar to the structure shown in the graph.
GD7: Social network of employees in a wood-processing facility (selected by FBSer-4) 	*Q: Why do you select these structures?* A: The background story mentions that the employees are divided into three groups by language and age, and three key figures are also mentioned. There are clear bridge structures between the communities in the graph, so I select 1, 2 and 3. *Q: Comment on your selection order.* A: My selection order is based on the logic of the background story. 1 is the key person who connects the Spanish-speaking and English-speaking group. Therefore 1, 2, and 3 represent Bob, Alejandro, and Norm, respectively.

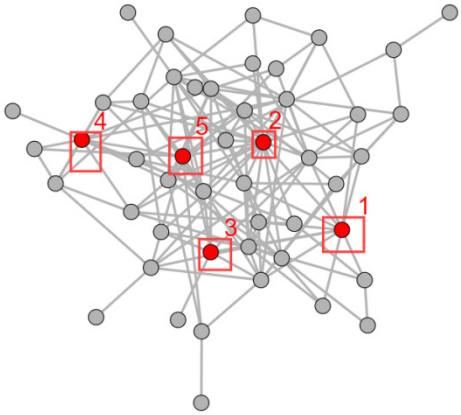
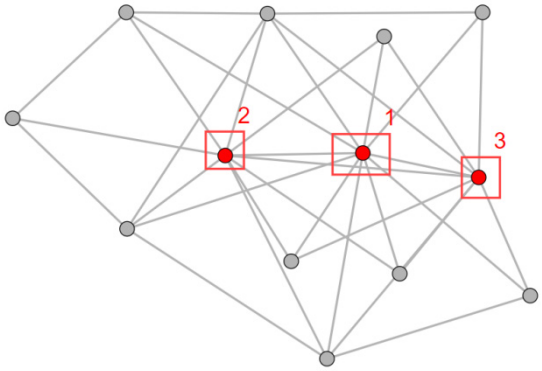
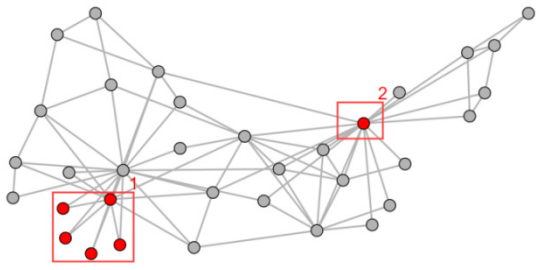
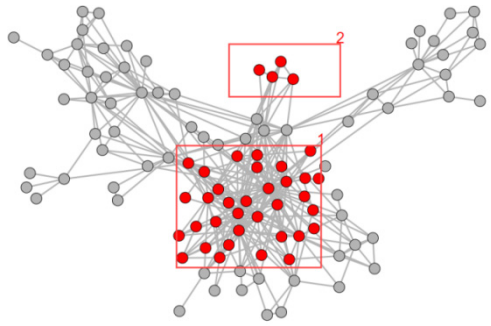
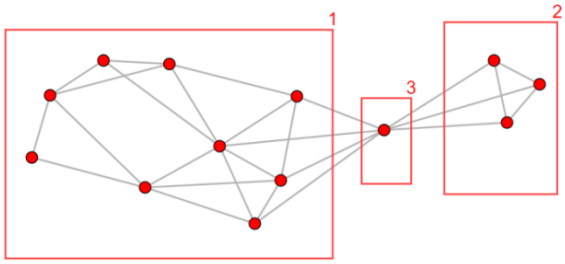
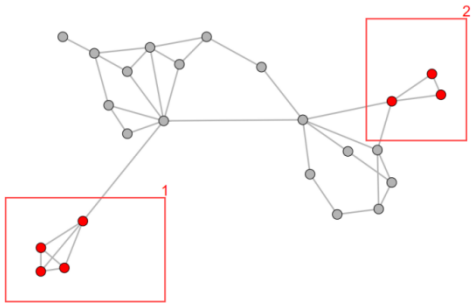
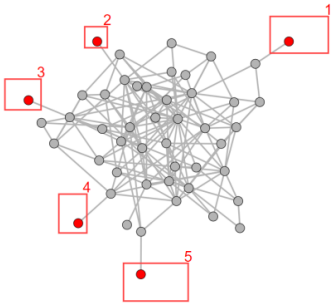
Illustrations	Interviews
GD10: Friendship network in a German boys' school class (selected by FBSer-24) 	*Q: Why do you select these structures?* A: The background story hints that high degree nodes (popular students) exist in the graph, so I select these high degree nodes. *Q: What do you think these nodes represent according to the background story?* A: 2 and 5 are in the center of the graph which may represent the pupils with good performance. 1 and 3 are far from the center and have a high density nearby, indicating that they may be the students who dominate extracurricular games. 4 may represent the student who "buys into" friendship with candy. *Q: Why do you select in this order?* A: Just by intuition.
GD12: Friendship network of the SA's baseball team (selected by FBSer-5) 	*Q: Why do you select these structures according to the background story?* A: The story mentions that Justin is the team leader. Harry is the best pitcher and Justin's best friend. Whit is a good friend of both Justin and Harry. Justin, Harry and Whit constitute the heart and soul of SA team. The information hints that the node representing Justin could have the highest degree, and Justin, Harry, Whit have relations, the nodes of which may be located in the center of the graph. That's why I select 1, 2 and 3. *Q: Well, why do you select in this order?* A: Based on the relationships and the degree of the nodes in the graph, 1 may represent Justin due to its high degree, and 2 and 3 represent Whit and Harry respectively.

Table 3. Cases of AOI selections and the feedback from the UBSers in Ex1.

Illustrations	Interviews
GD3: Friendship network of members of the Zachary's Karate Club (selected by UBSer-7) 	*Q: Why do you select these structures?* A: I feel that the structure of 1 and its location are special, so I select 1 first. Then I select 2 because of high degree.

Illustrations	Interviews
GD4: Relationship network of characters in Game of Thrones (selected by UBSer-7) 	*Q: Why do you select these structures?* A: 1 is located in the center of the graph. 2 is a margin structure away from the center of the graph. *Q: Comment on your selection order.* A: I select 1, which apparently represents a community in the center of the graph. Then I select 2; it is a margin structure and relatively distinct.
GD5: Friendship network of the TI's baseball team (selected by UBSer-6) 	*Q: Why do you select these structures?* A: The graph is very easy to identify, and the edges and the nodes are very distinct. Each node is worth exploring in such a small-sized graph. *Q: Comment on your selection order.* A: The areas in the graph are clearly divided. 1 has many nodes. 2 is a margin structure. 3 is the node connecting 1 and 2.
GD7: Social network of employees in a wood-processing facility (selected by UBSer-23) 	*Q: Why do you select these structures?* A: 1 and 2 are at the edge of the graph and look like umbrellas. These structures are very beautiful and distinct. *Q: Why do you select in this order?* A: 1 looks like an umbrella. Then I select 2 because it is very similar to 1 in shape.
GD10: Friendship network in a German boys' school class (selected by UBSer-6) 	*Q: Why do you select these structures?* A: I think the nodes at the margins of the graph are very interesting. *Q: Why don't you select the nodes in the center of the graph?* A: The center area of the graph is very dense and does not seem to have a special structure. *Q: In what order do you select these structures?* A: Nothing special, I just pick them randomly.

1.3 Detailed Results of OS Indicator

We proposed an order similarity (OS) indicator to measure the differences between the orders of selecting different types of graph structures performed by the FBSers and UBSers in the same graph. The calculation of OS indicator was based on the matrices $\boldsymbol{OM}_{FBSers,k}$ and $\boldsymbol{OM}_{UBSers,k}$. In the paper, the results of OS indicator are provided, but the results of these two matrices are not given. Table 4 provides the detailed results of these two matrices. We take GD10 as an example to illustrate how to read the table. The story of GD10 implied the existence of high degree nodes (popular classmates) in a school class friendship network. We found high degree structures received 25 and 7 entries of 1st from the FBSers and UBSers, respectively, whereas other structures received 5 and 17 entries of 1st from the FBSers and UBSers. The results of GD10 reflect that the FBSers tended to select high degree structures, whereas the UBSers preferred to select other structures, indicating the background story of this graph affected the order of selecting different types of structures.

Table 4. Detailed results of $\boldsymbol{OM}_{FBSers}$ and $\boldsymbol{OM}_{UBSers}$ in Ex1 by graph.

Graph ID	User Types	Order	Number of Entries by Order			
			HD	BS	CS	OT
GD3	FBSers	1st	31	0	3	1
		2nd	28	0	3	0
		3rd	9	0	2	0
		other	0	0	1	2
	UBSers	1st	16	0	11	8
		2nd	13	0	3	4
		3rd	3	0	0	5
		other	0	0	0	2
GD4	FBSers	1st	9	0	23	3
		2nd	10	0	17	0
		3rd	7	0	14	1
		other	7	0	8	4
	UBSers	1st	8	0	26	1
		2nd	3	0	13	2
		3rd	2	0	4	1
		other	4	0	0	2
GD5	FBSers	1st	30	0	3	2
		2nd	16	0	0	7
		3rd	7	0	0	10
		other	1	0	0	0
	UBSers	1st	18	0	6	11
		2nd	5	0	0	8
		3rd	1	0	0	3
		other	1	0	0	2
GD6	FBSers	1st	5	0	28	2
		2nd	6	0	17	3
		3rd	5	0	16	1
		other	11	0	17	5
	UBSers	1st	4	0	25	6
		2nd	4	0	10	4
		3rd	2	0	6	3
		other	6	0	10	0
GD7	FBSers	1st	0	26	8	1
		2nd	0	19	9	1

Graph ID	User Types	Order	Number of Entries by Order			
			HD	BS	CS	OT
		3rd	0	13	7	1
		other	0	0	0	3
	UBSers	1st	0	14	20	1
		2nd	0	7	4	6
		3rd	0	2	0	3
		other	0	0	1	5
GD8	FBSers	1st	29	0	3	3
		2nd	23	0	2	3
		3rd	17	0	1	3
		other	29	0	4	11
	UBSers	1st	18	0	5	12
		2nd	11	0	3	3
		3rd	5	0	1	1
		other	1	0	0	3
GD9	FBSers	1st	6	1	26	2
		2nd	6	0	24	0
		3rd	5	0	9	3
		other	0	0	0	1
	UBSers	1st	2	3	22	8
		2nd	2	0	13	5
		3rd	1	1	0	3
		other	0	1	0	0
GD10	FBSers	1st	25	0	5	5
		2nd	19	0	0	5
		3rd	15	0	0	4
		other	26	0	0	10
	UBSers	1st	7	0	11	17
		2nd	4	0	1	10
		3rd	3	0	0	4
		other	3	0	0	6
GD11	FBSers	1st	18	1	11	5
		2nd	11	2	7	9
		3rd	6	1	4	7
		other	1	0	0	2
	UBSers	1st	10	4	10	11
		2nd	6	2	4	6
		3rd	0	0	0	2
		other	0	0	0	3
GD12	FBSers	1st	34	0	1	0
		2nd	22	0	0	0
		3rd	13	0	0	3
		other	1	0	0	3
	UBSers	1st	24	0	7	4
		2nd	13	0	0	2
		3rd	1	0	0	4
		other	0	0	0	3

1.4 Detailed Results of SS Indicator

We proposed a structure similarity of AOIs (SS) indicator to measure the differences between the specific graph structures selected by the FBSers and UBSers in the same graph. The calculation of SS indicator was based on the vectors $\boldsymbol{SV}_{FBSers,k}$ and $\boldsymbol{SV}_{UBSers,k}$. In the paper, the results of SS indicator are provided, but the results of these two vectors are not given. Table 5 provides the detailed results of these two vectors. We take GD3 as an example to illustrate how to read the table. The background story of GD3 had two protagonists: the president and leading instructor of the Zachary's karate club, which indicated that there were at least 2 high degree nodes in the graph. The results of $\boldsymbol{SV}_{FBSers,3}$ and $\boldsymbol{SV}_{UBSers,3}$ showed that high degree structures received 80 and 35 entries from the FBSers and UBSers, respectively, whereas other structures received 3 and 19 entries from the FBSers and UBSers. The results of GD3 reflected that the FBSers noticed that there were at least 2 high degree nodes in the graph based on the background story, whereas most of the UBSers selected only one high degree node and were attracted by other structures, indicating that the background story of this graph affected the selection numbers of different structure types of the participants.

Table 5. Detailed results of $\boldsymbol{SV}_{FBSers}$ and $\boldsymbol{SV}_{UBSers}$ in Ex1 by graph.

Graph ID	User Types	Number of Entries by Structure			
		High Degree	Bridge	Community	Others
GD3	FBSers	80	0	9	3
	UBSers	35	0	14	19
GD4	FBSers	48	0	62	8
	UBSers	23	0	43	6
GD5	FBSers	57	0	3	19
	UBSers	26	0	6	24
GD6	FBSers	52	0	78	11
	UBSers	21	0	51	13
GD7	FBSers	0	66	24	6
	UBSers	0	26	25	15
GD8	FBSers	101	0	10	20
	UBSers	35	0	9	19
GD9	FBSers	26	1	59	6
	UBSers	7	5	35	16
GD10	FBSers	95	0	5	24
	UBSers	26	0	12	37
GD11	FBSers	37	6	22	23
	UBSers	16	7	14	22
GD12	FBSers	92	0	1	6
	UBSers	43	0	7	13

2 Supporting Information for Ex2

Ex2 aimed to examine whether the background stories can affect the performance of identifying graph structures, including high degree, bridge, and community structures. We designed 15 objective questions. Each question inquired a specific case about one of the three types of graph structures. In the paper, we provide the experimental results by graph structure type. In this supplementary material, we provide the detailed results by question. As shown in Table 6, the results by question show that significant differences mainly exist in the questions (Q5, Q8 and Q12). All the three questions are related to community structure identifications.

Table 6. Detailed results of Ex2 by question in terms of means of accuracy, difficulty, and confidence. Colors indicate significant differences between the FBSers and UBSers in accuracy. The winners are shown in dark blue, and the losers are shown in light blue.

Questions	Structure Types	Accuracy		Difficulty		Confidence	
		FBSers	UBSers	FBSers	UBSers	FBSers	UBSers
Q4	High degree node	0.96	0.97	2.54	2.14	3.74	3.83
Q7		0.94	0.99	2.14	1.60	4.00	4.34
Q11		0.83	0.69	2.40	2.77	3.83	3.31
Q13		0.31	0.37	3.51	3.23	3.20	2.83
Q15		0.97	0.92	1.83	1.89	4.23	4.29
Q10	Bridge	0.94	0.94	2.03	1.89	4.20	4.26
Q14		0.27	0.33	2.54	2.51	3.71	3.49
Q5	Community	0.66	0.37	2.29	3.00	3.94	3.20
Q6		0.09	0.11	3.37	3.23	3.09	3.17
Q8		0.54	0.09	3.20	3.71	3.29	2.83
Q9		0.86	0.77	2.29	2.03	3.94	4.11
Q12		0.74	0.29	2.31	2.83	3.80	3.34

In Ex2, we asked the participants to rate two subjective indicators, namely difficulty and confidence, for each objective question by a five-point Likert scale ranging from 1 (lowest level) to 5 (highest level). There were five, five, and two objective questions related to high degree, community, and bridge identifications, respectively. Therefore, 175, 175, and 70 ratings were obtained for high degree, community, and bridge identifications, respectively, from the 70 participants (35 FBSers and 35 UBSers). In this supplementary material, we provide the detailed subjective ratings of the FBSers and UBSers by structure type in terms of confidence (Figure 1) and difficulty (Figure 2). The results show that the distributions of the subjective ratings of the FBSers in high degree and bridge identifications are highly similar to those of the UBSers in terms of confidence (Figure 1) and difficulty (Figure 2). For community identification, the overall confidence of the FBSers is higher than that of the UBSers (Figure 1), and the overall difficulty of the FBSers is lower than that of the UBSers (Figure 2). These results are consistent with the results analyzed in the paper.

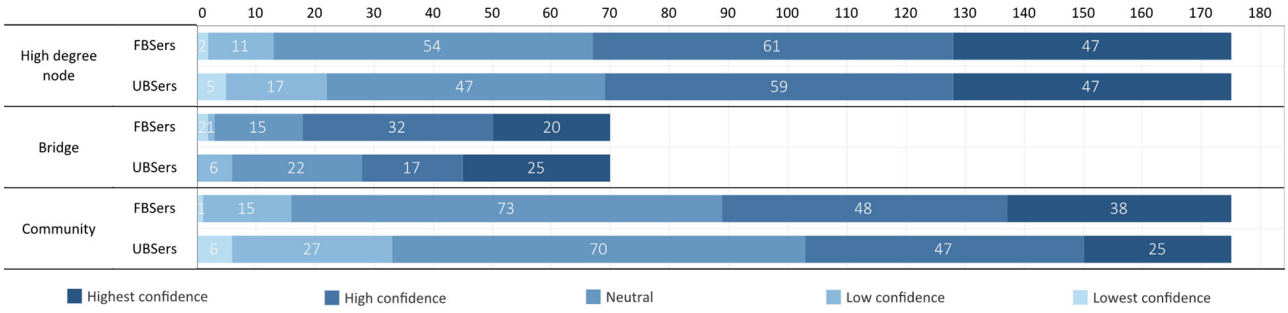


Figure 1. Stacked bar chart of subjective ratings with respect to confidence in Ex2.

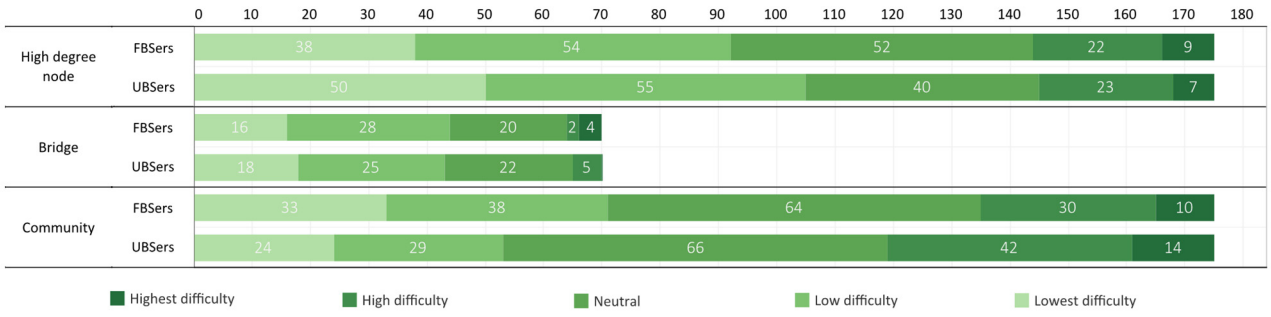


Figure 2. Stacked bar chart of subjective ratings with respect to difficulty in Ex2.

3 Supporting Information for Ex3

In Ex3, we asked the participants to rate two subjective indicators, namely difficulty and confidence, for each of 40 graph recognition trials by a five-point Likert scale ranging from 1 (lowest level) to 5 (highest level). 1400 and 1400 ratings for each indicator were obtained from the FBSers and UBSers, respectively. In this supplementary material, we provide the detailed subjective ratings of the FBSers and UBSers in Figure 3 (confidence) and Figure 4 (difficulty). The results in Figure 3 reflect that the confidence ratings of the FBSers are generally higher than by the UBSers, and the results in Figure 4 indicate that the difficulty ratings of the FBSers are generally lower than by the UBSers, which are consistent with the results analyzed in the paper.

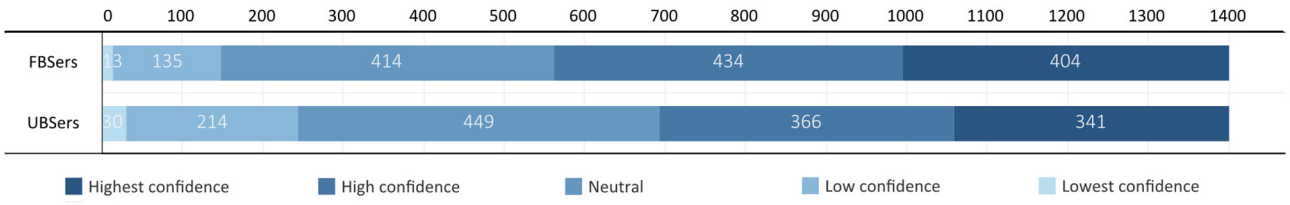


Figure 3. Stacked bar chart of subjective ratings with respect to confidence in Ex3.

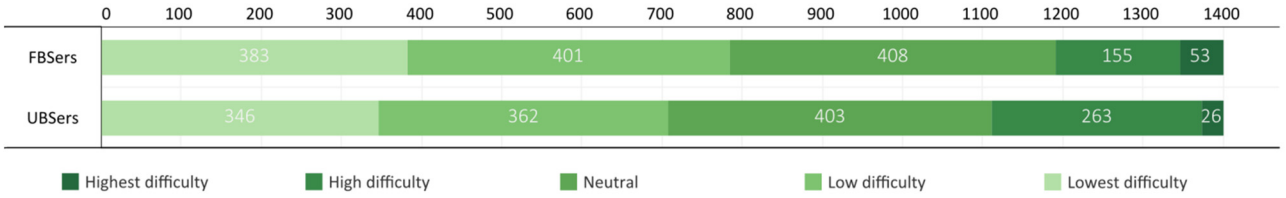


Figure 4. Stacked bar chart of subjective ratings with respect to difficulty in Ex3.

4 Supporting Information for the Influence analysis of Participants' Backgrounds

We were interested in whether the participants' professional backgrounds influence graph perception. We divided the participants into two groups named computer-science group (40 participants) and non-computer-science group (30 participants) based on their professional backgrounds. The results of the three experiments after re-grouping based on the participants' professional backgrounds are detailed as follows.

4.1 Supporting Information for Ex1

4.1.1 Detailed Results of OS Indicator

The calculation of OS indicator was based on the matrices $OM_{FBSers,k}$ and $OM_{UBSers,k}$ within a group by graph. Table 7 and Table 8 provide the detailed results of these two matrices of the computer-science group and non-computer-science group, respectively. We take the first row of Table 7 to illustrate how to read the two tables. For GD3, the FBSers in the computer-science group selected 18

high degree nodes, 0 bridge, 1 community, and 1 other structure in the 1st order.

Table 7. Detailed results of OM_{FBSers} and OM_{UBSers} of the computer-science group by graph.

Graph ID	User Types	Order	Number of Entries by Order			
			HD	BS	CS	OT
GD3	FBSers	1st	18	0	1	1
		2nd	17	0	2	0
		3rd	6	0	1	0
		other	0	0	0	0
	UBSers	1st	12	0	4	4
		2nd	9	0	2	2
		3rd	2	0	0	3
		other	0	0	0	2
GD4	FBSers	1st	7	0	12	1
		2nd	7	0	9	0
		3rd	5	0	8	0
		other	4	0	5	1
	UBSers	1st	6	0	14	0
		2nd	2	0	8	1
		3rd	2	0	3	1
		other	4	0	0	2
GD5	FBSers	1st	18	0	0	2
		2nd	12	0	0	3
		3rd	4	0	0	7
		other	1	0	0	0
	UBSers	1st	13	0	3	4
		2nd	2	0	0	5
		3rd	1	0	0	1
		other	1	0	0	2
GD6	FBSers	1st	4	0	15	1
		2nd	5	0	12	1
		3rd	4	0	12	1
		other	9	0	16	1
	UBSers	1st	3	0	16	1
		2nd	4	0	8	0
		3rd	2	0	4	1
		other	6	0	10	0
GD7	FBSers	1st	0	16	4	0
		2nd	0	12	5	1
		3rd	0	10	4	0
		other	0	0	0	1
	UBSers	1st	0	11	9	0
		2nd	0	4	4	2
		3rd	0	2	0	1
		other	0	0	0	4
GD8	FBSers	1st	17	0	1	2
		2nd	15	0	1	1
		3rd	13	0	0	1
		other	18	0	4	6

Graph ID	User Types	Order	Number of Entries by Order			
			HD	BS	CS	OT
	UBSers	1st	13	0	2	5
		2nd	6	0	3	2
		3rd	4	0	1	0
		other	1	0	0	3
GD9	FBSers	1st	4	1	14	1
		2nd	5	0	13	0
		3rd	3	0	5	3
		other	0	0	0	0
	UBSers	1st	1	2	14	3
		2nd	1	0	10	2
		3rd	1	0	0	1
		other	0	1	0	0
GD10	FBSers	1st	16	0	0	4
		2nd	12	0	0	4
		3rd	9	0	0	3
		other	19	0	0	8
	UBSers	1st	6	0	4	10
		2nd	3	0	1	7
		3rd	3	0	0	3
		other	3	0	0	4
GD11	FBSers	1st	12	1	6	1
		2nd	6	1	4	7
		3rd	5	1	2	4
		other	0	0	0	1
	UBSers	1st	8	2	6	4
		2nd	3	2	2	4
		3rd	0	0	0	1
		other	0	0	0	3
GD12	FBSers	1st	20	0	0	0
		2nd	14	0	0	0
		3rd	8	0	0	3
		other	1	0	0	2
	UBSers	1st	15	0	2	3
		2nd	9	0	0	2
		3rd	1	0	0	3
		other	0	0	0	3

Table 8. Detailed Results of OM_{FBSers} and OM_{UBSers} of the non-computer-science group by graph.

Graph ID	User Types	Order	Number of Entries by Order			
			HD	BS	CS	OT
GD3	FBSers	1st	13	0	2	0
		2nd	11	0	1	0
		3rd	3	0	1	0
		other	0	0	1	2
	UBSers	1st	4	0	7	4
		2nd	4	0	1	2

Graph ID	User Types	Order	Number of Entries by Order			
			HD	BS	CS	OT
		3rd	1	0	0	2
		other	0	0	0	0
GD4	FBSers	1st	2	0	11	2
		2nd	3	0	8	0
		3rd	2	0	6	1
		other	3	0	3	3
	UBSers	1st	2	0	12	1
		2nd	1	0	5	1
		3rd	0	0	1	0
		other	0	0	0	0
GD5	FBSers	1st	12	0	3	0
		2nd	4	0	0	4
		3rd	3	0	0	3
		other	0	0	0	0
	UBSers	1st	5	0	3	7
		2nd	3	0	0	3
		3rd	0	0	0	2
		other	0	0	0	0
GD6	FBSers	1st	1	0	13	1
		2nd	1	0	5	2
		3rd	1	0	4	0
		other	2	0	1	4
	UBSers	1st	1	0	9	5
		2nd	0	0	2	4
		3rd	0	0	2	2
		other	0	0	0	0
GD7	FBSers	1st	0	10	4	1
		2nd	0	7	4	0
		3rd	0	3	3	1
		other	0	0	0	2
	UBSers	1st	0	3	11	1
		2nd	0	3	0	4
		3rd	0	0	0	2
		other	0	0	1	1
GD8	FBSers	1st	12	0	2	1
		2nd	8	0	1	2
		3rd	4	0	1	2
		other	11	0	0	5
	UBSers	1st	5	0	3	7
		2nd	5	0	0	1
		3rd	1	0	0	1
		other	0	0	0	0
GD9	FBSers	1st	2	0	12	1
		2nd	1	0	11	0
		3rd	2	0	4	0
		other	0	0	0	1

Graph ID	User Types	Order	Number of Entries by Order			
			HD	BS	CS	OT
	UBSers	1st	1	1	8	5
		2nd	1	0	3	3
		3rd	0	1	0	2
		other	0	0	0	0
GD10	FBSers	1st	9	0	5	1
		2nd	7	0	0	1
		3rd	6	0	0	1
		other	7	0	0	2
	UBSers	1st	1	0	7	7
		2nd	1	0	0	3
		3rd	0	0	0	1
		other	0	0	0	2
GD11	FBSers	1st	6	0	5	4
		2nd	5	1	3	2
		3rd	1	0	2	3
		other	1	0	0	1
	UBSers	1st	2	2	4	7
		2nd	3	0	2	2
		3rd	0	0	0	1
		other	0	0	0	0
GD12	FBSers	1st	14	0	1	0
		2nd	8	0	0	0
		3rd	5	0	0	0
		other	0	0	0	1
	UBSers	1st	9	0	5	1
		2nd	4	0	0	0
		3rd	0	0	0	1
		other	0	0	0	0

4.1.2 Detailed Results of SS Indicator

The calculation of SS indicator was based on the vectors $\boldsymbol{SV}_{FBSers,k}$ and $\boldsymbol{SV}_{UBSers,k}$ within a group by graph. Table 9 and Table 10 provide the detailed results of these two vectors of the computer-science group and the non-computer-science group, respectively. We take the first row of Table 9 to illustrate how to read the two tables. For GD3, the FBSers in the computer-science group selected 47 high degree nodes, 0 bridge, 4 communities, and 1 other structure.

Table 9. Detailed results of $\boldsymbol{SV}_{FBSers}$ and $\boldsymbol{SV}_{UBSers}$ of the computer-science group by graph.

Graph ID	User Types	Number of Entries by Structure			
		High Degree	Bridge	Community	Others
GD3	FBSers	47	0	4	1
	UBSers	25	0	6	11
GD4	FBSers	35	0	34	2
	UBSers	20	0	25	4
GD5	FBSers	35	0	0	12
	UBSers	17	0	3	12
GD6	FBSers	41	0	55	4

Graph ID	User Types	Number of Entries by Structure			
		High Degree	Bridge	Community	Others
	UBSers	20	0	38	2
GD7	FBSers	0	42	13	2
	UBSers	0	18	13	7
GD8	FBSers	63	0	6	10
	UBSers	24	0	6	10
GD9	FBSers	17	1	32	4
	UBSers	5	3	24	6
GD10	FBSers	65	0	0	19
	UBSers	24	0	5	24
GD11	FBSers	24	4	12	13
	UBSers	11	4	8	12
GD12	FBSers	54	0	0	5
	UBSers	27	0	2	11

Table 10. Detailed results of $\boldsymbol{SV}_{FBSers}$ and $\boldsymbol{SV}_{UBSers}$ of the non-computer-science group by graph.

Graph ID	User Types	Number of Entries by Structure			
		High Degree	Bridge	Community	Others
GD3	FBSers	33	0	5	2
	UBSers	10	0	8	8
GD4	FBSers	13	0	28	6
	UBSers	3	0	18	2
GD5	FBSers	22	0	3	7
	UBSers	9	0	3	12
GD6	FBSers	11	0	23	7
	UBSers	1	0	13	11
GD7	FBSers	0	24	11	4
	UBSers	0	8	12	8
GD8	FBSers	38	0	4	10
	UBSers	11	0	3	9
GD9	FBSers	9	0	27	2
	UBSers	2	2	11	10
GD10	FBSers	30	0	5	5
	UBSers	2	0	7	13
GD11	FBSers	13	2	10	10
	UBSers	5	3	6	10
GD12	FBSers	38	0	1	1
	UBSers	16	0	5	2

4.1.2 Detailed Results of PS Indicator

The calculation of PS indicator was based on the matrices $\boldsymbol{PM}_{FBSers,k}$ and $\boldsymbol{PM}_{UBSers,k}$ within a group by graph. A ***PM*** matrix can be visualized by using a heatmap. Figure 5 is the heatmap visualizations of the two matrices of the computer-science group by graph.

Figure 6 is the heatmap visualizations of the two matrices of the non-computer-science group by graph.

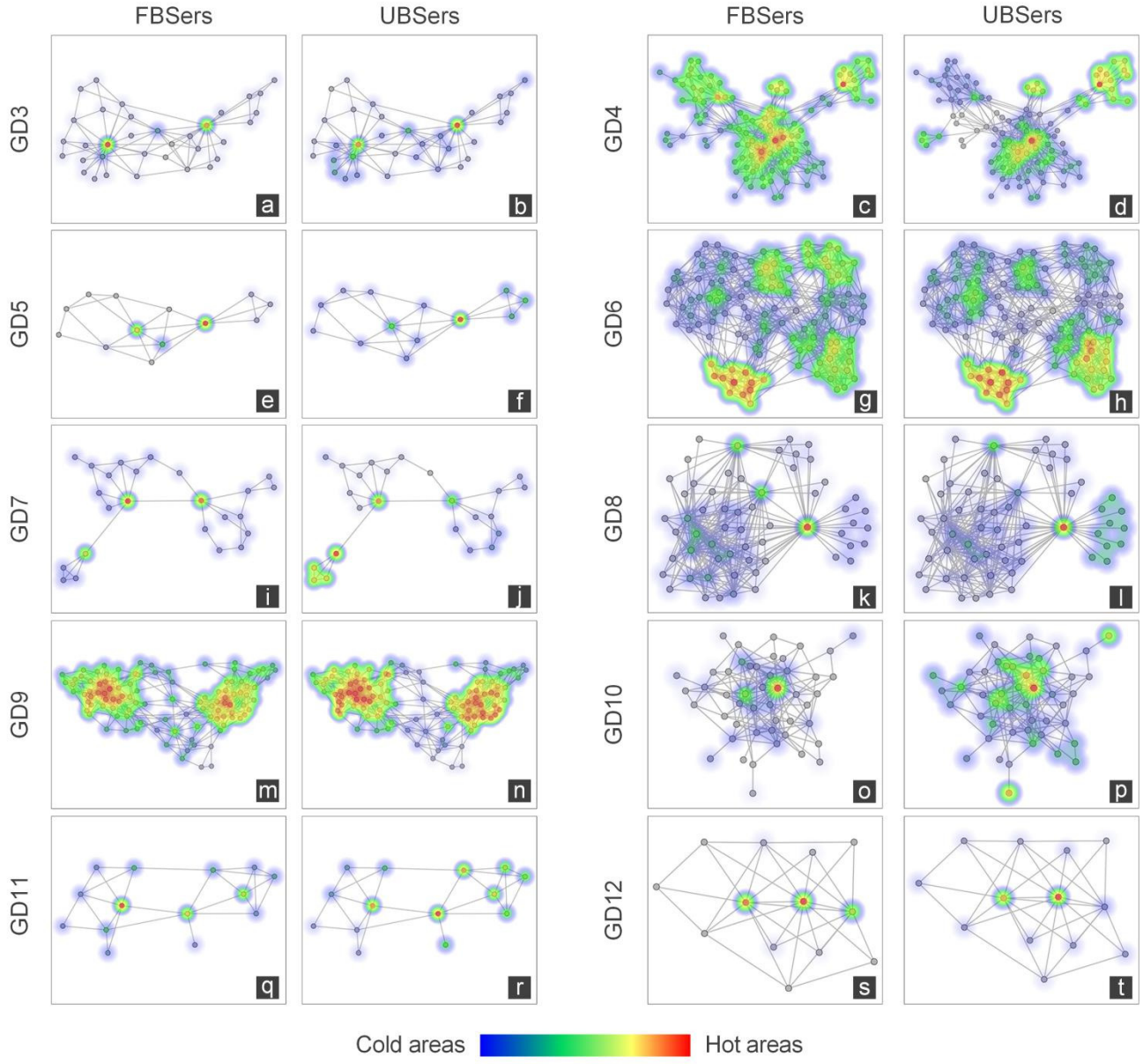


Figure 5. Visualizations of $\boldsymbol{PM}_{FBSers}$ and $\boldsymbol{PM}_{UBSers}$ of the computer-science group by graph.

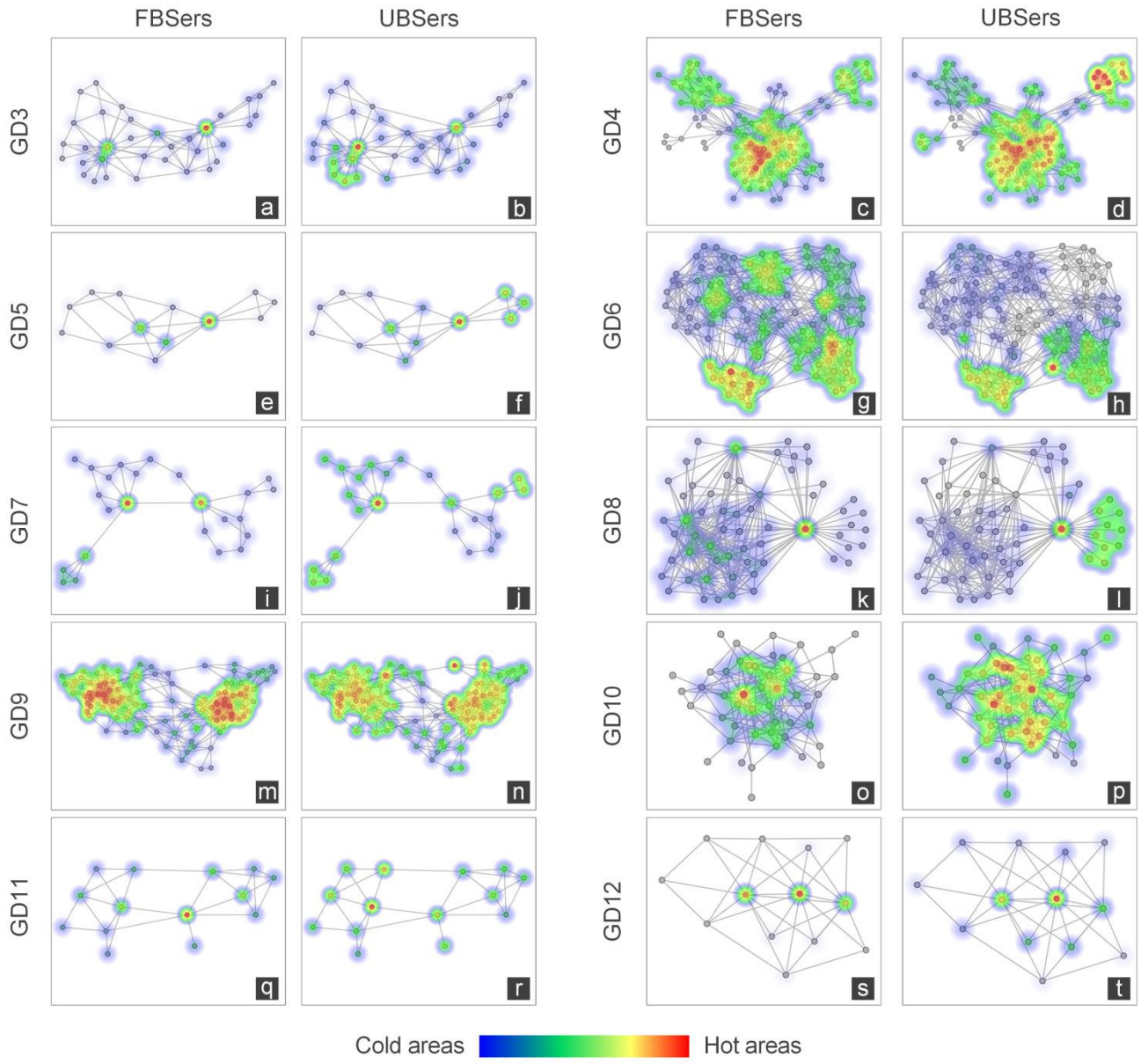


Figure 6. Visualizations of PM_{FBSers} and PM_{UBSers} of the non-computer-science group by graph.

4.2 Supporting Information for Ex2

Table 11 provides the detailed results of Ex2 re-grouped by the participants' professional backgrounds in terms of mean values of accuracy, difficulty, and confidence. No significant difference was found between the computer-science group and non-computer-science group by question in terms of accuracy in Ex2.

Table 11. Detailed results of Ex2 re-grouped by the participants' professional backgrounds.

Questions	Structure Types	Accuracy		Difficulty		Confidence	
		computer-science group	non-computer-science group	computer-science group	non-computer-science group	computer-science group	non-computer-science group
Q4	High degree node	0.99	0.93	2.30	2.40	3.85	3.70
Q7		0.98	0.95	2.00	1.70	4.05	4.33
Q11		0.80	0.70	2.63	2.53	3.63	3.50

Questions	Structure Types	Accuracy		Difficulty		Confidence	
		computer-science group	non-computer-science group	computer-science group	non-computer-science group	computer-science group	non-computer-science group
Q13		0.35	0.33	3.45	3.27	3.08	2.93
Q15		0.95	0.94	1.93	1.77	4.30	4.20
Q10	Bridge	0.93	0.95	2.00	1.90	4.33	4.10
Q14		0.34	0.25	2.50	2.57	3.63	3.57
Q5		0.60	0.40	2.50	2.83	3.73	3.37
Q6		0.10	0.10	3.30	3.30	3.20	3.03
Q8	Community	0.35	0.27	3.50	3.40	3.00	3.13
Q9		0.88	0.73	2.18	2.13	4.00	4.07
Q12		0.50	0.53	2.50	2.67	3.75	3.33

4.3 Supporting Information for Ex3

Table 12 provides the detailed results of Ex3 re-grouped by the participants' professional backgrounds in terms of mean values of accuracy, difficulty, and confidence. No significant difference was found between the computer-science group and non-computer-science group by question in terms of accuracy in Ex3.

Table 12. Detailed results of Ex3 re-grouped by the participants' professional backgrounds.

Graph ID	Accuracy		Difficulty		Confidence	
	computer-science group	non-computer-science group	computer-science group	non-computer-science group	computer-science group	non-computer-science group
GD3	0.66	0.64	2.59	2.73	3.38	3.42
GD4	0.74	0.77	2.44	2.44	3.61	3.69
GD5	0.81	0.83	2.31	2.38	3.78	3.78
GD6	0.76	0.67	2.40	2.58	3.71	3.53
GD7	0.81	0.86	2.30	2.07	3.88	3.98
GD8	0.73	0.75	2.36	2.31	3.69	3.72
GD9	0.66	0.71	2.69	2.69	3.38	3.56
GD10	0.68	0.65	2.55	2.48	3.53	3.47
GD11	0.75	0.68	2.21	2.24	3.87	3.78
GD12	0.75	0.68	2.21	2.28	3.79	3.73

Questionnaire Example for *FBSers*

Name：_____

Sex：_____

Age：_____

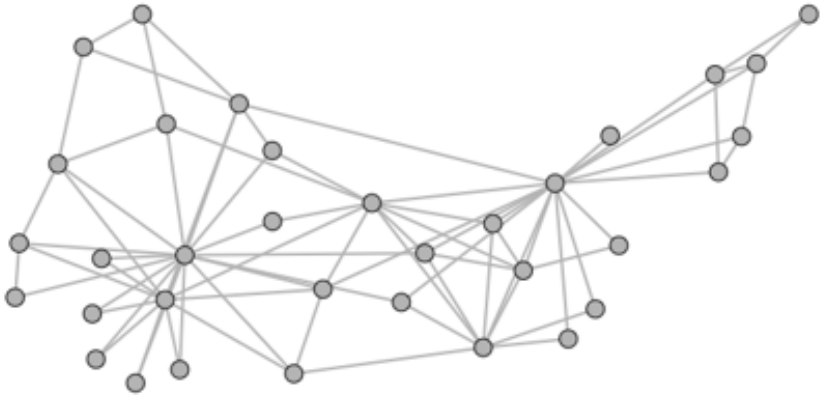
Profession/Major：_____

Data for examination: Friendship network of members of the Zachary's karate club.

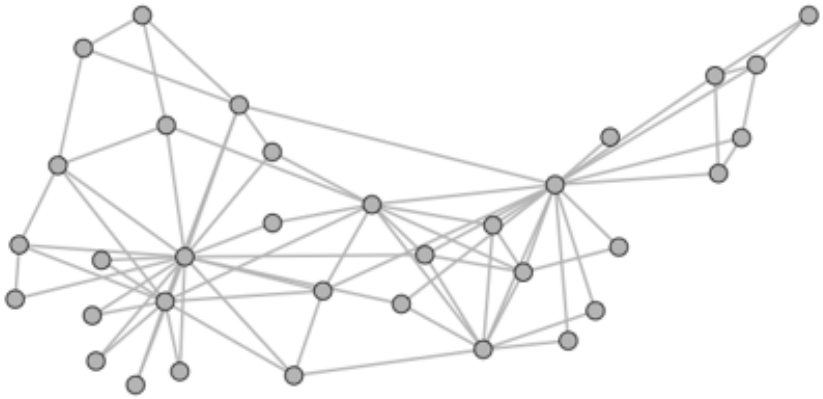
Instructions: Please put a tick ☑ in the box next to the answer of your choice or write the answer in the space provided.

Experiment 1

Please select any areas/nodes of interest in this graph.



Experiment 2



Q1: The nodes that represent the club president and the club instructor are _____and _____ .

What level is the **difficulty** of the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐
What level is your **confidence** when answering the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐

Q2: There is/are _____ faction/factions in the club.

A. 1 B. 2 C. 3 D. 4

What level is the **difficulty** of the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐
What level is your **confidence** when answering the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐

Experiment 3

Q1: You _____ this graph.

A. have seen **B. haven't seen**

What level is the **difficulty** of the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐
What level is your **confidence** when answering the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐

Questionnaire Example for *UBSers*

Name：_____

Sex：_____

Age：_____

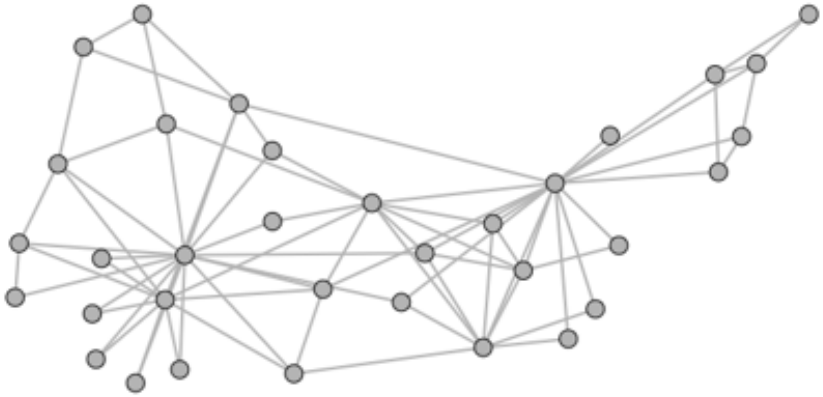
Profession/Major：_____

Data for examination: Friendship network of members of the Zachary's karate club.

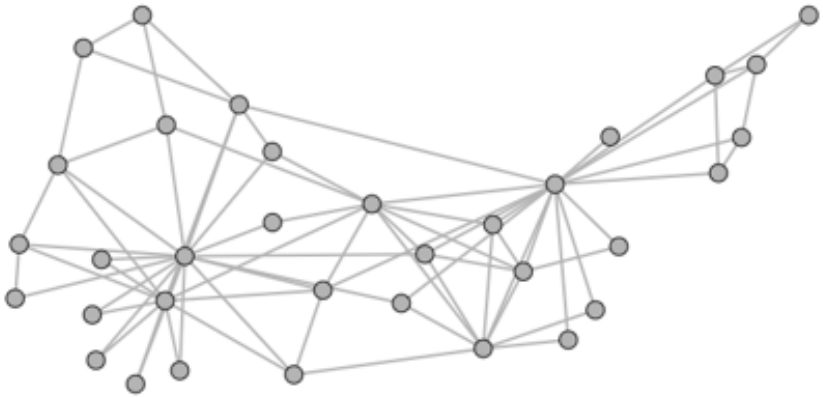
Instructions: Please put a tick ☑ in the box next to the answer of your choice or write the answer in the space provided.

Experiment 1

Please select any areas/nodes of interest in this graph.



Experiment 2



Q1: The top 2 highest degree nodes in this graph are _____ and _____ .

What level is the **difficulty** of the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐
What level is your **confidence** when answering the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐

Q2: There is/are _____ community/communities in this graph.

A. 1 B. 2 C. 3 D. 4

What level is the **difficulty** of the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐
What level is your **confidence** when answering the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐

Experiment 3

Q1: You _____ this graph.

A. have seen **B. haven't seen**

What level is the **difficulty** of the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐
What level is your **confidence** when answering the question? (1 is the lowest level and 5 is the highest level)				
1	2	3	4	5
☐	☐	☐	☐	☐