Selecting Open Innovation Ideas in Teams vs. Nominal Groups: Exploring the Effects of Idea Quantity and Idea Assignment on Idea Selection Quality and Satisfaction with Process

Shixuan Fu
Beijing International Studies University
fsx8888@163.com

Xusen Cheng
Renmin University of China
xusen.cheng@ruc.edu.cn

Triparna de Vreede
University of South Florida
tdevreede@usf.edu

Gert-Jan de Vreede
University of South Florida
gdevreede@usf.edu

Abstract

Idea selection is a critical activity in open innovation crowdsourcing projects. Yet, the generation of vast amounts of ideas makes it cognitively challenging to identify the subset of ideas that are worthy of further consideration. We conducted an experiment to explore the influence of idea quantity and idea homogeneity on idea selection outcomes evaluated by crowds in the form of teams and nominal groups. We found that higher idea quantity is positively associated with idea selection quality and negatively associated with satisfaction with process. Further, team idea selection quality outperformed individual idea selection quality in both homogeneous information groups and low idea quantity groups. We did not find significant differences between group idea selection quality and individual idea selection quality in the heterogeneous information groups and high idea quantity groups. Theoretical contributions and practical implications are discussed.

1. Introduction

Idea crowdsourcing facilitates collaborative innovation by tapping into the collective wisdom of online crowds [1]. With the proliferation of market competition, organizations increasingly rely on open innovation crowdsourcing for ideation. For example, Starbucks organized open innovation initiatives to gather suggestions ranging from new drinks and new snacks to store layout and background music [2]. General Electric actively embraces open innovation to bring together the brightest minds to solve their business challenges [3].

Despite its potential to shorten R&D cycles and result in high quality innovation [4], open innovation is not without challenges. One particular challenges concerns the difficulty to screen out high potential ideas [5]. Facing large numbers of ideas generated by online crowds, it becomes too time consuming for organizations to carefully assess each idea [6]. Further, it is also hard to identify related ideas among in large idea sets and there will be a high likelihood that high quality ideas are overlooked [7]. Therefore, it is critical for organizations that use open innovation to implement solid idea selection processes to separate the most promising ideas from the others.

Idea selection represents a convergent thinking pattern that aims to reduce idea sets. It encompasses filtering processes where individuals compare and systematically integrate ideas to identify which ideas will be chosen for further consideration. Idea selection is a part of idea convergence [8] and a precursor to idea evaluation [9].

Relative to the wide range of studies that focus on idea generation approaches in open innovation [4, 10], idea selection has received limited attention [1]. Recent studies [11, 12] on the influence of the role of contributors and idea contents on idea selection outcomes found (a) that a contributor's prior participation is positively related to the likelihood of idea implementation, and (b) that idea length is negatively related to idea selection outcome. Other studies focusing on crowd feedback show that the number of crowd comments and number of crowd votes are the most important indicators of idea selection outcomes [13]. These studies, however, neither provide any guidance on how the idea selection responsibilities should be assigned to members of the crowd nor on how the starting idea set should be organized in terms of the allocation of ideas to evaluators. These are critical elements for any idea selection activity in an open innovation project.

In terms of organizing/assigning the crowd members to serve as idea selectors, there are generally two forms: crowd members working together as a (small) team vs. crowd members working as a nominal group. A nominal group is a collection of individuals who individually select ideas, while a crowd that works as a team select ideas through direct interactive discussions [14]. Studies in economics have shown that crowds learn faster than nominal groups, and thus crowds outperform nominal groups in economic decisions [15].Other research has shown that crowds follow a more rational decision-making process than individuals or nominal groups [16],

URI: https://hdl.handle.net/10125/79415
978-0-9981331-5-7

which yields more benefits to the crowds. In this study, we compare the resulting idea selection quality that results from both types of idea selectors. Specifically, our first research question is:

RQ1: *Does a crowd team outperform a nominal group in terms of idea selection quality in open innovation crowdsourcing? Is this true for all idea quantity levels?*

In terms of the organization of idea contents, an important issue concerns the assignment of ideas to idea selectors. First, it has to be determined whether the selectors are working on homogeneous or heterogenous idea sets. Heterogeneous idea sets represent an unshared assignment of ideas where selectors evaluate different ideas. Homogeneous idea sets represent a shared assignment of ideas where selectors evaluate the same ideas. Second, it has to be determined on how many ideas the selectors will work.

Two theoretical perspectives are relevant for the organization of idea contents. First, shared information bias refers to individuals' tendency to discuss information that is already known to most team members [17, 18]. In the context of open innovation idea selection, individuals may ignore ideas known only to them. Thus, the heterogeneity of idea sets may influence idea selection quality. Second, according to Cognitive Load Theory, idea selectors may suffer from cognitive overload when the number of ideas exceeds their information processing abilities [1]. Thus, idea quantity may also influence idea selection quality. Accordingly, our second research question is:

RQ2: *How does the organization of idea sets influence idea selection quality in crowd teams and nominal groups?*

The remainder of this paper is structured as follows. In the next section we first develop our hypotheses related to idea quantity and idea homogeneity. Next, we provide the details of our laboratory experiment to test the hypotheses. The results of our study are reported in section 4. We conclude the paper with a discussion of the implications of our study, its limitations, and directions for future research.

2. Background

2.1. Idea quantity

Existing research shows that starting with a higher number of generated ideas increases the probability of selecting good ideas [19]. In the context of group ideation, previous studies examined the relationship between quantity and quality, and found that the cumulative number of ideas and the number of high quality ideas are generally positively correlated [20]. Based on these findings, we expect that there is also a positive correlation between idea quantity and quality in the context of idea selection in open innovation.

Apart from idea selection quality, it is also important to consider the selectors' perceived satisfaction with the selection approach. Research shows that low satisfaction may lead individuals to discontinue using a system or following a procedure [21, 22]. According to Yield Shift Theory, individuals perceive the highest satisfaction level when their ascribed utility corresponds to the perceived yield [21]. During an information processing task such as selecting promising ideas from an open innovation initiative, individuals will (subconsciously) estimate the utility for the selection task. Cognitive Load Theory [23] predicts that cognitive overload leads to low level of satisfaction [1]. When the number of ideas pending to be processed exceed an individual's cognitive abilities, they will likely get frustrated, dissatisfied and will discontinue processing the ideas. We expect that this would be especially the case if an individual is presented with an overwhelming number of ideas to select from.

Based on the above, we propose the following two hypotheses related to idea quantity:

H1a: *Higher idea quantity is positively associated with idea selection quality.*

H1b: *Higher idea quantity is negatively associated with satisfaction with process.*

Further, when selecting ideas in a crowd team, team members have the opportunity to discuss ideas before making their selection. This is not the case in nominal groups, where individuals need to make the selections based on their personal insights only. Thus, if the number of ideas to be considered is low such that crowd teams have sufficient time to discuss and compare them, we expect that the selection quality from a crowd team will be higher than from a nominal group. When the number of ideas to be considered is high, the comparison and discussion of the ideas becomes very time-consuming. This may negatively impact the selection performance of a crowd team. Yet, when the number of ideas to be considered is high, an individual may not have comprehensive knowledge to judge each idea independently [23]. Especially in when a selector is faced with limited cognitive capacity to judge a high number of ideas, (s)he may resort to cognitive heuristics [24] and be biased while screening out the ideas to speed up the process.

On balance, in a high idea quantity setting, the ideas are more likely to be generally more diverse in different domains. An individual may not have a comprehensive knowledge basis for every domain, and thus sometimes will use intuition leading to biased decision making [25]. We expect that crowd teams will still be able to share sufficient knowledge

about a number of ideas such that their overall selection quality will be higher than a nominal group's performance. Thus, we propose the following hypotheses:

H2a: *In low idea quantity groups, crowd teams' idea selection quality is better than nominal group's idea selection quality.*

H2b: *In high idea quantity groups, crowd teams' idea selection quality is better than nominal group's idea selection quality*.

2.2. Idea homogeneity/heterogeneity

Shared information bias posits that team members mostly discuss information that all team members possess while there is limited discussion on information that only a few team members possess [18]. Due to the limited availability of time and energy, team members tend to unconsciously ignore information that is unfamiliar to them during idea selection, and tend to tap into information that resides in their shared knowledge bases [7]. The existence of shared information bias may hinder teams from achieving better decision quality as critical information may not be considered [18].

On the one hand, individuals will have a preference towards information that they receive initially. According to the primary effect, initial preferences are hard to change [26]. Homogeneous information is viewed by each individual to form their initial preferences, and thus, it has a higher chance to be selected by separate individuals to form their first impressions. On the other hand, from the perspective of Cognitive Load Theory [23], processing information that is already known to all individuals requires fewer cognitive resources than processing information that is unfamiliar, and thus this contributes to higher task performance. Moreover, we argue that selecting ideas from a heterogeneous idea assignment is cognitively more challenging than from a homogeneous assignment which will lead to reduced satisfaction with process[23]. Therefore, we propose the following:

H3a: *Teams working on a homogeneous idea assignment will have higher idea selection quality than teams working on a heterogeneous idea assignment.*

H3b: *Teams working on a homogeneous idea assignment will have higher satisfaction with process than teams working on a heterogeneous idea assignment.*

In homogeneous idea assignment (shared idea sets), crowd teams do not need to explain and discuss unshared ideas. Their discussions are thus expected to be more focused and efficient. In the absence of unshared ideas, team discussions can fully focus on the collective wisdom in the team, which will facilitate idea selection outcomes. At the same time, in unshared idea sets (heterogeneous idea assignment), nominal groups will avoid dominant behaviors by other individuals that may negatively influence group discussions [14]. Thus, they can fully focus on their own intelligence and experience. Therefore, we propose the following hypotheses:

H4a: *In a homogeneous idea assignment, crowd teams' idea selection quality is better nominal group idea selection quality*.

H4b: *In a heterogeneous idea assignment, crowd teams' idea selection quality is better than nominal groups' idea selection quality.*

3. Method

3.1. Conditions

To manipulate quantity of ideas to be considered and form of idea assignment, we employed a 2 (information quantity: high and low) x 2 (heterogeneous and homogeneous idea assignment) between-group factorial design. This leads to the following four experiment conditions:

Condition 1: The number of ideas to consider is 24 and all subjects will receive the same 24 homogeneous ideas.

Condition 2: The number of ideas to consider is 24 and all subjects will receive 12 homogeneous ideas and 12 unique ideas.

Condition 3: The number of ideas to consider is 8 and all subjects will receive the same 8 homogeneous ideas.

Condition 4: The number of ideas to consider is 8 and all subjects will receive 4 homogeneous ideas and 4 unique ideas.

3.2. Subjects

288 MBA students were recruited from a public university in China. Subjects received extra credit for their participation. All subjects had work experience in a wide range of occupations, including but not limited to investment manager, secretary, foreign trade salesman, marketing consultor, and product manager. Subjects were randomly assigned to 72 4-member groups across the four conditions. We randomly assigned the participants into different conditions. The demographic profiles of the subjects were controlled in the statistical analyses to eliminate potential baseline biases.

3.3. Measures

We used a collection of ideas for the experiment that were selected from a real-life challenge raised in

OpenIDEO, an open innovation idea crowdsourcing community. The OpenIDEO challenge was "How can we use technology to inspire all socioeconomic and multicultural groups to lead healthier lives". This challenge received a wide range of contributions. We randomly selected 24 task relevant ideas from the idea pool as the priming ideas of this research.

We recruited 5 specialists in the domain of ICT-enabled innovation to code the quality of the 24 ideas. The quality of each idea was coded according to the following coding principles: we coded the quality of each idea based on the principles of novelty, feasibility, acceptability, elaboration, relevance as proposed by Dean et al. [27] (see Appendix A). Based on the idea quality scores, we determine the following baselines for all four conditions:

1. The average priming idea quality is similar across the four conditions.
2. For heterogenous idea groups, the quality of unique ideas that are assigned to different subjects is controlled.

We measured satisfaction with process based on a short survey (see Appendix A) that was adapted from survey items proposed by Briggs and colleagues [28].

3.4. Procedures

At the start of the experiment, we informed the subjects that they were going to participate in an exercise that requires group discussion to make choices from a collection of idea alternatives. Subjects were told to shortlist the ideas that are worthy of further consideration from the given pool of ideas. They were asked to select the ideas that they would implement if they were the decision makers regarding to the issue "How can we use technology to inspire all socioeconomic and multicultural groups to lead healthier lives". Subjects were given 10 minutes to read the idea sets separately and select two ideas that they considered had the best qualities. We then provided another 20 minutes for subjects to discuss the ideas one by one, and select the two ideas with the best qualities based on group discussions. The experiment time for each of the four conditions was fixed and equal. After making the selections, subjects individually completed a post-survey which assessed their perceptions on the experiments as well as on the top two ideas selected by themselves and by the group. In terms of the comparisons between crowds idea selection quality and nominal groups' idea selection quality, our experiment is a within-subject design since we asked the participants to sequentially select ideas as nominal groups and as crowds.

We also included questions to perform a manipulation check (see Appendix A). The results of the manipulation check show that there is significant difference between the homogeneous idea assignment groups and the heterogenous idea groups ($t(256)=-18.074$, $p<0.001$). There is also significant difference between the high and low idea quantity groups ($t(256)=2.013$, $p<0.05$).

4. Results

After initial screening, we removed samples from the dataset if they were found to be incomplete, i.e. if the subjects did not report their selected ideas. This resulted in 258 included subjects for our analyses, with 65, 54, 71, 68 subjects in conditions 1-4. Table 1 shows the demographic information of the remaining subjects. Most subjects are aged between 26 and 35, while their work experience appears evenly distributed. As summarized in table 2, condition 2 shows the highest group idea selection quality on average (Mean=0.5212), while condition 4 shows the lowest selection quality on average (Mean=0.4533). Also in terms of individual idea selection quality, condition 2 shows the highest individual idea selection quality on average (Mean=0.5308), while condition 4 shows the lowest selection quality on average (Mean=0.4554).

First, we tested the influence of idea quantity and idea assignment on group idea selection quality. Results show that crowd idea selection quality is significantly different between high and low idea quantity groups ($t(256)=3.001$, $p<0.05$). And, nominal groups' idea selection quality is also significantly different between high and low idea quantity groups ($t(256)=4.545$, $p<0.001$). Thus, H1a is supported.

However, crowd idea selection quality in homogeneous idea groups and heterogeneous idea groups is not statistically different ($t(256)=0.891$, $p=0.374$). Nominal groups' idea selection quality in homogeneous idea groups and heterogeneous idea groups is not statistically different either ($t(256)=-1.515$, $p=0.131$). Thus, H3a is rejected.

Finding 1: In summary, higher idea quantity is positively associated with idea selection quality. In other words, idea selection quality in high idea quantity groups is better than in low idea quantity groups.

Next, In conditions 3 and 4 (with low idea quantity), the difference in idea selection quality is significant between crows-level and nominal group-level idea selections ($t(138)=2.138$, $p<0.05$). Thus, H2a is supported.

In conditions 1 and 2 (with high idea quantity), the difference in idea selection quality is not significant between crowd-level and nominal group-level idea selections ($t(118)=0.155$, $p=0.877$). Thus, H2b is rejected.

Finding 2: In summary, crowd teams' idea selection quality is better than nominal groups' idea selection quality when working on a low number of ideas to be considered. There is no significant difference between crowd teams' idea selection quality and nominal groups' idea section quality when working on a high number of ideas to be considered.

Table 3 shows the results concerning participants' satisfaction with process. We found that satisfaction with process was higher in low idea quantity groups (conditions 3 and 4) than for high idea quantity groups (conditions 1 and 2). We conducted an independent t-test to test the influence of idea quantity on individuals' satisfaction with process. Result shows that satisfaction with process in low idea quantity groups is significantly different from satisfaction with process in high idea quantity groups ($t(256) = -1.912$, $p<0.05$). Thus, H1b is supported.

However, satisfaction with process in homogeneous idea groups is not statistically different from satisfaction with process in heterogeneous idea groups ($t(256) = -0.420$, $p=0.0675$). Thus, H3b is rejected.

Finding 3: In summary, higher idea quantity is negatively associated with satisfaction with process. In other words, individuals' satisfaction with process is lower when working on a higher number of ideas to be considered for selection.

Finally, for conditions 1 and condition 3 (with homogeneous idea assigment), group idea selection qualities are higher than individual idea selection qualities. Specifically, in experiment condition 1 and 3, the differences in idea selection quality are significant between group-level and individual-level ($t(135)=2.586$, $p<0.05$). In other words, group idea selection quality is higher than individual idea selection quality in the homogeneous idea assigment groups. Thus, H4a is supported.

For conditions 2 and 4 (with heterogeneous idea assigment), individual idea selection quality is slightly better than group idea selection quality from the mean value. In conditions 2 and 4, there is no significant difference between group-level and individual-level idea selection quality ($t(121)=-0.675$, $p=0.501$). In other words, individual idea selection quality was found to be similar to group idea selection quality in the heterogeneous idea assignment groups. Thus, H4b is rejected.

Finding 4: In summary, crowd teams' idea selection quality is better than nominal groups' idea selection quality when working on homogeneously assigned idea sets. There is no significant difference between crowd teams' idea selection quality and nominal groups' idea section quality when working on heterogenously assgined idea sets.

We have summarized the t-test statistics in table 4 below for clarity.

Table 1. Demographics.

		Number	Percentage
Gender	Male	93	36.2%
	Female	164	63.8%
Age	18-25	26	10.1%
	26-30	109	42.2%
	31-35	80	31%
	36-40	32	12.5%
	Above 40	11	4.2%
Industry	Agriculture	3	1.2%
	Manufacturing	34	13.2%
	Computer	29	11.2%
	Transportation	12	4.6%
	Finance	77	29.8%
	Tourism/Sport	3	1.2%
	Others	100	38.8%
Experience	1-3 years	42	16.3%
	4-5 years	58	22.6%
	6-10 year	84	32.7%
	Over 10 years	73	28.4%
Knowledge of the ideas being selected	Extremely unfamiliar	3	1.7%
	Unfamiliar	23	13.1%
	Neutral	100	56.8%
	Familiar	49	27.8%
	Extremely familiar	1	0.6%
Position	General staff	100	39.1%
	Low-level manager	72	28.1%
	Middle-level manager	69	27%
	High-level manager	15	5.9%

Table 2. Comparisons of idea selection quality.

	Condition	N	Mean	Standard Deviation	Standard Error	95% confidence interval		Min	Max
						Lower bounds	Upper bounds		
	1	65	.4974	.08727	.01082	.4758	.5190	.36	.67

Group idea selection quality	2	54	.5212	.13064	.01778	.4855	.5569	.36	.78
	3	71	.4906	.08476	.01006	.4706	.5107	.31	.62
	4	68	.4533	.06226	.00755	.4382	.4683	.39	.61
	Total	258	.4889	.09465	.00589	.4773	.5005	.31	.78
Individual idea selection quality	1	65	.4866	.09738	.01208	.4625	.5107	.28	.78
	2	54	.5308	.10668	.01452	.5017	.5600	.33	.78
	3	71	.4594	.06871	.00815	.4432	.4757	.31	.62
	4	68	.4554	.05265	.00639	.4427	.4682	.39	.62
	Total	258	.4802	.08688	.00541	.4695	.4908	.28	.78

Table 3. Comparisons of satisfaction

	Condition	N	Mean	Standard Deviation	Standard Error	95% confidence interval		Min	Max
						Lower bounds	Upper bounds		
Satisfaction	1	65	4.05	0.891	0.111	3.83	4.27	1	5
	2	54	4.08	0.551	0.075	3.98	4.28	3	5
	3	71	4.31	0.918	0.109	4.02	4.46	1	5
	4	68	4.24	0.755	0.092	4.05	4.42	3	5
	Total	258	4.17	0.803	0.050	4.07	4.27	1	5

Table 4. Summary of t-test comparisons

Dependent variable	Pairs	t value	df	p value	
Crowd idea selection quality	High v.s. low idea quantity groups	3.001	256	0.035	Support H1a
Nominal groups' idea selection quality	High v.s. low idea quantity groups	4.545	256	0.000	Support H1a
Crowd idea selection quality	Homogeneous v.s. heterogeneous idea groups	0.891	256	0.374	Reject H3a
Nominal groups' idea selection quality	Homogeneous v.s. heterogeneous idea groups	-1.515	256	0.131	Reject H3a
Idea selection quality in low quantity groups	Crowd v.s. Nominal groups	2.138	138	0.027	Support H2a
Idea selection quality in high quantity groups	Crowd v.s. Nominal groups	0.155	118	0.877	Reject H2a
Satisfaction with process	High v.s. low idea quantity	-1.912	256	0.022	Support H1b
Satisfaction with process	Homogeneous v.s. heterogeneous idea groups	-0.420	256	0.0675	Reject H3b
Idea selection quality in the homogeneous idea assigment	Crowd v.s. Nominal groups	2.586	135	0.012	Support H4a
Idea selection quality in the heterogeneous idea assigment	Crowd v.s. Nominal groups	-0.675	121	0.501	Reject H4b

5. Discussion and conclusions

5.1. Discussion of results

Based on the results above, our findings can be summarized as follows.

First, we found that crowds outperform nominal groups only in the homogeneous idea assignment and in low idea quantity conditions. In the heterogeneous idea assignment and in high idea quantity conditions, results show that there are no significant differences between crowds and nominal groups. Compared with existing studies that mostly focused on the comparisons between nominal groups and crowds in economics decisions, computer-mediated ideations, and committee decision making [14, 15, 16], to the

best of our knowledge, very few studies have examined the differences of decision making between nominal groups and crowds in various idea quantity/ idea assignments conditions. We will further explore the validity of our results and the causes of the identified differences.

Second, higher idea quantity is positively associated with idea selection quality. Higher idea quantity is negatively associated with satisfaction with process. The findings regarding the relationships between idea selection quality/satisfaction and idea quantity is in line with some previous studies [29] but counter to some other findings [30]. A possible explanation is that the number of ideas in high quantity group is still within the threhold that a group of individuals could deliberately discuss, but idea selection quality might be decreased when the ideas to be selected reach 48 in the same timeframe. Future studies will continue to examine the boundary conditions of the relationships between outcome variables and idea quantity.

Finally, idea selection quality in teams working on a homogeneous idea assignment is not significantly different from teams working on a heterogeneous idea assignment. Satisfaction with process in teams working on a homogeneous idea assignment is not significantly different from teams working on a heterogeneous idea assignment.

5.2. Implications for research

Our findings make several contributions to research literatures. First, to the best of our knowledge, our study represents one of the first empirical comparison between idea selection in crowd teams and nominal groups in terms of the resulting idea selection quality [14].Consequently, our work contributes to the existing body of knowledge on open innovation crowdsourcing [4, 5] by providing insights into the associations between the organization of idea selectors and idea selection quality. Our results confirm findings in previous decision-making studies, where group decision quality is generally found to be superior to individual decision quality as group settings facilitate knowledge sharing between team members [14].

However, interestingly, our results do not offer full support for the concept of shared information bias in group decision making [18]. In the context of open innovation crowdsourcing, we found no significant differences in idea selection quality and satisfaction with process between homogeneous idea assignment groups and heterogeneous idea assignment groups. However, when working on homogeneous idea assignment groups, crowd teams outperform nominal groups on idea selection quality, regardless of the quantity of ideas. When working on heterogenous idea sets (shared information bias exists), there is no significant difference between crowd teams and nominal groups. Our results confirmed that idea selection outcomes were not sufficiently influenced by idea homogeneous assignment as a whole, but idea homogeneous assignment had impacts on the comparisons between crowd teams' work and nominal groups' work.

5.3. Implications for practice

The findings from our study can be leveraged by open innovation crowdsourcing platforms to optimize the organization of contents and crowds during the idea selection process. Our results suggest that team idea selection quality is better than nominal group idea selection quality when working either on a low number of ideas to be consdiered or on a set of homogeneous idea assignment. Therefore, when the number of ideas pending to be evaluated is low, platform organizers could assign all the ideas to crowd teams to converge on the ideas.

Furthermore, our findings show that higher idea quantity is associated with higher idea selection quality and lower satisfaction with process. Thus may imply that crowdsourcing organizers need to balance between idea selection quality and satisfaction, and assign the optimal number of ideas to be considered. The findings from this research could also contribute to distributed collaboration practices during the new normal of COVID-19.

5.4. Limitations and future research

Our study is not without limitations. First, all subjects come from a university in China. The findings might be biased for the homogeneity of the samples. Therefore, in future research, we will recruit a wider range of subjects. If possible, we plan to conduct a natural experiment to follow the behavioral patterns of the idea selectors. Second, the number of ideas in the high idea quanity conditions (24) may still not be high enough to invoke extreme cognitive load. We only have two discrete groups to examine the differences between low and high idea quantities. Thus, we plan to collect additional data for conditions with even higher idea quantity and more diversity of idea quantity in different groups, i.e., low, medium and high idea quantity conditions. Third, the subjects consecutively work as nominal groups and crowds to select ideas. We cannot test if the improvement comes from the discussion or from the fact that people have more time to think of their idea. Therefore, future research will compare nominal groups and crowds using different sets of subjects.

In this research, we found significant differences between team idea selection and individual idea selection in homogeneous idea assignment (shared information groups). Further research is encouraged to incorporate mediators to test the influencing mechanisms of information quantity and information hemogeneity on idea selection qualities and satisfaction, such as perceived task complexity, degree of stake in the outcome, team diversity, and equality of participation.

Furthermore, we acknowledge that team diversity, equality of participation, degree of stake in the outcome and the amount of discussion may all influence idea selection quality. In future research, we plan to consider the differences of composition of the team and the knowledge distance of each team member to the ideas they defend in the experiment design.

6. Acknowledgement

The authors would like to thank the National Natural Science Foundation of China (Grant No.72001005; No. 72061147005) and fund for building world-class universities (disciplines) of Renmin University of China (Project No.KYGJA2021004) for providing funding for part of this research. Xusen Cheng is the corresponding author.

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Appendix A. Instruments

Idea quality measurement (adapted from Dean et al.[27]; Likert-type scale 1-5, where 1 represents strongly disagree and 5 represents strongly agree):

1. Novelty (the degree to which the idea is rare and not expressed in the context before)
2. Feasibility-implementability (the degree to which the idea is workable if it does not violate known constraints for easy implementation)
3. Acceptability (the degree to which others will deem the idea as useful)
4. Elaboration (the degree to which the idea is complete and well understandable)
5. Relevance (the degree to which the idea is relevant to the topic)

Satisfaction with process questionnaire (adapted from Briggs et al.[28]; Likert-type scale 1-5, where 1 represents strongly disagree and 5 represents strongly agree):

1. I feel satisfied with the way in which the idea processing was conducted.
2. I feel good about today's idea processing.
3. I liked the way the idea progressed today.
4. I feel satisfied with the procedures used in idea processing.

Manipulation check (Likert-type scale 1-5, where 1 represents strongly disagree and 5 represents strongly agree):

1. The number of ideas pending to be processed is high.
2. During group discussion, we found that the ideas initially assigned to me are different others