Academic Journal of Humanities & Social Sciences
ISSN 2616-5783 Vol.3, Issue 9: 120-131, DOI: 10.25236/AJHSS.2020.030914

Research on efficiency and quality in the process of creative screening

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ABSTRACT. *Brainstorming is a common method to stimulate creativity, but it often ignores the cost of time and labor. Objective The purpose of this paper is to study the quality and efficiency of the four methods of brainstorming creative screening, and strive to explore a screening method that takes both into account. Methods collaborative filtering technology was used to eliminate not good ideas, while maintaining the collective consensus of all participants on good ideas. New screening strategies and methods were proposed and preliminarily verified. Each group was divided into three groups based on 50 different screening methods. Result The results show that the new design group takes the shortest screening time, the participants have the highest satisfaction with the process, and the screening quality is close to that of the negotiation group. Conclusion the new design can achieve a faster screening speed than the scoring method by reducing workload effectively. Meanwhile, the screening quality close to the negotiation method can be obtained by maintaining the consensus of the whole team, which achieves the purpose of both efficiency and quality.*

KEYWORDS: *brainstorming; creative screening; information screening; collaborative filtering;*

Quotation: Brainstorming was first proposed by A. Osborne in 1939 [1], and has been widely used in design practice to stimulate creativity.

Mr Osborne divided the brainstorming process into three stages: pre-meeting preparation, creative output and creative screening[2].

The first two links serve the creation of ideas, while the last one is used to screen out the good ideas from the bad ones.

In the past, the research mainly focused on the problems generated in the first two links, ignoring the problems of time and labor cost. This paper aims to explore a new screening method with both efficiency and quality.

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1 Research status

Many studies [3,4,5,6,7,8] focus on the problems existing in the two links of "pre-meeting preparation" and "creative output", mainly aiming at three problems of Production blocking, Evaluation and Free riding [9].

Three main improvement schemes are proposed:

(1) Nominal groups method requires members to attend meetings in full and limit discussions. Before filtering ideas, we make a list of each member's ideas and keep them anonymous. After filtering, each member makes a decision to rank all the ideas individually and then select the one or more ideas with the highest overall ranking for further optimization.

In the Nominal groups method, members keep independent thinking, follow the principle of delayed evaluation, which is helpful to solve the Production blocking and Evaluation apprehension, and promote the generation of higher-quality ideas among members.

(2) The Delphi Method, also known as the Expert survey method, was proposed by the RAND Corporation in 1946.

This method is a collective empirical judgment method to obtain the prediction results through anonymous expert opinions, which is widely used in military, commercial, medical and other industries. The anonymity of Delphi method can eliminate the apprehension of the traditional brainstorming method, and multiple rounds of expert feedback can enhance the objectivity and authority of the results. It will hardly cause any problem of Free riding, but the operation process is complicated and the input cost is higher than the traditional brainstorming method.

(3) Electronic brainstorming, the development of Internet technology and Electronic communication technology, has created a new environment for the emergence of Electronic brainstorming. Electronic brainstorming is similar to the traditional face-to-face brainstorming process, but with the help of a computer system for online brainstorming. Members can input ideas, view their ideas, discuss and other tasks in the machine .

Due to the fact that all members can input and comment at the same time, Production blocking issues will not affect them.

Meanwhile, the anonymous evaluation mode of Electronic brainstorming also solves the problem of Evaluation apprehension. Interestingly, there is little research on the creative screening process. This reflects the pursuit of creative quality by enterprises and groups. However, with the development of social economy, time cost and labor cost have become more and more concerns of enterprises.

For example, as early as 1988, G.J.Talk facilitated the *Harvard Business Review* to put forward the idea that time is the next competitive advantage resource, which can be obtained by reducing the time of each link in the whole product development chain [10]. Therefore, ignoring efficiency for the sake of quality is not a wise choice.

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How to maintain the quality of creativity while minimizing the amount of time spent is a realistic question. Harvesting good ideas requires a considerable amount of creative output as a basis.

Brainstorming encourages creativity in design and thus presents a challenge in the selection of ideas.

There's a lot of information that needs to be stored and processed by the brain in the face of a lot of ideas with very different ideas. This imposes a great burden on the working memory with limited capacity and holding time less than 30 seconds [11], making participants either prolong the information processing time to avoid errors in memory and lead to errors in judgment, or make unreliable judgments based on unreliable memories and thus affect the final quality.

Therefore, if the burden of working memory in the screening process can be reduced, the efficiency of screening can be improved, the overall time of brainstorming can be shortened, and time and labor cost can be saved.

2 Common brainstorming screening methods

There are four common screening methods: negotiation, ranking, voting and scoring.

2.1 Negotiation method

In the negotiation method, all participants jointly discuss and evaluate each idea, and then jointly decide whether to retain the idea [12].

As it takes too much time, an alternative approach is to first screen the creativity of each participant, and then negotiate based on the results of all participants to form the final conclusion [13].

A negotiation approach that discusses each idea in depth can produce high-quality results. However, the efficiency of negotiation method is very low. In-depth discussion of each idea increases the overall workload of participants, and consensus cannot be reached quickly when there are differences.

2.2 Ranking method

The ranking method asks participants to select a certain number of ideas from the list and rank them in order of merit.

Then, the ranking of each idea is weighted according to the results of each person to calculate the score, thus producing the final ranking [14].

Ranking method reduces the number of ideas that need to be dealt with by making a selection before screening, thus improving efficiency to a certain extent. However, ranking tasks require the brain to remember and compare multiple ideas at

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the same time, which still causes a great burden of working memory and is prone to errors. Therefore, the quality of the final result is not as good as that of the negotiation method.

2.3 Voting method

The voting method takes the majority as the starting point and summarizes and sorts the voting status of each idea according to each participant to obtain the final screening result.

The voting method eliminates the most time-consuming negotiation link in the negotiation method, which can significantly improve the efficiency.

However, this also makes the voting law introduce too much personal subjective opinions, which makes it easy to make the votes tend to be even and hard to form an undisputed result. As a result, voting method often add rules, such as multiple rounds of voting or comparison voting, to improve screening.

These supplementary rules either increased the time or the working memory burden, but did not improve the effect of screening effectively.

2.4 Scoring method

The scoring method asks each participant to rate each idea.

The scoring criteria can be formulated in advance according to the actual needs of different dimensions, such as innovation, feasibility, practicality and so on. Through the statistics of the total score of each idea, the ranking of all ideas is completed, and several ideas with the highest score are selected successively as the final screening results.

The idea of scoring ideas from multiple dimensions increases time, but helps to increase the richness and quality of the results.

At the same time, this practice will inevitably lead to deviation due to the difference in the subjective understanding of each person on the scoring criteria, which often leads to different results in the order of total scores and scores in the order of individual dimensions, thus increasing the uncertainty of the results and affecting the quality of the final results.

To sum up, the four common screening methods at present do not achieve good time control, reduce the burden of working memory, and obtain good output quality, as shown in Table 1.

Although in many cases the relationship between time and quality is a paradox, we believe that a new method can be found in the creative selection process, which can achieve the effect of short time of scoring and high quality of negotiation by controlling the burden of working memory.

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Table 1. Comparison of four common screening methods

Screening approach	Time-consumed	Working memory burden	Output quality
Negotiation method	Very long	High	Great
Ranking method	Long	Higher	Good
Voting method	Medium	Low	Bad
Scoring method	Short	Medium	Good

3 New brainstorming screening strategies

Collaborative filtering technology emerged to solve the problem of "information overload" in the Internet environment [15].

With the rapid development of Internet technology, people are faced with more and more information, and it becomes more and more difficult to find the information they need, that is, the problem of "information overload".

In the past, information retrieval technology was used for active retrieval by users. The system classifies and organizes information resources according to specific rules. Although information retrieval technology can help users obtain the information they need to a certain extent, it has defects such as complex preliminary preparation, slow content update, poor matching accuracy, and fails to meet the personalized needs of users [16].

Collaborative filtering technology makes use of collective intelligence to determine the content that users may or may not be interested in based on user behavior analysis, so as to achieve the purpose of actively filtering information.

Therefore, collaborative filtering technology can be applied in the creative screening process of brainstorming, so that good ideas get more attention, while bad ideas consume less time and human resources. The purpose of idea filtering is to separate good ideas from mediocre ones and bad ones. Therefore, completing the classification of ideas is the core of the creative screening process.

The above four methods all introduce the idea of scoring or sorting to some extent, which is helpful to classify the ideas, but also brings the complexity and cost of operation.

The new screening method will return to the essence of classification, no longer taking scoring or sorting as the main operation means, but only requiring participants to complete the classification operation, so as to simplify the process and improve the efficiency.

The new screening approach uses three main strategies:

1) Everyone needs to make qualitative judgments about good and bad, not quantitative ones.

2) Good ideas should be seen by as many people as possible.

3) Bad ideas should be seen by as few people as possible.

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The first strategy reduces the cognitive burden of making judgments.

Participants were simply asked to make good or bad choices about the ideas they currently saw, without having to make any kind of comparison with other ideas.

As a result, judgment becomes easier, time becomes faster, and stress becomes less. The second strategy ensures that each participant has a chance to see a good idea and make his or her own judgment.

This allows for maximum objectivity in the final evaluation of a good idea, with less chance of making mistakes.

The third strategy ensures that bad ideas "die" quickly, allowing participants to focus their energy and time on the good idea. From this, we can get a new design of filter operation flow.

1) The number of participants is not less than 5;

2) Three participants were randomly assigned to make initial good and bad judgments for each idea;

3) If all three participants gave bad judgments, the idea was classified as a "bad group" and not assigned to more people;

4) Ideas that were not included in the "bad" group continued to be assigned to two new participants to make good and bad judgments;

5) If the first five participants' judgments were overwhelmingly bad, the idea was also classified as bad and no longer distributed to more people;

6) Ideas that were judged by five participants but not included in the "bad group" were then assigned to new participants, who made their judgments before being reassigned to the next participant;

7) Any time since then, an idea has had the same number of good and bad judgments, and the idea is classified as a "dispute group" and no longer assigned to more people;

8) Only when an idea is seen by all participants will it be classified as an "excellent" idea.

In this design, when the opinions of the first three people are denied, the collaborative filtering technology assumes that other participants will reach the same judgment, stopping the allocation of decisions to more people.

The error rate for this session was 1 in 8, that is there was a 12.5 percent chance of misjudging an idea that belonged in the "good" group as "bad".

If want to reduce this error rate, increase the total number of participants and adjust the setting from 3 to 5, so that the error rate can be kept below 4%, meeting the statistical requirement of 5% error rate. In order to simplify the complexity of the test and quickly evaluate the effectiveness of the filtering strategy, the operation process in this paper adopts the setting of three people in the initial judgment.

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4 Validation methods

It is expected that the new screening strategy will help improve screening efficiency while maintaining the quality of the results. Therefore, three groups were used for comparison. They are separately: Negotiation group, Scoring group and New design group.

Negotiation group adopts the Negotiation method to screen, and the output quality is the best among the four common methods.

The Scoring method is adopted in the Scoring group for screening, and time-consuming is the shortest among the four common methods.

In the New design group, the above screening process is adopted to understand the comprehensive performance of the new solution in terms of quality and time consumption by calibrating the output quality by Negotiation group and the time consumption by Scoring group.

A total of 50 ideas were presented to the three groups for selection.

This 50 creativity is all about mobile phone design of innovative ideas, through the Baidu search keywords "mobile phone innovations", and in order from the results after 2018, pick 50 ideas that have not yet been implemented on any phone or only on individual brands, for example, using holographic projection technology, can penetrate the screen in the palm and the entire operating system, can operate.

Each idea was made into a separate idea card for distribution and recycling during the test. The three groups used an inter-group design, each consisting of eight recruited volunteers. The volunteers of Negotiation group are all second-year graduate students majoring in industrial design in Guangzhou Academy of Fine Arts, so they can better play the role of experts in negotiation. Volunteers at Scoring group and New design group are recruited online, where everyone has their own smart-phone and is aged between 25 and 35.

In addition, volunteers in the Scoring group and the New design group must have no postgraduate qualifications or above, and not belong to industrial design and related majors, in order to form differences from the expert roles in the negotiation method.

The age and gender of the volunteers are shown in Table 2.

Table 2. Composition of volunteers in the three test groups

Grouping	Average age	Male	Female
Negotiation group	26	5	3
Scoring group	28	4	4
New design group	29	4	4

Each group was told to sift through 50 ideas and choose as many as were good.

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Participants in each group will be told what they need to do. For example, Negotiation group needs to discuss each idea and then reach a consensus through discussion. Scoring group requires everyone to score each idea on a scale of 0 to 10, and then rank the average score.

New design group needs to issue creative cards to each person in batches, and each person gives a judgment on the good or bad of the creative cards they have been given. After all participants understand what is to be done, the creative cards are distributed to the participants in the manner in which each group operates, and the timing starts.

When the final result is reached, the timing stops.

Each participant filled out a satisfaction questionnaire and the test ended.

Three variables were used to compare the performance of the three groups.

1) Screening time: The total time between the issuance of the idea card and the final result.

2) Screening quality:Taking the ideas selected by Negotiation group as the standard, the evaluation of the other two groups on these ideas was calculated respectively.

Screening quality = (The actual score/Theoretical maximum score) x 100%

3) Satisfaction:At the end of the screening, each volunteer rated his or her satisfaction with the screening process on a scale from 0 (very dissatisfied) to 5 (very satisfied).

The Negotiation group needs to discuss the ideas one by one, which takes longer than the other two groups that do not need to be discussed. Scoring group requires each participant to score each idea, while New design group allows less good ideas to be seen only by some people, so the scoring time is shorter.

Hypothesis 1: According to the order of Negotiation group, Scoring group and New design group, the screening time decreases successively. The Scoring group blends more noise into the scoring process for all ideas, blurring the boundaries between good and bad.

The New design group allows good ideas to be seen by all, and the introduction of collaborative filtering technology helps build consensus among the participants of the New design group and has an obvious effect on the improvement of Screening quality.

Hypothesis 2: Compared with the Scoring group, New design group has better Screening quality.

Hypothesis 3: The Screening quality of New design group is similar to that of Negotiation group.

The strategy of the New design group is to produce good results that are consistent with the consensus of the group in an efficient way.

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If this is achieved, participants should be satisfied with the whole process.

Due to the full negotiation, people will have a higher degree of acceptance for the results, but at the same time, the long discussion will also lead to fatigue, which will affect the satisfaction of the whole process.

As for the Scoring group, there is no need to discuss in the process, as everyone is only responsible for himself. Although the results may be poor, satisfaction on the process is better.

Hypothesis 4: According to the order of Negotiation group, Scoring group and New design group, the watchmaking process satisfaction rises successively.

5 Results and Discussion

The satisfaction of Screening time, Screening quality and Screening process of three test group is shown in Table 3.

Table 3. Performance of three test groups in screening time, quality and process satisfaction

Grouping	Screening time (minutes)	Screening quality	Screening process satisfaction
Negotiation group	89.45	100%	3.5
Scoring group	19.65	57.3%	3.7
New design group	17.75	91.8%	3.9

The results are consistent with the above four hypotheses and provide support for the effectiveness of the new filtering method based on collaborative filtering.

Negotiation group takes as long as 89.45 minutes, significantly longer than the Scoring group and New design group.

The latter two have no negotiation, and the final deliberation time is less than 20 minutes, which is 78% shorter and 80% shorter than the Negotiation group, indicating that the Negotiation group spends most of its time in negotiation and discussion.

Meanwhile, the process satisfaction score of Negotiation group is the lowest, indicating that participants are dissatisfied with the fatigue caused by long-term negotiation.

Thus, while negotiation contributes to a full discussion of ideas and consensus, taking long time as a price for high quality does not meet the needs of participants.

New design group is nearly 2 minutes faster than the Scoring group in terms of Screening time.

This was mainly due to the fact that bad ideas were not distributed to other participants after a few participants had seen them, thus reducing the overall evaluation workload.

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In total, 400 person-times of evaluation are needed in the Scoring group. However, only 318 person-times of evaluation are performed in the final screening of the New design group, which is 20.5% less than the workload of the Scoring group.

This indicates that collaborative filtering technology in New design group does effectively reduce the workload of participants and make the filtering process more efficient.

It is worth mentioning that New design group not only performs well in the Screening time, but also is similar to the Negotiation group in terms of Screening quality.

This means that New design group can improve efficiency while avoiding the occurrence of quality landslide.

The New design group also scored the highest among the three test groups in the process satisfaction score, reflecting participants' approval of the new approach.

However, the current comparative test is still insufficient in the data sample.

Although the time of New design group is shorter than that of the Scoring group, there should be more room for improvement in efficiency if computer programming is used instead of manual distribution in future tests, as the New design group conducts manual distribution scheme in 8 rounds and there is a certain interval between each round. At the same time, it is hoped that more data can be used in the future to conduct more accurate quantitative demonstration of hypothesis and effect from a statistical perspective.

In addition, applying the new design to a greater number of creative sifting will help to better understand the scope of the new design and its value.

6 Conclusions

Theoretical guesses have been somewhat validated by comparative testing.

The new screening method based on collaborative filtering theory performs better than the two traditional screening methods which focus on speed scoring and quality negotiation.

The new design achieves a faster screening speed than the scoring method by effectively reducing the workload, while obtaining Screening quality close to negotiation method by maintaining the establishment of consensus. The new screening method combines speed and quality and can be easily implemented online, making it possible for participants to complete creative screening in future mobile scenarios.

In addition, the effectiveness of the new strategy also provides new thinking on issues involving negotiation and consensus in telecommuting and teleconferencing. It may not be impossible to have your cake and eat it, with good strategy.

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