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Creative reflections on brainstorming

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Brainstorming is the default method of idea-generation in organisations, and is widely applied in higher education by students, academics and support staff. Its popularity is mainly attributable to an illusory belief that groups working together are more productive than individuals working apart. Shared responsibility, the need for collaboration and the social dimension to work also sustains the popularity of brainstorming. To add further insight to the numerous studies that have been demonstrated the inefficiencies of brainstorming, this paper describes preliminary results on participants' self-reflection during a brainstorm. Recommendations are made for improving the productivity of group brainstorms.

Keywords: brainstorming; group dynamics; creative problem-solving; idea generation

Introduction

Reference to the first use of the phrase 'Brainstorming' is made in Alex Osborn's published books: How to think up (Osborn 1942) and Applied imagination (Osborn 1963). This latter text states (151):

> It was in 1938 when I first employed organised ideation in the company I headed. The early participants dubbed our efforts 'Brainstorm sessions'; and quite aptly so because in this case, 'brainstorm' means using the brain to storm a problem.

Osborn (1888–1966) was an executive for BDO (Barton, Durstine & Osborn) an advertising company he formed in 1919. After publishing books on the subject of creativity based on his researches on 'organised ideation' at BDO, he founded the Creative Education Foundation (CEF) in Buffalo State, USA.

Osborn's book first signalled the idea that creativity, rather than being the gift of a tiny minority, could be harnessed and channelled in a deliberate way by any individual or group of people, to solve problems or challenges that needed new ideas. His books along with other published research of the time (for example J.P. Guilford's 1950 work on divergent thinking) nurtured a climate of creativity for all, and brainstorming was the way for anyone to contribute to the generation of original ideas.

Osborn later partnered with Sidney Parnes – an academic based at Buffalo State University – and developed the first version of a more complex process that included brainstorming known as creative problem-solving (CPS), and founded the Creative Education Foundation's Creative Problem-Solving Institute (CPSI). This institute hosts the world's longest-running (> 50 years) annual international creativity conference (CPSI Conference).

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I first attended CPSI in 2006 where I learned the methodology of CPS and experienced 'real' brainstorming for the first time. My prior experience of brainstorming in both industry and academia had been quite different to that developed by Osborn in the US.

Following my attendance at the CPSI conference, I presented numerous workshops involving brainstorming with groups of people in UK secondary schools, higher education institutions and businesses. In addition to facilitating these workshops they also provided an opportunity for action research and some of the findings are described later.

One qualitative observation from this research concerned the various groups' general knowledge of brainstorming. Before beginning a group brainstorm session, I enquired with the attendees how many had previously attended a brainstorm at some time, and it was a rare occasion to find someone who hadn't. This was then followed by a question about what the preparation and guidelines were for running a brainstorm and this usually met with silence.

The general view on the constitution of a brainstorm seems to be: 'A group of people gathering together to solve a problem with new ideas – a kind of creative free for all!' This simplified description chimes with Osborn's observation in *Applied imagination* (Osborn 1963) when he says (151):

> Brainstorming has become so much a part of the American scene that the verb brainstorm, in the sense of creative effort, is now included in Webster's International Dictionary and defined as follows: 'To practice a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously contributed by all its members'.

Furthermore Osborn had observed (Osborn 1963, 152):

> In the early 1950s brainstorming became too popular too fast, with the result that it was frequently misused. Too many people jumped at it as a panacea, then turned against it when no miracles resulted. Likewise, too many people erroneously regarded group brainstorming as a complete problem-solving process, whereas it is only one of several phases of idea-finding; and idea-finding is only one of the several phases of creative problem-solving.

It is important to note that during the time that brainstorming in groups was becoming very popular, evidence was emerging that it wasn't the best way to find ideas even when Osborn's brainstorming guidelines were being applied. This was based initially on a research study at Yale university (Taylor, Berry, and Block 1958) showing that the number of ideas produced by individuals working alone (nominal groups) on a creative challenge and then pooled, was twice as great as that obtained with a group working together. Prior to attending the CPSI conference the 'mis-used' form of brainstorming described by Osborn concurred with my own experience of being a participant in the process.

Following the aforementioned Yale study, numerous published studies (summarised in meta analyses by Diehl and Stroebe 1987; Mullen, Johnson, and Salas 1991) have unequivocally confirmed that individuals working apart produce more ideas than when they work in a group even when applying Osborns' guidelines. In their meta-analysis of productivity in brainstorming, Mullen, Johnson, and Sallas (1991, 18) arrived at the following salutary conclusion about brainstorming: 'It appears to be particularly difficult to justify brainstorming techniques in terms of any performance outcomes, and the long-lived popularity of brainstorming techniques is unequivocally and substantively misguided'.

At the current time group brainstorming is more popular than ever, and is practised in the majority of organisations of any size or shape from the village parish council to large business corporations and in schools and universities. It is the established default process

used to deliberately apply creative thinking in groups, to find new ideas for solving virtually any kind of problem big or small.

Given these aforementioned facts that the mis-used form of brainstorming is still in widespread use, and the results starting with the Yale study (Taylor, Berry, and Block 1958) showing it is much less productive than nominal groups, raises two important questions that are discussed here: Why does brainstorming continue to be so popular? And given that it is so popular: How can the productivity of group brainstorms be improved?

Before addressing these questions further it will be useful for the purposes of discussion to describe Osborn's brainstorming process. This is followed by a brief summary of some of the research on brainstorming up to the present.

Osborn's original brainstorm

The standard procedure for a conventional group brainstorm consists of a number of people (Osborn suggested between six and 10) working together in the same room, seeking ideas to solve a prescribed problem or challenge. The challenge is stated and ideas are recorded one at a time usually on a flip-chart or whiteboard by either a member of the group or by a facilitator. Having an experienced facilitator present at a brainstorm is often overlooked. Most sessions proceed without one and instead someone from the group is elected to record the ideas and to also include their own.

Osborn originally described four basic principles to guide a group brainstorm. These are 'Deferment of judgment', 'Quantity breeds quality', 'Free-wheeling is encouraged' and 'Combination and improvement are sought' described separately below.

Deferment of judgment

This aims to avoid the ever-present tendency for others to assess or critique ideas as they are put forward. This is particularly challenging for academics engaged in research because critical thinking and creative thinking are in a sense inseparable in dialogues concerning research questions and new ideas. In a typical dialogue someone might suggest an idea and this might then be challenged as not consistent with current theory, counter to agreed assumptions, information may be supplied indicating this idea had already been tried before, etc.

Here the dialogue is focused more on finding truth than it is on finding a number of new ideas. Such truths are not necessarily objective, especially when there are competing theories, and the outcome may be dependent on which school of thought the protagonist subscribes to. Nevertheless the outcomes from this kind of discussion are, generally speaking, not a long list of ideas, but maybe one or two high quality ideas arrived at through analysing and discarding lots of potential ideas on the way.

A brainstorm is a quite different kind of interaction usually involving more than two people, and is initially concerned with finding as many ideas as possible without discarding any. The alleged merits then of the principle of 'Deferment of judgment' seem at first sight clear. In practice this is facilitated by issuing instructions to the group to avoid any questioning, commenting on ideas, challenging assumptions or offering opinions on the quality of ideas put forward by others, no matter how extraneous or bizarre such ideas may appear. There is however plenty of opportunity to discard ideas in the second stage of a brainstorm which takes place after the idea-generation stage is deemed to be over. In many current brainstorms in large or small organisations, the time allocated to idea-generation is usually between 20 and 60 minutes.

Quantity breeds quality

In a brainstorm the default method of finding ideas is by free association. The group having been given the problem or challenge statement, seek ideas in a spontaneous, accidental fashion through internal 'semantic networks' of association connecting the challenge to other words, phrases, concepts and experiences they can recall from memory.

The first flush of ideas that emerges – provided the aforementioned deferral of judgment is adhered to – tend to be the rather familiar associations that many people would have.

For example in workshops I have conducted, I have invited the brainstorm groups to list as many ideas (words, phrases, slogans and visual icons) they have in response to the question: 'What is Creativity?' To assist the flow of ideas I have added the prompts: 'What does creativity look like?', 'What does it feel like?', 'Where is creativity?', etc.

The first set of ideas that arise are typically listed as follows (this was with a group of PhD students): originality, having ideas, innovation, invention, artistic, thinking outside the box, imagination, doing things differently, being inspired, and drawings invariably included a light-bulb and a flash of lightning. The rate of suggested ideas drops off rather quickly after this initial flow of associations. However if the group is further encouraged by the facilitator to come up with more ideas, less familiar associations start to appear such as intuition, exciting, insight, surprising, unusual connections, ingenuity, envisioning, holistic, irrational thinking, finding order in chaos, and visual images include sketches such as clouds with the sun peeping through, random patterns and spirals. A brainstorm facilitator working with the 'Quantity breeds quality' principle will continue to encourage the group to come up with ideas even though quite a few people are no longer contributing.

As part of my research, I have asked the numerous groups how they are feeling, at the point where there is a long list of ideas and the flow of ideas has virtually stopped, and there is a general sense of discomfort, boredom, restlessness and the desire to stop the brainstorm. The capacity in some people to continue seeking ideas at this stage is referred to as 'tolerance to ambiguity' in the literature (Norton 1975). Occasionally however, some people will say they feel energised at this point and the experimental work by this author described later was prompted by this observation.

The important point about this is that the more interesting and unusual ideas start to appear later when the rate of suggested ideas has diminished almost to a standstill. However, few people are contributing at this time, and would prefer to be doing something else.

'Free-wheeling is encouraged'

This encourages participants to contribute ideas as they arise no matter how wild or imaginative. Clearly this will not happen if the deferment of judgment guideline is not adhered to because criticism of ideas can inhibit the performance of other people.

'Combination and improvement are sought'

Osborn stated (Osborn 1963, 156): 'In addition to contributing ideas of their own, participants should suggest how ideas of others can be turned into better ideas; or how two or more ideas can be joined into still another idea'.

Seeing the individual contributions to a brainstorm written up in one place can trigger a new cascade of associations leading to more ideas. Even if the newly formed ideas are not combined with the ideas that stimulated them, they can in theory have an amplification effect on the total number of ideas generated.

In later developments of Osborn's technique, the divergent and convergent thinking styles of J.P. Guilford (1950) were incorporated into the brainstorming guidelines and the over-arching principle of brainstorming became: 'Diverge before you converge!', with the aforementioned guidelines enabling divergent thinking.

When sufficient ideas have been generated and recorded, the next stage of convergence ensues in which the best ideas are selected, and this is an opportunity to engage in debate and to critique, compare and discard ideas that are irrelevant, impractical etc. For simplicity brainstorming here will refer simply to the idea generation (divergent) phase because it is this that has caused the controversies on its value and effectiveness and that has been the subject of research.

Creative problem-solving

Building on his brainstorming ideas, Osborn later introduced a more comprehensive process known as creative problem-solving (CPS), the first version of which consisted of three stages. These were fact-finding, idea-finding and solution-finding and each of these stages involved a separate brainstorm, first to re-shape the original challenge statement, then to find ideas for the challenge and finally to identify the best solution by testing against the appropriate criteria.

Over the next 40 years as part of the CEF's research, the CPS process (often referred to as Osborn–Parnes CPS) evolved to its most recent version which is defined as follows: 'working from the outside inward, comprises of three conceptual stages, six explicit process steps with six repetitions of divergence and convergence within each, and one executive step at the heart of the model to guide them all' (Puccio, Murdock, and Mance 2007).

It is important to note that CPS, unlike brainstorming for ideas only, usually takes a full day or longer to complete and would be impractical without a facilitator.

Productivity losses in group brainstorming

This section summarises some of the factors that contribute to the observed poor performance of group brainstorming based on research spanning some 50 years.

In all of the studies cited below, Osborn's guidelines were included in the brief to the brainstorm group. Studies were made in the early days (Meadow, Parnes, and Reese 1959; Parnes and Meadow 1959) of the productivity of idea generation with groups that were given no guidelines compared with groups that were given guidelines. The results showed a greater number of ideas and better quality ideas emerged from groups that applied Osborn's guidelines.

After the Yale publication (Taylor, Berry, and Block 1958) many other studies were conducted in order to understand whether or not brainstorming in groups worked, what the underlying influences were that led to the observed lower productivity of ideas in groups, and how these influences might be minimised. What emerged through these studies and the debate that has ensued is a complex mix of issues concerning the design of the experiments, the dynamics of the group, the degree of engagement of the individuals, the time taken, the nature of the problems set, whether or not a facilitator is present, quality, and how it is defined, versus quantity of ideas, and the way in which the ideas were gathered.

In spite of these complexities and with well-designed investigations, overwhelming evidence has emerged that the combined output of nominal groups exceeds that of real groups in conventional brainstorms by a large margin both in terms of quantity and quality.

The first comprehensive reviews of previous studies of brainstorming to confirm this was conducted by Diehl and Stroebe (1987). They reviewed 22 experimental studies that

compared group brainstorming with nominal groups and found that in 18 cases the number of ideas produced by the nominal group exceeded that of real groups. The remaining four involving two-person groups reported no difference. Six of these studies assessed the quality of ideas, which itself is not straightforward to define, and in each case the nominal groups performed better. Quality in these cases was defined as the sum of the quality ratings of the ideas produced by a given subject or group. Other measures of quality (e.g., those that exceeded a chosen score on a scale of quality), led to inconsistent results between studies and within individual studies.

These 'Productivity losses' as they are called in the literature, have also been the subject of in-depth studies by Diehl and Stroebe (1987), Diehl and Stroebe (1991) who discussed three kinds: 'Production blocking' arising from the procedure used in the brainstorm (Lamm and Trommsdorf 1973), 'Evaluation apprehension' which is the fear of critical evaluations by others (Maginn and Harris 1980), and 'Free-riding' which describes ways in which a participants' motivation to contribute is diminished. Their studies have shown that the most important contribution to this loss is 'Production blocking' due to waiting time as the ideas are serially recorded in writing. Strictly speaking these three mechanisms are not independent because, for example, the waiting time can provide more opportunity for an individual to reflect on their idea and their evaluation apprehension may build up to the point where they decide not to contribute. If this occurred several times it could be interpreted as free-riding.

In their meta-analysis Mullen, Johnson, and Sallas (1991) used different terminology to account for the lower output of ideas in real group brainstorms and this is summarised below.

'Procedural mechanisms'

These relate to the way in which the task performance time of each of the individuals is punctuated by the requirement to gather ideas one at a time from the group (identical to the aforementioned 'production blocking'). Examples here would be a change of mind about mentioning a potential idea during the waiting time to speak, or even forgetting an idea whilst waiting. Logic would dictate that larger groups would experience a greater loss of ideas due to the increased waiting time.

'Social psychological mechanisms'

These concern the internal dynamics of the individuals that are engaged when working in a group. This has two main components: (a) 'Drive arousal' (Geen and Bushman 1987) relates to the motivational forces moving us to goal-oriented behaviours. In the context of brainstorming these include emotional, social and cognitive goals. (b) 'Self-attention' (Carver and Scheir 1981) describes how we internally compare our own behaviour with that of the larger group. An example of productivity loss in this category would be the inhibiting effect on members of a team in the presence of someone of higher status or someone who appears to speak with authority. These mechanisms subsume Diehl and Stroebe's (1987) evaluation apprehension and imply other processes that determine individual performance in a brainstorm.

'Economic mechanisms'

These concern ways in which individuals intentionally modulate their efforts in the brainstorm (described earlier as free-riding). For example withdrawing effort by 'social loafing' (Kravitz and Martin 1986) when attendees no longer feel accountable to the brainstorm. Other knock-on contributions to this mechanism include the 'sucker effect' (Paulus and

Dzindolet 1993) by which is meant a fear of doing all the work for the free-riders or loafers. In general then attendees tend to match their effort to others in the group.

Mullen Johnson, and Salas (1991) reviewed 20 separate studies going back 25 years and quantified the relative contributions of the three productivity losses. Some of their findings are listed below and quoted from their paper.

Productivity loss will be greatest when:

> (a) The brainstorming group is relatively large in size (b) When the experimenter (or some authoritative observer) is present (c) When group members vocalise their contributions (rather than writing them down)…

Furthermore they observed:

> … that the stronger productivity losses in the context of larger groups, experimenter presence, tape-recorded vocalisation of contributions… were highly consistent with (a) social psychological mechanisms (b) moderately inconsistent with the procedural mechanisms and (c) highly inconsistent with the economic mechanisms.

These findings concerning the loss due to procedural mechanism were contrary to those of Diehl and Stroebe (1987). Mullen, Johnson, and Salas (1991) suggested that whilst procedural mechanisms might contribute to loss, this was secondary to social psychological mechanisms. Furthermore with regard to the inconsistency with economic mechanisms the implication of these studies is that people are not deliberately underproductive in a brainstorm. This may be the case in facilitated brainstorms but further research is required to verify this in situations where there is no facilitator present, which is often the case in many brainstorms that are part of larger meetings.

Another form of productivity loss that belongs with the earlier classification of 'Economic mechanisms' has been identified from studies of intelligence analysts. These people, who spend a good deal of time generating hypotheses, are increasingly required to work in teams, and studies (Straus, Parker, and Bruce 2011) have shown that they are subject to the 'common knowledge effect' (CKE) (Gigone and Hastie 1993). This is an effect whereby a minority of people who have knowledge relevant to the challenge for which ideas are being sought, fail to introduce it into the discussion and when they do it is overlooked. Furthermore it has been demonstrated that discussions are more likely to ensue about information that is shared by the majority even when unshared information is introduced into the discussion.

There are other intrapersonal factors that can influence the productivity of brainstorming groups such as personality characteristics, e.g., proneness to social anxiousness (Furnham and Yazdanpanahi 1994; Camacho 1995) and the role of mood (Baas, De Dreu, and Nijstad 2011), gender differences (Nijstad et al. 2004) and culture differences (Lamm and Tromsdorf 1973). Recent developments in neuroscience and cognitive psychology are also contributing to a better understanding of the cognitive factors that influence idea generation in brainstorming (see for example Iyer et al. 2009; Doboli and V. Brown. 2009). It's not within the scope of this paper to review these factors except to note that a better understanding, if not a more complex picture, is emerging from these parallel strands of research.

Improvements to group brainstorming

The work cited in the previous section has established that nominal groups under normal brainstorming conditions, irrespective of group size, most of the time out-perform groups working together in terms of the quantity and quality of ideas produced.

Given this fact, if finding ideas was the most important reason for groups that are facing common challenges to meet and work together in organisations, then the practice of brainstorming would have ended decades ago. Apart from, for better or worse, the usual meetings that are necessary to ensure the smooth running of an organisation, there is a stronger desire with many people to meet when there is an opportunity to exercise their creativity. Based on earlier research (Diehl and Stroebe 1987) and feedback conducted by the author after a brainstorm, it is usually viewed as an enjoyable, social occasion to work with colleagues in a more engaging way away from the daily routine. However, how much of this enjoyment can be attributed to immersion in creativity rather than an opportunity for social intercourse remains an open question.

Another perhaps more important reason why brainstorming continues to be popular is due to what has become known as the 'Illusion of Productivity'. This stems from a belief, in spite of published research to the contrary, that a group working together will be more productive than the same individuals working apart. Intuitively one expects this to be the case because different people bring different knowledge and experiences to a group, but the numerous studies on productivity blocking show that this doesn't happen in practice. The illusion of productivity ranks alongside numerous other cognitive illusions that have been the subject of intensive research in recent years, and testimony to their importance in contemporary thought is the award of a Nobel prize to one of the pioneers of this field of research Daniel Kahnemann (Tversky and Kahnemann 1974).

In larger organisations the need for direct involvement in brainstorming by members of the organisation with a shared ownership of future challenges, is driven from both the top down – good leadership practice – and the bottom up – the desire by individuals to be involved, partly for career development purposes, in shaping the organisation's future. This plus the aforementioned other reasons will ensure that real-time group brainstorming will continue to be popular. Given these facts there is a challenge to improve group brainstorming in order to diminish the productivity gap both in terms of quantity and quality of ideas because nominal groups lack these social, and group ownership benefits.

With the advent of personal computers in the 1990s electronic methods of brainstorming were first demonstrated by Dennis, Valaich, and Nunamaker (1990). This approach enabled the more productive nominal group to share ideas resulting in greater group productivity. With the Internet and mobile telecommunications technologies much progress has been made with this form of idea generation, and it is commonplace now to find electronic brainstorming taking place in a huge variety of social networks and other media.

A number of studies on electronic brainstorming have been conducted (Gallupe et al. 1994; Valacich, Dennis, and Connolly 1994; Cooper et al. 1998) and the general results are that it is more productive in quantity and quality than real groups. However studies by Pinsonneault et al. (1999) have shown that additional process losses can appear in electronic brainstorming resulting in lower productivity compared with nominal group brainstorming. In common with real brainstorming, there is a measurable sense of satisfaction by participants in electronic brainstorming (Valacich, Dennis, and Connolly 1994). However electronic brainstorming like video conferencing and Skyping is not the same as a real meeting and only partly fulfils the aforementioned benefits of meeting people in the same room.

The majority of brainstorms are led by someone who is a member of the group and who has a stake in the challenge or problem being discussed. This in itself can lead to problems of bias and to deal with this Osborn (1963) had originally suggested that a trained facilitator should lead a brainstorm, though very few studies followed this advice. A facilitator is not a member of the group and is someone skilled in eliciting interaction between, and encouraging involvement with, all group members. This approach was endorsed by Gross-

man, Rodgers, and Moore, (1989) and in another study (Offner, Kramer, and Winter 1996) provided additional guidelines (to Osborn's) to participants to enable a more equal contribution from team members and to minimise irrelevant discussions or monologues.

A closure of the productivity gap was also observed in another study (Oxley, Dzindolet, and Paulus 1996) when facilitators were trained to help keep the brainstorm focussed by applying the following additional guidelines: (a) stay focused on the task; (b) do not tell stories; (c) do not explain ideas; (d) keep people talking, possibly by bringing up previous ideas; (e) encourage others to contribute and (f) remember not to criticise (i.e., Osborn's 'defer judgment' rule).

More recently (Paulus et al. 2006) undertook a detailed investigation of the effects on idea-generation in both nominal and real groups with various combinations of a facilitator present, with Osborns' rules only and with the inclusion of the additional guidelines. Although, in keeping with earlier studies, the real groups didn't perform as well as the nominal groups irrespective of additional guidelines, the productivity gap for the real group was narrowed considerably when the additional rules were applied.

Taking short breaks is another intervention that has been shown to improve group brainstorming productivity (Offner, Kramer, and Winter 1996; Paulus et al. 2006). The results of the experimental work described in the next section also suggest that a break from brainstorming would help restore the participants' creative behaviour.

Finally several studies have been carried out on brainwriting (i.e., writing down ideas individually whilst participating in a group brainstorm) and the results produce a reduction in the productivity gap between brainstorming groups and nominal groups (Van Gundy 1984; Madsden and Finger 1978; Heslin 2009).

Experimental work

Referring to the work of Mullen, Johnson, and Salas (1991) it is clearly important to understand the social psychological mechanisms better in order to make additional recommendations for improved versions of brainstorming. Furthermore it is well known that brainstorms decline after a short period of time when the rate of idea generation drops as described in the earlier section on 'Osborns' original brainstorm'. This is particularly apparent when the brainstorm is not led by a skilled facilitator and during this decline fewer people are actually contributing to the brainstorm and may well be further contributing to productivity loss by free-riding etc.

In work conducted by the author with several groups of PhD students involved in brainstorming their research challenges, a state of what can be described as 'Creativity fatigue' was often observed in which participants simply don't wish to think about new ideas any more. It was of interest therefore to explore how individuals felt about their own creative state during a brainstorm, how this changed over time and how quickly fatigue could set in.

To this end a 'Creativity thermometer' was devised that consisted of a chart which enabled each individual to reflect and record their performance at regular intervals during the brainstorm. The chart shown in Figure 1 below consisted of an adaptation of the Yerkes–Dodson inverted 'U' curve (shown to the left of the figure) of performance versus arousal (Yerkes and Dodson 1908) on the vertical axis, and time along the horizontal axis.

The original Yerkes–Dodson curve describes how performance increases with physiological or mental arousal, which in turn relates to the emotional demands put upon the individual. In Region 1 (R1) where performance is minimal there is low arousal characterised by inactivity or lassitude. Region 2 (R2) indicates an increased alertness, higher energy and engagement as performance improves to its optimum. Finally in Region 3 (R3) there is a

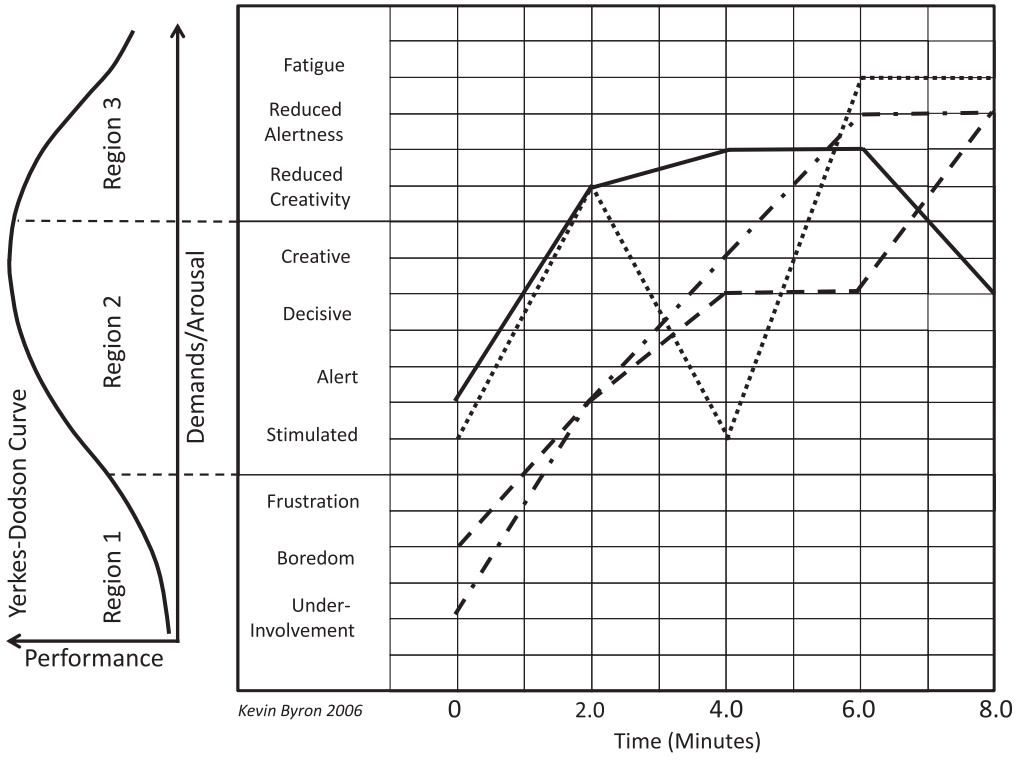

Figure 1. Reflective assessment of arousal by individuals during group brainstorming.

decline in performance as healthy strain turns to stress, due to over-arousal, and this is marked by reduced concentration and lack of alertness. Creative thinking is associated with a positive, energised state and is located in R2. Of course not all tasks are as intensively creative as idea-generation so other positive task dependent labels could be attached to this region too.

In the investigations there were six separate groups of students each with either four or five members per group. There were no facilitators but one member of each team had the role of writing the ideas on a flipchart and also contributing their own ideas. Each team member was supplied with their own 'Creativity thermometer' and invited to briefly reflect on and record how they were feeling at regular intervals during the brainstorm without sharing their thoughts with the other team members.

The first point that was recorded on the chart was just after the challenge had been described. The plots in Figure 1 show a typical result for four people in the same group brainstorm working on the 'hybrid car'[1] problem. Here we see that two of the group members started off at a low level of involvement in the problem whereas the other two felt they were more engaged.

On commencing the exercise there was a general trend by all participants in this example toward the region of higher performance and engagement, but with the exception of one person, it was surprising how short-lived the experience of working at their optimum had been. There is some indication that one of the team felt re-energised again after six minutes but the other three experienced a sense of fatigue or over-arousal after only 10 minutes.

The general trend of the plots obtained from all groups was from the bottom left corner to the top right corner over a time similar to that shown in Figure 1. There was usually variation within this trend for each group however with a few individuals starting off in R2 and remaining in this region for the duration of the brainstorm, which lasted 10 minutes. By the end of the brainstorm 68% of all participants had entered R3. These investigations have been repeated on two other occasions with multiple groups and similar results obtained.

These preliminary studies indicate that groups working without a facilitator very quickly cease to be productive. Furthermore, inasmuch as the participants could be described as harmonising during the brainstorm, the similarity of the plots shown in Figure 1 may be suggesting that the group are normalising through internal comparisons of their own behavior with that of the larger group (e.g., through self-attention; see Carver and Scheir 1981), again resulting in productivity loss.

Conclusion and recommendations

Given the reasons described earlier that group brainstorming is likely to continue in organisations even though it is not the best way to generate ideas, there is a need to ensure it is as effective as possible. Based on the earlier discussions on previous studies and the action research of the author a number of recommendations can be made to optimise idea generation in a group brainstorm.

The most important contribution to improving the productivity of brainstorming groups is in having an experienced facilitator to run the brainstorm (which rarely happens in brainstorms that are part of larger meetings). Ideally the facilitator would have no ownership of the challenge being discussed. The facilitator can extend the time over which people remain productive by adding prompts and additional instructions, and by reminding attendees of the guidelines when these have been ignored. Furthermore they can identify when creativity fatigue has crept in and call for periodic breaks as and when necessary.

To simulate the benefits of the superior productivity of nominal groups, by having a parallel activity in a group brainstorm of anonymous 'brain-writing', some reduction in productivity blocking can also be obtained. Furthermore by continuing the brainstorm as a nominal group after the real brainstorm, by means of a social network or e-mail group a further narrowing of the productivity gap can be achieved.

Another benefit can be gained if the group is large – say six people or more – by dividing the brainstorm group into smaller independent groups (they can still be subject to one facilitator if there is one available). Techniques such as 'World Café' (Brown and D. Isaacs. 1995) and 'Open Space' (Owen 1997), though longer duration events can be adapted to smaller scale and shorter duration.

One technique that the author has developed for larger groups where there is limited time is to write the challenge on say three flip-charts attached to different places in the room. The attendees are then invited to have two or three random paired conversations about the challenge then write down any ideas that arise on to the flipcharts. This much more fluid approach fulfills all the organisational desiderata for a meeting and again simulates aspects of a nominal group. In paired conversations there is also the opportunity to engage in a more critical dialogue by suspending the 'Deferment of judgment' guideline. Indeed this could be tested in larger groups in order to lead to higher quality ideas.

Finally it is worth mentioning new technology developed by Wunderworks (http://www.dicolab.com/) that has been developed to support a brainstorm as both a real and nominal group at the same time. This consists of a data projector connected via a computer to an array of wireless keyboards. Each participant can type in their ideas on their own keyboard

whilst seated in a group and offering ideas verbally to the facilitator who records verbal responses in the conventional way.

In conclusion there is still much to learn about the dynamics of groups engaged in brainstorming in order to improve productivity. The preliminary investigations of reflective observations of creative behavior during brainstorming described here is a novel approach that may cast further light on future studies. Clearly the influence of procedural interruptions on productivity with this approach needs to be investigated. Future work will compare the reflective observations of individuals working in groups with and without a facilitator, in nominal groups, with different problems and whilst applying different idea generation tools.

Note

1. In the hybrid car problem the team are invited to come up with ideas to solve a problem caused by the low engine noise of hybrid cars when they are driven in urban areas. Whilst this has an ecological benefit because they are powered by electricity, it has resulted in an increase of accidents with people with sight impairments who can no longer hear them approaching. The teams are invited to brainstorm both socially engineered and technological solutions.

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