CHAPTER - 4

BRAINSTORMING IN GROUP CREATIVITY

4. Introduction:

‘Brainstorming’ is a term that is frequently used, misused and misunderstood. Brainstorming was first proposed by the advertising executive Alex Osborn, in his book ‘Applied Imagination’ (Osborn, 1967). He invented it as a tool to assist idea generation, to be used in creative problem solving (CPS). As such it should not be confused with the process of idea generation itself, nor that of creative problem solving. Osborn himself defined brainstorming as "a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously by its members" (Osborn, 1967). He also described it as “a means of group problem solving that considerably increases the quality and quantity of ideas produced by groups” (Osborn, 1967). The emphasis of brainstorming was on, coming up with as many deliberately unusual solutions as possible. But unfortunately, its interpretation vary widely even between the various scientific papers produced from brainstorming studies. Studies have revealed that group level creative output extends beyond simple brainstorming or idea generation. However, much of the researchers have not ventured into remodeling the basic concepts of brainstorming and studying its effects on individual or group performance. This is what the study aims for.
4.1. Brainstorming vis-à-vis idea generation:

Research has consistently shown that people perceive brainstorming in groups to be more effective (Homma, Tajima, & Hayashi, 1995; Paulus, Larey, & Ortega, 1995) and believe that groups will help to produce higher quality ideas (Rowatt, Nesselroade, Beggen, & Allison, 1997) than individuals brainstorming alone. There is an inconsistency between the impression held by brainstorming groups about the success of their productivity and their actual performance under laboratory conditions.

Clearly, intuition tells people that group brainstorming has something to offer over and above the simple combination of individually generated ideas. In addition, group level creative output extends beyond simple brainstorming or idea generation; for creative groups to be successful in the workplace, their ideas need to be both novel and useful (Amabile, 1988.) In addition, research in creativity also reminds us that creative products can be described not only by their novelty or originality, but also by the degree of fluency (quantity of distinct thoughts) and flexibility (number of different perspectives, or categories of thought) they contain (Guilford, 1950.) Research has also shown that groups tend to be better than individuals at idea evaluation (McGrath, 1984), which is a necessary step towards choosing ideas that will be not only novel but useful as well. Indeed, this dissertation, in line with previous research (Quinn and Rohrbaugh, 1983), considers creativity and quality to be distinct constructs, both of which are valued for the
creative team’s work. Therefore, there is a benefit to creative production for people to work together in teams instead of brainstorming alone and then pooling their individual ideas. Thus, it is possible that, as commonly thought, teams do have something to offer to creative tasks (like brainstorming)—something that has yet to be captured by researchers in this field.

This research project attempts to extend the literature in this field by exploring the central research question: What is it about groups, specifically, that makes for the most effective creative outcomes? The central theme of this research is that there are two elements of crucial importance to understanding effective creativity in teamwork: the individual differences in the team members’ creative style, and the ways in which the team members interact during the team’s process. This project also suggests a link between the two; different combinations of creative style in individual team members may be related to the types of social and cognitive interactions that team members may have. Individual creativity is the motor that drives the group creative outcomes; however, the team’s processes provide the harness that translates the creative energy from the individual minds into a group level outcome.

Individual creativity, defined as the propensity for idea generation, is most important to the team because all ideas need to start within individual minds, even if these ideas are later shaped and changed by others in the group. The presence of this trait is a necessity for groups striving for creative output. However, as research in the past has shown (e.g. Kirton, 1976, 1989), creative style in individuals and the propensity for idea generation
may come attached to other personality traits such as resistance to rules and group norms, or more boundary-breaking thinking styles. Traits like these may make it more difficult for teams to coordinate their activities in order to be able to best translate their individual skills and talents into team-level outcomes. Therefore, though some individual creativity is necessary for teams striving for creative output, there may be an optimal amount, proportionally, of individuals high on this creativity dimension for a team to achieve its highest performance.

4.1.1. Productivity in creative teams:

Issues of coordination are faced by all groups of individuals working on a common goal or task. While, as researchers, it is most relevant to examine how a group performs as a whole, it is impossible to forget that the group is made up of individual members, each of whom has individual ideas, agendas, and strategies as to how the group process and the outcome should occur. Clearly, all group members are going to face challenges of coordination, “process losses” (Steiner, 1972), and conflict en route to successful group production. This project asserts that in the specific case of creative teams, or teams that are striving for creative outcomes, these challenges are going to be even greater since individual creativity may go hand in hand with other traits that make coordination even more difficult and conflict (disagreements or differences of opinion on any topic) all the more likely. This dissertation explores the interaction among creative and non-creative individuals as they engage in a group creative task. Creative ideas thrive on openness of
thought (Sternberg and Lubart, 1993), yet conflict seems to be triggering the opposite effect.

However, in the group context, certain types of conflict such as disagreements of opinion on specific work issue and goals, can aid the creative process (James, 1995.) Trying to conceptualize a group working on producing innovative ideas can elicit images of people engaged in heated debate and thriving in a noisy environment where conflict, argument and discussion merge to unleash creativity. The question paused is what type of conflict becomes a necessary part of creative production? Which aspects of conflict aid the creative process, and which hinder it? Much research has been done on the idea that conflict does play a role in group work (e.g. Amason and Schweiger, 1994; van de Vliert and de Dreu, 1994), though this role is not understood fully and properly. Conflict in this research has been shown to enhance the quantity of ideas in a work group if the disputants’ goals were positively interdependent, when tension levels were high, and when the conflict was focused on task issues. Though disagreements can bring to light more diversity of opinions and may actually aid the creative production process, (James, 1995; Smith and van der Meer, 1994; Kolb and Glidden, 1986), the dangers of the negative affect that conflict can cause are a risk to the team process, like performance management.

4.2 Traditional brainstorming:

It is crucial in the first instance to appreciate exactly what is meant by the term ‘brainstorming’ since it is a term that is frequently misused and misunderstood. Its
interpretation varying even between the various scientific papers produced from brainstorming studies. Brainstorming was first proposed by the advertising executive Alex Osborn, in his book ‘Applied Imagination’ (Osborn, 1967). He invented it as a tool to assist idea generation, to be used in creative problem solving (CPS). As such it should not be confused with the process of idea generation itself, nor that of creative problem solving.

According to Osborn, brainstorming is "a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously by its members" (Osborn, 1967). He described this method as “a means of group problem solving that considerably increases the quality and quantity of ideas produced by groups” (Osborn, 1967). The major emphasis of brainstorming was on, coming up with as many deliberately unusual solutions as possible and to push the ideas as far as possible. Crucially, it was only ever seen by Osborn to be a supplement to individual ideation and was never considered to be a replacement. He was keen to emphasise the importance of individual ideation both before a brainstorming session and after in achieving maximum creativity.

A traditional brainstorming session typically comprises a group of four to fifteen people working together in a room suggesting ideas which are noted down, usually on a flipchart or blackboard, for analysis at a later stage. A facilitator should be present to introduce and coordinate the session and to ensure that the brainstorming rules are followed. The
introduction should involve detailing the purpose of that particular session and should also include an outline of the rules of brainstorming.

Osborn (1967) defined four basic rules of brainstorming. All these basic rules aim to promote flexibility and fluency by overcoming motivational and social factors that can inhibit idea generation in a group.

The four rules are:

1. Criticism is ruled out. This includes self criticism as well as criticism of other. Judgment of ideas should be deferred until a later stage. The premise is that even a seemingly foolish idea can spark off better ones.

2. 'Freewheeling' is welcomed. The wilder the ideas the better. Wild and exaggerated ideas should be encouraged as these may in turn spark off more valid ideas.

3. Quantity is wanted. The more ideas the better, as this will increase the capture of a good idea and the chance of sparking off new ideas in others.

4. Combination and improvement of ideas is sought. The aim is to elaborate on and expand the suggestions and ideas of others, using the ideas of others as inspiration for your own. At the same time, combination of existing ideas can allow the exploration of
new possibilities. While the emphasis was on these guidelines, Osborn also made a number of suggestions to encourage effective brainstorming:

4.2.1 Conditions stipulated in traditional Brainstorming:

Firstly, a brainstorming session should have a facilitator who should:

- Have taken a course in creative problem solving.
- Guiding the idea generation process.
- Be able to ask stimulating questions.
- Plan and schedule meetings and follow up sessions.
- Teach and reinforce the guidelines and provide practice and orientation for participants.

Secondly, participants should:

- Not be from different levels of seniority.
- Have a range of experience with the task.
- Be between 5 and 10 in number.(Group size)

Thirdly, a brainstorming session should:

- Be recorded by someone.
- Be preceded by individual ideation.
- Be followed up by individual ideation to allow incubation time.
Osborn claimed that by following the brainstorming rules "the average person can think up about twice as many ideas when working in a group than when working alone" (Osborn, 1967). As brainstorming has steadily gained in popularity since its inception, the practice of the technique has often lost its way. Despite being a simple technique, adequate training in its appropriate use is crucial to its success. This was a feature recognized by Osborn himself. Failure over time not to comply with the basic guidelines of brainstorming has meant that today the term has different meanings to different people and it is commonly used in modern organisations to represent nothing more than an informal discussion. The importance of this dilution of the terms meaning should not be underestimated and it is a point which will be returned to, but for now it should be clear that to study brainstorming in depth one must first be sure of the original meaning of the term as defined by Osborn.

4.2.2. Process losses in Brainstorming:

Traditional brainstorming has enjoyed a lot of scientific interest regarding its effectiveness. Much of this work has concentrated on comparing the productivity of group brainstorming with that of nominal groups (groups comprised of individuals who generate ideas alone and whose results are then pooled). This usually involves setting the two groups the same brainstorming task and then comparing the pooled nominal group results with those of the physical group.
The most common basis for comparison is the number and quality of ideas generated (Diehl & Stroebe, 1987 and 1991; Dennis et al., 1996; Pinsonneault et al., 1999; Dennis et al., 1999) and a number of such papers have shown that nominal groups outperform interactive groups both in terms of the number and quality of the ideas produced (Taylor, Berry, Block, 1958; Diehl & Stroebe, 1987) though the increased quality of ideas is often considered to simply be a side-effect of the increased number of ideas. Diehl & Stroebe, in their 1987 summary of brainstorming research, concluded that brainstorming groups have never outperformed nominal groups. Mullen, Johnson & Salas (1991), by statistical analysis of previous work, noted that productivity was “significant and of strong magnitude” between such groups both in terms of quantity and quality of ideas. Based on such comparisons, some authors have entirely discounted the usefulness of group brainstorming. (Diehl & Stroebe, 1987, 1991; Mullen, Johnson & Salas, 1991)

A number of reasons have been suggested for the apparent productivity loss in traditional brainstorming groups: Mullen, Johnson & Salas (1991) identified three classes of mechanism that can be used to explain the productivity loss: ‘Procedural mechanisms’, which include problems of how task time is split between participants, such as when participants interrupt one another, ‘social psychological mechanisms’, which represents the effects the group can have on the individual in a session, and ‘economic mechanisms’ which represent when participants intentionally withdraw from participation or make no effort.

1) Procedural mechanisms:
**Cognitive interference:** This effect, highlighted by Lamm & Trommsdorff (1973), is where a participant’s ideas generation is interfered with by the content of the ideas verbalised by the other group members.

**Duplication:** Numerous individuals coming up with the same ideas. This is not a problem in traditional brainstorming but it is noted in relation to nominal group technique and it may have an influence in wiki-based brainstorming. (Lamm & Trommsdorff, 1973)

**Production blocking:** Also highlighted by Lamm & Trommsdorff (1973), this phenomenon is where ideas are not verbalised as they occur because only one group member is able to speak at a time. While there is always time later on in a session to verbalise the idea, it seems that this does not happen in practice. This may be the result of participants suppressing ideas that they were not able to immediately verbalise because they may seem less relevant or less original later in the session. Alternatively, limited short-term memory may mean users simply forget their idea while listening to another speaker. Listening to another speaker may even distract them from their own thought process and so prevent them from thinking up new ideas. Another possibility suggested was that of nominal groups having more speaking time than interacting groups. Research in brainstorming has been based around ‘equal man hour’ comparisons, where participants are given an equal amount of time in both individual or group conditions, with the result that nominal group members effectively get more ‘air-time’.
Although not noted in the literature, it also seems possible that users having more time to reflect on their idea in such circumstances may hold them back (by increasing evaluation apprehension). Ideas that would otherwise have been contributed without much thought would now be more considered. Diehl & Stroebe (1987) assessed the effects of production blocking by introducing artificial blocking into nominal groups. They found that subjects able to suggest ideas as they came to them, produced approximately twice as many as they do when they have to wait for other participants to finish speaking. In total, as we will see, they assessed three major explanations of production loss in brainstorming. These were production blocking, evaluation apprehension and free-riding. While all three factors were seen to affect productivity, they concluded that production blocking affected it the most and provided the most convincing evidence. The results from this work and subsequent research (Diehl & Stroebe, 1991) ruled out the following explanations:

a) *Speaking time*: They ruled out the possibility that the difference might be caused by individuals in brainstorming groups having less speaking time than those that brainstorm individually by performing experiments where the length of time available to groups and individuals was varied.

b) *Re-evaluation of ideas*: The suggestion here was that participants listening to the comments of others may be distracted from looking at the chart of existing ideas or from making their own suggestions. By including experiments that involved introducing production blocking into nominal groups, they also concluded that blocking was unlikely
to result from a re-evaluation process that was thought might occur when participants were listening to the suggestions of another while waiting to raise their own suggestion. i.e. it was not the distractive quality of communication that was causing blocking.

c) Thought distraction: No difference was seen between a group blocked by lights that could hear other contributors and a group blocked by lights that could not.

d) Forgetting ideas: Diehl & Stroebe (1991) also looked into the suggestion that participants may be forgetting ideas or that they may try to avoid losing them from short term memory by rehearsing them, and that subsequently they are unable to come up with new ideas during this time. As one of the experiments in their 1991 study, Diehl & Stroebe studied the effect of external storage of ideas in brainstorming. They found that providing participants with notepads to externalise ideas and overcome the blocking effect did not have a profound effect on productivity. However, they did consider that participants may not be making the best use of note-taking as it is not an efficient alternative to keeping ideas in short term memory, being both effortful and time consuming. Mullen, Johnson & Salas (1991) found that their results were inconsistent with those of Diehl & Stroebe since they found production losses to be highly consistent with basic social psychological mechanisms and only moderately consistent with procedural mechanisms (while being highly inconsistent with economic mechanisms). From their perspective, then, the primary focus should be on eliminating the production losses that relate to basic social psychological mechanisms, rather than those that relate to procedural or economic mechanisms.
2) Socio-psychological mechanisms:

**Cognitive uniformity:** In a group environment, where everyone is hearing the same stimulus provided by the suggestions of others, there is likely to be a trend towards mutually similar suggestions (Lamm & Trommsdorff, 1973) and therefore away from the more ‘free-wheeling’ type responses. They also suggest that this might be augmented by motivational pressures as “interpersonal agreement, which is psychologically more comfortable than disagreement”.

**Social influence:** This represents when particular members of the group have a dominant effect over the group (McGrath, 1984 cited in Pinsonneault et al., 1999). This might happen, for example, if a group of staff were accompanied by a more senior member of staff in a brainstorming session.

**Evaluation apprehension:** This explanation, which revolves around self-criticism, has received a great deal of attention. It is based on the assumption that many people are unwilling to state some of their ideas because they are afraid of negative evaluation, despite the instructions in brainstorming. It seems plausible that the suppressed ideas are also likely to be the most original or ‘way-out’ ones. This effect has been shown in groups that are told they are being observed and rated (Diehl & Stroebe, 1987) and in groups that are told that other group members are experts (Collaros & Anderson, 1969). Experiments by Collaros and Anderson (1969) showed that the greater the number of
experts perceived to be in a group, the less productive the group became. Participants admitting feeling inhibited when another participant was thought to have greater expertise. They also felt their groups were less pleasant than the non-expert groups.

However, Diehl & Stroebe (1987) had different results. Two experiments were performed by Diehl & Stroebe in their 1987 study in order to establish the effects of evaluation apprehension and the second of these showed that while it may be a factor, it does not appear to account for the productivity gap between interacting groups and nominal groups as the gap is similar in both low and high evaluative conditions.

**Observational learning:** Watching others perform the same task may lead to some imitation of their performances. Pinsonneault et al (1999), regard this as a process gain, although Lamm & Trommsdorff, who originally noted it in their 1973 review of traditional brainstorming made no such claim. Although not seen in the literature, it seems plausible that this could lead to process gain or process loss depending on the level of performance of the group members. As a process loss this is distinct from productivity matching as it would involve specifically learning bad performance traits as opposed to simply applying less effort.

**Distraction:** Lamm and Trommsdorff (1973) suggest that face to face interaction involves social-emotional stimuli unrelated to the task, which may distract participants from the task. This can be due to many reasons like inter-personal conflicts, psychological and emotive distractions etc.
3) **Economic mechanisms:**

**Free-riding/Social Loafing** (Kerr & Bruun, 1983, Diehl & Stroebe, 1987): It seems in the literature that there are different meanings of the terms 'free-riding' and 'social loafing'. Kerr & Bruun (1983) interpret free-riding as motivation losses that result from participants feeling their ideas are dispensable, while they interpret social loafing as motivation losses as a result of a lack of identifiability in a group. Meanwhile others, including Diehl & Stroebe (1987), consider the term free-riding to be an umbrella term that represents both types of motivation loss. For the purposes of this study, the latter interpretation will be followed. Essentially, members of groups do not work as hard as when they work alone. The assumption is that any reduction in the ability for individual performance to be monitored will also reduce the perceived accountability and therefore motivation of the subject to produce ideas and make suggestions. Group members may therefore free ride on the suggestions of the other group members if all the suggestions are being viewed only at the group level. Decreased identifiability has also been shown that perceived effectiveness of suggestions may have an effect (Harkins & Petty, 1982). If so it is likely that increasing group size would decrease this perceived effectiveness and thus increase free-riding.

While there is support for the role of free-riding, experiments by Diehl & Stroebe (1987) that increased the accountability in groups determined that it is not a major cause of productivity loss in traditional brainstorming. They suggested that “temptation to free
ride should vary as a function of the cost of contributing” and that since there are no time
costs (as participants are already committed to attending the session) and since
brainstorming is almost effortless, there should be little temptation to free ride. Williams,
Harkins & Latane (1981, cited in Paulus & Dzindolet, 1993) also suggest social loafing is
unlikely where participants can be identified with their ideas as the originators, as is the
situation in traditional brainstorming.

Karau and Williams (1994) developed an integrated theory of social loafing, which
accounts well for prior research. This is illustrated in Figure X. The basic assumption is
that people will work hard (greater motivational force) if they think their effort will lead
to some performance that will help to achieve some valued goal. Thus changing the link
between their effort and the outcome or changing the valence of the outcome should
influence the effort they exert. This model predicts that when working in a group,
individuals would work harder when they think that their contributions are unique or that
other members will perform poorly, because in these cases their effort is more essential
for group success, which is presumably a valued outcome. In addition individuals should
work harder if they like the group, because this increases the value of the outcome for
them.

Chart No. 4.1: Theory of social loafing –flow chart- (from Karau and Williams,
1994).
**Production matching:** Participants may be uncertain as to the expected level of individual productivity and will therefore be likely to compare their productivity to that of those around them and then to match their own productivity with that of the others (Paulus & Dzindolet, 1993). The result in interactive groups is that performance will tend towards a group mean. Paulus & Dzindolet (1993) demonstrated this by comparing individuals in nominal pairs with partnership performances and found that individual performance levels within interactive pairs was more similar than that between individuals in nominal pairs. By splitting the brainstorming time into 5 minute blocks they found that social influence starts early in the session and is maintained throughout. They also showed that this was true even when different problems were used. They predict that this could have an important effect. They feel that other production losses (like evaluation apprehension, production blocking and free-riding) are likely to occur early in the brainstorming session and that the production matching effect could lead to an initial low level of group performance becoming the normal level of performance that will be maintained throughout the session (even if the other production losses are not major factors during the later stages). Although not specified in the literature, it seems plausible that nominal group members might also tend towards a higher performance level than interactive groups. This is because they are likely to predict an average performance level for the rest of the group that is greater than the level that is likely to be achieved in reality. (This is in keeping with the work “illusion of group effectivity”, a concept proposed by Diehl & Stroebe (1991)).
Mullen, Johnson & Salas (1991) concluded that “the long-lived popularity of brainstorming techniques is unequivocally and substantively misguided” and from the research findings published in both the 1987 and 1991 studies, Diehl & Stroebe emphatically concluded that “group sessions should not be used to generate ideas.” Overall then, production blocking was highlighted as the most likely weakness of traditional brainstorming by Lamm & Trommsdorff (1973) and based on their research Diehl & Stroebe (1987,1991) wholly endorsed this view and concluded that if production blocking could be reduced, brainstorming groups could increase their productivity. Others, including Mullen, Johnson & Salas (1991) disagree, citing social psychological mechanisms as the most likely cause. What is clear, is that there are a number of interpretations for productivity loss and many are not mutually exclusive. The effects seen in reality are likely to be the result of a complex interplay of all these factors. Sometimes, some of the factors have supplementary and additive effects. For this reason the full range of these factors should be considered when designing a new tool for brainstorming. Despite this apparently overwhelming evidence that brainstorming simply doesn’t work, the brainstorming technique is as popular in the modern work place as it has ever been. The ‘illusion of group effectivity’ (Diehl & Stroebe, 1991) has been suggested as a possible explanation for the continued success enjoyed by the brainstorming technique. Paulus et al., (1993), showed that even though interactive brainstorming leads to productivity loss compared to nominal groups, participants report that they think they produce more ideas working in a group than they do working individually. They also showed that nominal group members generally felt they would have been more productive had they been working in a group. There appears to be
tendency for participants in groups to perceive their performance more favourably and to overestimate the number of their own ideas. Paulus et al. (1993) showed that an individual in groups being able to compare their performance with that of other group members is a “key factor in the favourable evaluation of group brainstorming”. This could be simply because in a 6 person group they are seeing the ideas of 6 people generated in the same time as it would take them to generate those of only one person. Alternatively it may be the result of individuals having trouble distinguishing between which ideas were there own following a session and which were the ideas of others in the group.

4.2.3 Process gains in Brainstorming:

Contrary to the mechanism of process losses, there are also some notable process gains identified in traditional brainstorming research:

1) *Procedural Mechanisms*

*Cognitive stimulation:* The opposite of cognitive interference, this is where the utterances of others in the group elicit ideas from another group member (Lamm & Trommsdorff, 1973).

2) *Socio- Psychological Mechanisms*
Observational learning: Watching others perform the same task may lead to some imitation of their performances. (Lamm & Trommsdorff, 1973) As mentioned earlier, this could be interpreted as potentially a process gain rather than a process loss.

Social recognition: Caused by members of the brainstorming group wanting recognition of their input from others (Goethlans and Darley, 1987, cited in Pinsonneault et al., 1999)

Task orientation: Focussing on the task (as opposed to the other group members) improves productivity (McGrath, 1984, cited in Pinsonneault et al., 1999)

3) Economic Mechanisms

Drive arousal: The presence of other participants can be arousing and enhance performance of simple tasks. (Green and Bushman, 1987, & Zajonc, 1965, cited in Mullen, Johnson & Salas, 1991). As brainstorming primarily seeks quantity rather than quality, it can be said to be a simple task.

4.2.4 Critique of Traditional Brainstorming Research and factors affecting process gains and losses:

A major problem in the evaluation of brainstorming in the past has been the variation in interpretations of the term ‘brainstorming’. Isaksen, in his 1998 critical review suggests that problems regarding correct definition of brainstorming have manifested themselves
in much of the research into traditional brainstorming. In this comprehensive review, Isaksen raises some very salient points regarding the usefulness of much traditional brainstorming research and makes suggestions for future research. The trend in traditional brainstorming research has been to compare the performance of collaborative interacting groups with that of pooled nominal groups. Isaksen claims that the finding from such research, that collaborative group participation inhibits ideative productivity, simply “reinforces the original intention of Osborn”, since the initial purpose of the brainstorming technique was to promote the ideative productivity that he recognized, was lacking in such groups. The intention was not to replace nominal group work but simply to facilitate group work where group work was a necessity. For example, when the resources available as a group are not matched by any one individual. As Isaksen points out, “Working as two or more individuals who influence each other through interaction is an important organizational reality”. This is true of many of today’s organisations and with knowledge and expertise becoming more specialised and being distributed between more people, it seems likely that this will only get more pronounced in the future. In a real world setting there are a number of competing factors that can affect the process gains and losses of any given collaboration method and therefore, as suggested in Lamm & Trommsdorff’s 1973 review, idea generation in groups must be studied within that larger context, to be able to give a holistic assessment of its associated advantages and disadvantages.

Traditional research is further criticized on the basis that it commonly takes the brainstorming task out of the context to which it naturally belongs as a part of creative
problem solving (CPS). Brainstorming in interactive groups is thought to make people feel better about the idea-generation process, provide a greater sense of satisfaction and confidence with the results (Gallupe, Bastionutti & Cooper, 1991) and promotes a sense of group ownership in the solution of shared problems (Greenberg & Folger, 1983 cited in Paulus et al., 1993). This, in turn, is thought to boost cohesiveness of the group. As cohesive groups are thought to be more likely to collaborate (Cartwright, 1968) this may boost group productivity in general as well as potentially benefiting later stages of the problem solving process, such as when the group needs to work together to implement the ideas generated. The extra satisfaction and sense of ownership with group results generated in traditional brainstorming may also be beneficial later on in getting an idea accepted for implementation. Increased participation in problem solving might therefore have longer term benefits regarding group productivity, idea implementation and change management processes that are unable to be captured by traditional research. Besides these, Isaksen (1998) highlights a number of other factors that can affect the process gains and losses in brainstorming and these should be taken into account during evaluation of the technique:

**Facilitator presence:** Very few of the traditional brainstorming studies are performed in the presence of a facilitator, despite the clear recommendation of facilitator presence made by Osborn. The facilitator could have a profound effect on the brainstorming process in a number of ways since they are responsible for preparation of the session, focusing the group and its resources and keeping them on track as well as ensuring the brainstorming guidelines are understood and followed. Mullen, Johnson & Salas (1991)
also raise the issue of experimenter presence and how this will affect process gains and losses. Specifically they tested the hypothesis that while it should have no effect on the procedural mechanisms, the presence of an experimenter is likely to affect the social psychological mechanisms by making participants of the brainstorming group “slightly more self-attentive” and lone participants of a nominal group “considerably more self-attentive”. The suggestion being that nominal group productivity is likely to increase proportionally as a result. They also felt it would affect the economic mechanisms and reduce productivity loss in groups as the tendency to free ride would be lowered. Their findings showed that there was “significantly greater” productivity loss in the presence of an experimenter than when the experimenter was absent”. It is also likely that the level of expertise of the facilitator will be a factor and the level of facilitator training may therefore be an important consideration. This also brings us to the subject of user training.

**Training:** Another notable omission from the bulk of the research into traditional brainstorming is the effect that dedicated brainstorming training for the users may have, on the process. Osborn suggested the importance of training in brainstorming technique and also pointed to the facilitator as an important figure in ensuring necessary training is in place. Mullen, Johnson, & Salas (1991) also recognised the area of training as a potential influence on productivity. Isaksen (1998) notes that for many of the traditional studies covered in their review where training took place, the training is provided by a researcher with little brainstorming qualification other than having read the rules. While this may in fact reflect the real word scenario fairly accurately the impact of adequate training of the facilitator is once again highlighted here.
**Individual ideation:** Osborn suggested that a session should be both proceeded and followed up by a period of individual ideation. However, group brainstorming research often lack such opportunities for individual ideation. This goes against Osborn’s suggestion that brainstorming is not meant to be a replacement for individual ideation (Osborn, 1967).

**Group composition:** Working in groups is often a necessity as organisational knowledge is distributed amongst its staff and getting together is the only way to ensure participants are able to share thoughts on a variety of aspects of the problem and to maximise the joint capabilities of the group. Lamm & Trommsdorff (1973) recognised “combining cognitive resources” as an effect in group participation, where solutions to problems may require various cognitive skills or ideas from a variety of different experiential backgrounds. Osborn suggested that groups should ideally comprise self-starters who have a range of experience with the topic being brainstormed and also made it clear that group members should not come from a mixture of different levels of seniority. However, it appears that such effects have been ignored in much of the subsequent literature. The majority of studies use college students as subjects. This raises a number of issues. Students are probably one of the least likely groups to have been involved in a traditional brainstorming session previously. A group of students is also less likely to have the wide range of cognitive skills and experiential backgrounds, nor the level of distributed knowledge that might be expected in members of a real organisation.
Group history: This is a further problem associated with using student groups in research as student subjects are unlikely to have worked together as a group prior to the study and are unlikely to work together again subsequently. In fact, it is likely that the student subjects will not even know each other prior to the study. This is an unlikely situation in a real world setting where participants are likely to have interacted and collaborated previously and will probably anticipate doing so again in the future. Paulus et al. (1993) recognised that “groups in natural settings may have learnt to work effectively together.”

A relationship of honest and earned trust between participants seems to be an important factor in brainstorming success and the history of the group is crucial to this. An aim to augment this relationship is one of the reasons for ‘ice-breakers’ or warm up sessions often held before a brainstorming meeting, often involving brainstorming on simple nonsense problems to get people comfortable with the process and each other.

Nature of the problem being addressed: Many traditional studies into brainstorming effectiveness have considered trivial artificial questions such as “What would be the implications of waking up to find you have an extra thumb” which clearly require no previous knowledge or expertise. By using similar problems, the studies are allowing comparisons to be made across studies. However, the problems used do not accurately reflect the way brainstorming is commonly used in organisations where generally the group need to brainstorm on a very real and often difficult problem. A real world problem is also likely to be relevant, engaging and of interest to all group members and there will
be a real business need for a solution. Participants are therefore likely to feel a greater sense of ownership of ‘real’ problems than they would for the sort of trivial problems typical in traditional brainstorming research. It is felt that the greater sense of ownership will help drive the brainstorming process and that the lack of ‘real’ problems used in experiments could have a detrimental effect on the quality and quantity of ideas being generated.

**Process Satisfaction:** Participant satisfaction with the process and with outcome/ideas generated is thought to possibly affect productivity, although it is clear that any effects are only likely to emerge after continued use of the brainstorming technique by any particular group. This may be the ‘illusion of group effectivity’ initially, but, although not noted in the literature, it seems possible that a belief in the productivity of the technique and happiness in the outcomes could serve to boost its productivity over successive sessions, perhaps to a level of ‘actual productivity’. Alternatively, it may even be considered that losses due to the inefficiency of brainstorming can be offset by the benefits gained in terms of team building as a result of process satisfaction.

This summary of problems with traditional brainstorming has served to highlight some factors that could affect process gains and losses in brainstorming sessions. Mullen, Johnson & Salas, (1991) also recommend several more factors to examine at evaluation which may affect the balance of the process gains and losses:
**Group Size:** It would be expected that each of the three mechanisms would cause productivity to fall more as group size was increased. More people in the group would mean increased evaluation apprehension, increased production blocking and increased free-riding for example. Osborn’s original suggestion for group size was between 5 and 10 participants. Bouchard and Hare (1970) found that there was a significant effect due to size of group. While larger groups produced more ideas, they noted that for real groups there was a “leveling-off effect” as the increase in the number of ideas became less as the group size increased. They felt that this might be the result of time being monopolised in an inefficient manner in groups and that effective time management was the crucial factor. Clearly then, it is a very complex interplay of mechanisms that determine how well or badly brainstorming works in groups. A review of the traditional brainstorming literature has allowed a number of process gains and losses to be identified. The review also identified a number of important factors that can affect these process gains and losses, which the researcher has also identified in the study.