

The Influence of Anonymity Level and Extraversion on Idea Generation Performance

An examination of selective anonymity as a new anonymity condition

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ABSTRACT,

Brainstorming is a widely used ideation technique across organizations. The effectiveness of Brainstorming is impacted by a variety of factors, weakening its benefit. It is assumed that free riding and evaluation apprehension, as well as social-psychological factors, have a profound impact on idea generation performance. This study aims to test selective anonymity as a new anonymity condition in brainstorming. Further, it investigates the moderating influence of Extraversion during ideation processes. Therefore, an experiment had been conducted in which 104 participants were randomly assigned to three anonymity conditions: anonymous, non anonymous and selective anonymity. The individuals were asked to complete an ideation task. The ideation performance was measured as the quality of best idea produced by each participant. A personality inventory test was utilized to ascertain the degree of extraversion. The data analysis by a one-way ANOVA failed to indicate significant differences among the three tested anonymity conditions. Multiple linear regression models could also not indicate a significant influence of extraversion as a moderating variable on the relationship between anonymity condition and idea quality. The results suggest that neither a specific method of anonymity nor the Extraversion level of participants lead to a high performance in ideation tasks. Therefore, organizations should feel encouraged to use the creative potential of all employees to obtain innovations for economic success.

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Keywords

Brainstorming; Anonymity; Idea quality; Extroversion; Selective anonymity; Arousal; Productivity loss

1. INTRODUCTION

“Everything begins with an idea” (Proctor, 2018). We wouldn’t enjoy the comfort of electricity if Thomas Edison hadn’t come up with the idea. Economic success relies heavily on innovative ideas (Lhuillery, 2014). The ability to generate innovative ideas ensures growth in today’s competitive markets (Van den Ende et al., 2015). Hence, increasing the effectiveness of ideation techniques is important.

The most widespread ideation technique is Brainstorming (Furnham, 2000). Webster (2015) defines brainstorming as a “group problem-solving technique that involves the spontaneous contribution of ideas from all members of the group; the mulling over of ideas by one or more individuals in an attempt to devise or find a solution to problem”.

This paper focuses on the effectiveness of several Brainstorm techniques which differ according to the extent to which the ideas produced can be attributed to participants in Brainstorming groups. In principle, these conditions, relevant to this study, range from anonymous to non-anonymous (Cooper et al., 1998). Schweisfurth (2019) proposes a combination of those methods as selective anonymity.

Although non anonymous and anonymous brainstorming aims to create a climate, that supports the contribution of each, participants often suffer from conditions that inhibit their preferred way of working. As a result, many individuals are reluctant to contribute and articulate their ideas effectively during those ideation sessions (Mauroner & Zschau, 2021). The cause of which can be attributed to free riding and evaluation apprehension. Under anonymous brainstorming, free riding is increased. Members of a group obtain benefits from group membership but do not bear a proportional share in the generation of ideas (Albanese & Van Fleet, 1985). Whereas under non anonymous brainstorming evaluation apprehension is increased. Individuals tend to hold back ideas as they fear of being judged (Cooper et al., 1998). Schweisfurth (2019) expects that the method of selective anonymity “...yields more and better ideas than the two traditional methods, as it dampens the inhibitors at work in each of the other methods.”

Further social psychological factors are widely seen as severely limiting efficacy, whereas the personality traits of individuals have a profound impact on the ideation outcome (Camacho & Paulus, 1995). According to the literature Introverted individuals strive under anonymity whereas extroverts favor non anonymous conditions (Mukahhi et al., 1998). An explanation for this effect can be found in the theory of arousal by Eysenck (1967).

Until now, no empirical studies have been done, to evaluate the effect of “selective anonymity” on ideation outcomes in comparison to traditional methods. The same applies to the influence of the degree on extraversion in personality characteristics. It remains unknown if selective anonymity can lower the impact of free riding and evaluation apprehension. And further create an environment that encourages idea contribution of Extroverts/Introverts.

This study aims to investigate the impact of the level of anonymity in Brainstorming on the best idea generated. Further the moderating effect of the degree of extraversion of the participants psychological traits is to be elaborated on: which type of people works best under which level of anonymity condition?

The research questions will be investigated by conducting an empirical study. In particular, a randomized control trial with three groups according to the types of brainstorming conditions of non-anonymity, anonymity and selective anonymity will be administered and a method to measure quality of ideas implemented. The degree of Extraversion of the participants psychological traits will be measured by a personality inventory test. The gathered data will be analyzed by several statistical methods. The overall goal is to give recommendations for the improvement of ideation techniques.

1.2 Research Question

This study investigates the following research question: what impact has the level of anonymity in Brainstorming on the quality of the best idea generated? How is this relationship moderated by the degree of Extraversion?

2. LITERATURE REVIEW

In the following literature review, relevant theories and concepts are critically acclaimed in order to establish an understanding of the above-mentioned study hypotheses.

2.1 Development of Brainstorm Research

Brainstorming research can be categorized in two distinct phases, presented in table 1. Those phases were first proposed in the paper of (Stroebe et al., 2010) and transferred to the research context.

Table 1. Development of Brainstorm Research

Phase	Main RQ	Paradigm	Productivity	Connected with
Productivity	How can productivity loss be explained?	Comparing group performance with pooled individual	Productivity (number of ideas)	Group performance literature social loafing/free riding)
Cognitive processes	How does group interaction affect cognitive processes?	Simulating aspects of group interaction with individual participants	Quality of ideas (originality)	Cognitive psychology, memory models, groups as information

The first phase focused on how the productivity loss can be explained. Since Osborn spawned the practice of brainstorming in 1953, the effectiveness of which has been widely debated (Diehl & Stroebe, 1987). A great deal of evidence has been published by Collaros and Anderson (1969), Paulus and Dzindolet (1993) and Rietzschel et al. (2006) indicating that nominal groups perform generally better than traditional group brainstorming.

The work conducted during this period tried to answer the question as to why individuals performed better than groups (Furnham & Yazdanpanahi, 1995). Mullen et al. (1991) study was the first to look at the possible causes of output differences, termed “process loss.” influenced by Steiner (1974) terminology. To reduce the negative impact of these processes more effective ideation methods were introduced (Michinov, 2012). Brainwriting and electronic brainstorming are proven to be more effective than traditional brainstorming techniques (Dennis & Williams, 2005), (Petrovic & Krickl, 1994), (Michinov, 2012).

The second phase focused on the question how the group context affects group members’ cognitive processes (Stroebe et al., 2010). Salas et al. (2005) and Kichuk and Wiesner (1997)

argue that there are innumerable variables that can affect the success and viability of a team. The diversity of cognitive styles (Ciufolini & Wheeler, 1995), gender and cultural differences (Trommsdorff & Lamm, 1980) and personality characteristics (Jablin et al., 1977) are said to have an impact on ideation outcomes. Personality traits are expected to have the greatest impact on outcomes according to Chamacho & Paulus (1995). Research by Hogan et al. (1988) and Bouchard Jr (1969) proves that certain personality characteristics impact brainstorming effectiveness. In particular creative performance is strongly impacted by personality characteristics (Montgomery & Dietrich, 1992)

2.2 Productivity loss

Although there is widespread agreement that factors inhibiting brainstorm performance exist, assigning distinct causes remains a challenge. The effect of group size (Bouchard & Hare, 1970), speaking time allowance (Lamm & Trommsdorff, 1973) and gender composition (Wood et al., 1985) are supported to influence ideation outcomes. However the difference in methodology makes it hard to formulate general rules (Furnham & Yazdanpanahi, 1995). The first theory that attempts to do so is the one by Diehl & Stroebe (1987), which identifies three separate processes, reducing the effectiveness of Brainstorming: production blocking, evaluation apprehension and free riding. The aspect of production blocking is not relevant as this paper's chosen nominal ideation method excludes the influence of this factor, which only occurs in groups (Stroebe et al., 2010).

2.2.1 Evaluation apprehension

The presence of evaluation apprehension had been investigated under various contexts by Collaros & Anderson (1969), Harari and Graham (1975), Maginn and Harris (1980) and partly relativized by Diehl & Stroebe (1987).

They all contributed to a mutual understanding that some individuals in Brainstorm sessions are reluctant to share their ideas of the fear on being judged. Collaros & Andersson's (1969) study, which looked at expert conditions as an externally exposed element, does not entirely match interactive processes. The study by Harari & Graham (1975) is more appropriate because the research focuses on social psychological processes. Individuals with a high dispositional anxiety would perform poorly because they are uncomfortable with group interactions, according to this theory. As a result, previously demonstrated in earlier studies, evaluation apprehension accounts for a large portion of productivity loss. Maginn & Harris (1980), who manipulated evaluation apprehension in subjects working individually, could not demonstrate an effect of social inhibition on productivity. As a possible explanation Diehl & Stroebe (1987) suggested that Maginn & Harris (1980) experimental design failed to induce evaluation apprehension. Diehl & Stroebe (1987) showed, that in relation to the studies of Maginn & Harris (1980) social inhibition is one-factor explaining productivity loss. However, a further finding had been, that the type of session (individual or group) accounted for more than 70% of the variance in brainstorming productivity (Diehl & Stroebe, 1987). This paper suggested, that even if social inhibition accounted for part of the productivity loss in brainstorming groups, the impact of this variable was minimal compared to that of type of session.

2.2.2 Free riding

According to Isaksen and Gaulin (2005) influence a variety of factors an individual's commitment during ideation. Literature has largely focused on the influence of free riding (Kerr &

Braun, 1983), (Stroebe & Frey, 1982), (Maginn & Harris, 1980) also referred to as social loafing (Simms & Nichols, 2014). Free riding occurs when there is a loss of personal accountability for performance (Isaksen & Gaulin, 2005). As a result the focus on performance standards is diminished and individuals rely to a greater degree on top performers (Kerr & Bruun, 1983). Research by (Stroebe & Frey, 1982) established three factors, influencing the degree to free ride. The validity of those factors has been examined in various experiments, in which different factors were manipulated (Isaksen & Gaulin, 2005). Collaros & Andersson (1969) manipulated dispensability. As a result free riding increased, negatively impacting their motivation to contribute towards the ideation process (Collaros & Anderson, 1969).

Diehl & Stroebe (1987) demonstrated that identifiability has a large influence within a group. Maginn and Harris (1980), replicate this finding, by making individual contributions more identifiable. The experiment failed to induce the identifiability (Maginn & Harris, 1980). As a result, there was no discernible difference in the degree to free ride. Nonetheless the findings are consistent with the literature on free riding, decreasing the identifiability of contributions reduces the effort of individuals (Ingham et al., 1974), (Kerr & Bruun, 1983).

2.2.3 The role of anonymity

The term anonymity first emerged in the literature by Postmes et al. (2001), explaining the process of social influence in group communications through digital means. It is widely used in the ideation literature to justify the implementation of new ideation techniques. Conventionally, ideation sessions were held non anonymous but Cooper et al. (1998), Shepherd et al. (1995) and Gallupe (1992) investigated the impact of anonymous brainstorming due to increasing evidence on the influence of evaluation apprehension. Their experiments indicated that anonymous groups created higher quality ideas compared to non-anonymous, as they were more critical and probing (Valacich et al., 2006). Further Bordia et al. (2006) concluded that anonymity of participants can mitigate evaluation apprehension and is projected to create favored conditions for participants as well as increasing productivity (Gallupe et al., 1994). Although anonymous brainstorming is demonstrably superior to non-anonymous brainstorming, (Cooper & Gallupe, 1998), Connolly et al. (1990) claimed that anonymity may be a mixed blessing. As claimed by Furnham (2000) show individuals under anonymity high degree of free riding behavior. According to Cooper & Gallupe (1987) this free riding behavior accounted for lower performance. Shah et al. (2001) cited by (Pissarra & Jesuino, 2005) found that anonymity could have both positive and negative effects on group interaction and on the performance of groups. According to Pissarra & Jesuino (2005) the effect will always be contingent on the type of group, the task and the situation.

2.3 Influence of Extroversion on Idea Generation

There is evidence that individual differences play a role in group brainstorming performance (Bouchard, 1969), (Furnham & Yazdanpanahi, 1995). Several studies found a positive interaction between extraversion on creativity (McCrae, 1987), (Yellen et al 1995), (Engle, 2002), (Kasof, 1997), (Martindale, 1999). McCrae (1987) points out the relevance of creativity in the ideation process. According to his results creative individuals have a higher score on the extraversion scale than less creative individuals. These findings are consistent with Camacho & Paulus (1995) who showed that lower ideation performance is connected to a high degree of social

anxiousness of participants, a characteristic of Introverted individuals.

Yellen et al., (1995) and Engle (2002) provide evidence that the personality characteristic of extraversion/introversion play a significant role in groups, influencing an individual's attention span, level of arousal, and participation in groups. The importance of extroversion as a key factor of personality traits in ideation processes is underlined by the results of Kasof (1997), who revealed that extroverts have a higher attention breadth. Jung et al. (2012) showed the higher productivity of extroverts in ideation processes. In detail they proved that a higher quantity and quality of ideas by extraverts. The findings of Hasan and Koning (2019) confirmed a positive influence of extrovert peers in ideation groups which lead to more unique and creative ideas.

In addition Eysenck's personality theory delivers a holistic explanation on the cortical arousal and the degree of extraversion (Eysenck, 1993). According to the theory, high creativity results from low cortical arousal. Eysenck (1993) also claimed that extroverts typically exhibit low cortical arousal at rest. Connecting the two, extroverts exhibit higher levels of creativity during creative thought processes. This finding is supported by (Martindale, 1989), (Kaspi-Baruch, 2019), (Chiang et al., 2017).

2.4 Theoretical Background

2.4.1 Idea quality

Prior research has focused on average quality of ideas (Paulus et al., 2013), number of ideas (Ritter & Mostert, 2017) and total quality as the combination of both. The objective of ideation in innovation is often to discern a set of highly quality ideas, thus this paper is interested in quality of best idea (Girotra et al., 2010). No consensus about definition of idea quality exists, rather multiple that resolve around the feasibility to implement and its potential to solve a problem. However, the research adopts Girotra et al. (2010) concept of best idea quality. In which a multidimensional grading method is used to assess the quality of an idea based on buy value and purchase intent.

2.4.2 Eysenck's theory of personality

Effects of Extraversion/Introversion on an individual's behavior within groups is often arousal mediated (Matthews et al., 1990). Individuals attempt to maintain an optimum level of moderate arousal [Appendix A], where they perform best (Hebb, 1955). Both personality types influence arousal, which in turn influences performance (Matthews et al., 1990). According to Eysenck (1967) extraverts tend to be low in cortical arousal, whereas introverts have a higher cortical arousal (Corcoran, 1964). Arousal is reactive to external stimuli (Stelmack, 2004). Knoll and Horton (2011) stated that the use of external stimuli can support the generation of solutions with higher average creativity rating. In the brainstorm context external stimuli can refer to the interaction with peers. When integrating the Yerkes Dodson Law (1908) then arousal is related to performance by an inverted U- function. Extroverts perform better under high arousal and worse under low arousal conditions, the inverted is true for Introverts (Matthews et al., 1990). Thus, introverts are stimulus shy while extraverts are stimulus hungry (Campbell & Hawley, 1982). This mirrors the tendency of introverts to perform better under anonymous conditions and non-anonymity conditions are inversely better suited to extroverted individuals (Mukahi et al., 1998). The method of selective anonymity is expected to enable both

personality types reaching a moderate level of arousal with less effort.

2.4.3 Selective anonymity

According to the literature both anonymous and non-anonymous conditions have their own set of limitations (Camacho & Paulus, 1995), (Mullen et al., 1991), (Pinsonneault et al., 1999). Within each condition different inhibiting factors are prevalent. Anonymity in brainstorming encourages free riding, which reduces productivity by preventing individuals from contributing to their full capacity (Cooper et al., 1998). Non anonymity inversely encourages evaluation apprehension, individuals tend to hold back their ideas out of the fear on being judged (Connolly et al., 1990), (Nunamaker et al., 1991). According to Shepherd (1995) those inhibiting factors cannot be fully terminated just minimized. The minimization of one factor requires a change of anonymity, which causes the maximization of the other inhibiting factor. The opposing effects as demonstrated by Furnham (2000) cause fewer quality and quantity of ideas, as also proven by Paulus (2011). Although anonymous brainstorming is expected to perform better (Cooper et al., 1998) it is still negatively impacted by free riding. Selective anonymity by Tim Schweisfurth (2019) is a combination of both kinds of anonymity methods, aiming at overcoming the inhibiting factors of both.

Evaluation apprehension is expected to be reduced as aspects of evaluation apprehension such as having an idea rejected or being humiliated (Zhou et al., 2019) are diminished as only the best ones are being revealed. Free riding is also expected to decline, as participants have no indication whether their idea will make it to the top 10 % and thus be revealed. As a result they are not able to withhold contribution as their identity might be revealed (Alnuaimi et al., 2009). A general assumption of the cited literature is that the reduction of both inhibiting factors will yield in a greater number of ideas. According to Osborns (1957) credo quantity breeds quality: any stimulation effect resulting in an increase in idea quantity would also increase idea quality. The high correlation was also replicated by Diehl & Stroebe (1987) and Meadow et al. (1959).

Hence selective anonymity is expected to generate better quality ideas which lead to the formulation of the first hypothesis.

2.4.4 Moderating effect of extroversion

As presented in the literature review, see [2, p. 2], extroversion has a powerful influence on the ideation outcome, in particular idea quality. The theory by Eysenck delivers a holistic explanation why Extroverts are expected to create higher quality ideas. Especially Jung et al. (2012) outlined the moderating effect of extrovertiveness which leads to the formulation of the second hypothesis:

2.4.5 Hypotheses

H1 Selective anonymity generates a higher quality of ideas compared to anonymity and non-anonymity.

H2 The relationship between the methods of Brainstorming and the quality of best idea produced is moderated by the degree of Extraversion of participants. A higher degree in extraversion results in greater quality of ideas generated.

2.4.6 Conceptual Framework

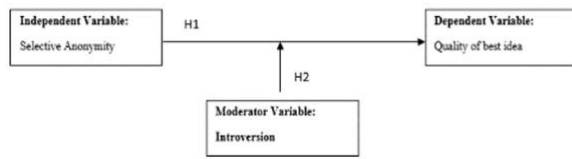


Figure 1. Conceptual Framework

3. METHODS

The Research design is not only a set of practices to empirically test a hypothesis but a way of approaching the subject matter of interest (Kazdin, 2003). Within the research design, the methods utilized to derive insights into the research hypothesis revolve around primary as well as secondary data. The primary data allows for customized data that in addition is more accurate and reliable (Admin, 2021). As a result, the data that is collected for the specific research problem at hand establishes procedures that fit the research problem best (Hox & Boeije, 2005). Secondary data refers to the utilization of existing data, providing a viable option for research with limited time and resources (Johnston, 2017). Secondary data had been obtained by using a combination of the following keywords: Brainstorming, Individual differences, ideation performance, productivity loss, and arousal. The primary data is collected by an experiment, see [3.2, p. 5], as well as a post-experimental survey. Throughout the experiment, quantitative data on idea quality of two control groups and one treatment group is collected. A post-experimental survey is employed to investigate the moderation effect by collecting data on the subject's personality traits and attitudes towards the ideation task. Surveys are frequently used in social sciences to collect data on participant's attitudes and behaviors (Mathers et al., 1998).

3.1 Experimental Research Design

A quantitative design, true experimental design, was chosen as the research is interested to generate objective data about human behavior, in particular ideation performance. The choice for experiments had been reasoned by the possibility of manipulating variables (anonymity conditions) as well as investigating the effects of interventions (Extraversion) to draw valid causal conclusions. According to (Campbell & Riecken, 1968) the experimental design controls for most threats to internal validity, thus increasing the confidence in which we can attribute causal effects to experimental manipulation of the treatment group (Preissler, 2021). Moreover, the experimental design allows for the recognition of the complexity of behavior by inserting a moderator variable to check, if the effect differs among treatment and control groups.

In order to assess the main effect of the independent variable (anonymity type) on the quality of best idea as a dependent variable, an experiment had been designed in which the conditions of anonymity varied. A treatment group received selective conditions for the ideation task and two control groups were administered to anonymous and non-anonymous conditions.

The aim of the survey while reflecting on the subjects experience is to gather data about interaction variables e.g moderators that might affect outcomes of the research study. As the topic is interested to assess different states of anonymity

but more importantly to explore and describe human behavior, surveys are most suitable in this context.

Similar papers in the research domain of "Brainstorming" and "Anonymity" have used predominately experiments that are held physically in a face-to-face context. Le Hénaff et al. (2018) and Furnham (2000) focused in their research design on experiments that are limited in time and held in person. Due to the inability to hold Brainstorming sessions and the validity of more responses, the design of the research resembles those already found in the electric Brainstorming literature.

3.2 The Experiment

The layout of the experiment had been inspired by a brainstorm study in the field of sport and fitness products which has been a joint research project of the University of Twente, Erlangen-Nürnberg, and Stuttgart. Comparable groups of students filled out the survey experiment in which the treatment (selective anonymity) was manipulated across the sampled group to see whether the outcome (quality of best idea) differs in comparison to the two control groups (non-anonymity/anonymity). In addition to determining if the main effects strength differs, depending on the moderator variable's category (Extrovertive/Introvertive). The 107 respondents that participated in the survey were directed to a secure web interface in which the experiment was held. Participants were then randomly assigned to an anonymity condition [figure 2] and informed at the beginning about the rules of the brainstorming task.

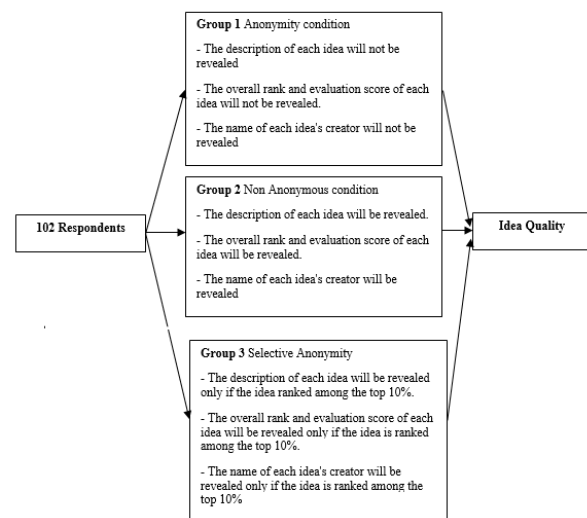


Figure 2. Experimental design

Task

You have been retained by a manufacturer of sports and fitness products to identify new product concepts for the student market. The manufacturer is interested in any product that might be sold to students in a sporting goods retailer. The manufacturer is particularly interested in products likely to be appealing to students. These products might be solutions to unmet needs or improved solutions to existing needs.

3.3 Subjects

In the experiment data had been collected from a sample of 107 subjects. The sampled subjects consisted of university students who participated in the experiment by a web interface. As the anticipated effect, difference in idea quality between groups, is assumed to be large, stated in [2, p. 2], only a small sample is

required (Burmeister & Aitken, 2012). The sample contained female (N= 67) and male (N= 38) as well as diverse (N=1) subjects. All subjects were familiar with several ideation processes prior to this experiment and represented a wide range of study fields as well as degrees (Girotra et al., 2010). The choice on students has been motivated by the necessity of a high response rate, to have valid and dependable results (Baruch, 1999). As the familiarity and knowledge of ideation processes is higher, students are expected to participate to a greater extent. Inclusion as a subject is guaranteed when enrolled in a university and excluded if not willing to sign informed consent and failing of the manipulation check. In social science such a check is commonly applied. It assessed a subject's attention to the treatment condition in order to improve the reliability of experimental findings. (Aronow et al., 2019). Moreover, voluntary participation was guaranteed by providing web accessibility and individuals were not punished in any form if they decide not to participate. Further upholding representativeness is detrimental for the experiment, as at all cost should be avoided that e.g. introverts were excluded as they are more reluctant to participate (J. H. Jung et al., 2012). Thus, web accessibility was chosen not only because it reaches a larger audience, but also because it allows both personality types to engage equally. By honestly assuring anonymity and confidentiality the likelihood of both personality types participating in the experiment is increased. Although the identities and ratings associated with suggestions were provided to study personnel and UT students throughout the trial, they were anonymized thereafter. Confidentiality had been guaranteed by stating that data is not used commercially and is for research and teaching purposes only.

3.4 Ten Item Big Five Inventory

After the ideation exercise participants were asked to express their conformity toward statements on a 7-point Likert scale. The statements stem from the 10-item short version of the Big five inventory, which according to Rammstedt (2007) has proven to be highly valid and reliable for short personality instruments. The majority of studies using the BFI-10, employed 5-point scales; however, as data becomes more reliable (Johns, 2010), the decision to add two more scales has been made. The dimension of Extraversion was assessed by two items "I see myself as someone who is reserved", "... is outgoing/ sociable", in which the score represents the degree of conformity. The spectrum of the trait is of interest to this study. Thus, in the regression model, see [3.6, p. 6], extraversion is entered as a continuous variable. Later the data was analyzed by the conditional effect at different values of the moderator. Therefore, two values corresponding to the 16th and 84th percentiles were used. The chosen percentiles corresponding to extroversion scores of 3 and 6 are used to divide the subjects: extroverts <3, introverts >6 and intermediates in between. With the division into percentiles, a categorization was also made.

3.5 Measurement of Performance

Based on previous argumentations in the literature review, quality of best ideas is chosen as actors in innovative processes are more likely to be interested in a single valuable idea rather than a wide array of less suitable ones (Girotra et al., 2010). Quality of best idea refers to the quality score of each individual's best idea. The quality of ideas is assessed according to a) novelty b) usefulness c) purchase intent by utilizing the consensual assessment technique.

3.5.1 Consensual assessment

The rating is executed by seven Bachelor students who act as independent experts in the domain. Judges are asked to use their sense in what is a quality idea without justifying themselves. Nonetheless "quality" is a term that is perceived by each student differently (Amabile, 1982). Hence the experiment is focused on quality that is associated with innovative ideas and governed by the three equally weighted variables. Quality is therefore a multidimensional scheme composed of: novelty, usefulness and purchase intent (Girotra et al., 2010). Ideas are rated separately on a 7-point likert scale (table 2). The premise that underpins the rating process is that the objective called "idea quality" is revealed in the ideas, and that judges and raters can recognize it (Bear & McKool, 2009).

Table 2. Rating dimensions

	1	2	3	4	5	6	7
Novelty	Not novel						Very novel
Uservalue	No value to users						Great value to users
Purchase Int.	Highly unlikely to buy this product						Highly likely to buy this product

Verifying the reliability of the ratings is detrimental as different judges differed from their assessment decisions (Kaufman et al., 2008). To verify, the Inter class correlation coefficient (table 3) is calculated, measuring the number of items raters agree on. An insufficient reliability has been found for b) user value (ICC= 0.548) and c) purchase intent (ICC= 0.520). Selecting cases with $\sigma^2_{\text{Novelty}} < 6$; $\sigma^2_{\text{Uservalue}} < 2$, the reliability increased for both indicating a moderate reliability according to Koo and Li (2016).

3.5.2 Novelty

Novelty is an essential notion in the Innovation context and is desired by organizations looking for the implementation of successful ideas. We strongly believe that students can best assess novelty as they often strive for new experiences.

3.5.3 Purchase intent

Since the ideas generated are related to feasible product ideas, the likelihood of purchase will allow for a further assessment of quality.

3.5.4 Usefulness

The last variable on which the ideas are evaluated refers to usefulness, determining the extent to which a new product idea fills a gap in the market or improves an existing demand better than competitor offerings.

3.6 Data Analysis

The research construct incorporates anonymity condition as an independent variable (IV) and quality of best idea as a dependent variable (DV) as well as Extraversion as a moderator (M). Both IV and DV are categorical whereas the rating scale responses are ordinal but are treated as a continuous variable and types of anonymity is nominal. The analysis focuses on a main effect as well as an interaction effect also referred to as moderating effect. The main effect refers to the effect of the anonymity condition (IV) on the quality of best idea (DV). Whereas the interaction effect looks at the interaction of each anonymity condition and Extraversion on the dependent variable, quality of best idea. Throughout the analysis a

significance level of 10% will be used ($\alpha=0.1$). The statistical analysis will be executed by a one-way ANOVA, multiple regression, and simple slope analysis on SPSS version 23. The labels and definitions of the variables utilized in SPSS can be found in Appendix H.

First the Levene's statistic as well as Q-Q plots are used to demonstrate normal distribution of the data. The main effect is assessed by an ANOVA test in which the difference in idea quality between the three ideation groups is analyzed. ANOVA has been chosen as it offers a robust design and an increase in statistical power and the ability to compare more than two groups (ANOVA, 2018). After executing the ANOVA test the p value associated with the F-statistic and a corresponding significance level ($\alpha = 0.1$) indicates whether a significant difference in idea quality exists. A t-test is then used to confirm the observations. Findings will be applied for the experimental validation of the first hypothesis (H1).

To perform multiple regression analysis, the categorical independent variable (anonymity condition) needs to be recoded into numerical dummy variables. This is needed to ensure the validity of the multiple regression results. The three categories ($k=3$) of anonymity condition are indicator coded into k-1 dichotomous variables (Montoya, 2016). An overview of the coding is provided below [table 2], where X1 corresponds to subjects in group two (non-anonymous) and X2 to subjects in group three (selective anonymity). The reference group, not represented by a dummy variable, are subjects in group one (anonymous). For the remaining chapters dummy codes are applied to describe the categorical independent variable (Montoya, 2016).

Table 2. Coding scheme

Coding of categorical X variable for analysis:		
Scenario	X1	X2
1	0	0
2	1	0
3	0	1

To estimate and probe the interactions within the regression model, the process tool by Hayes (2014) is used. The dependent variable (QUALITY) is regressed on each independent (SELECTIVE) and (NONANONYM), as well as the intercept of coded variables and the moderator (EXTRA), to carry out multiple regression. The regression coefficient of either (SELECTIVE) or (NONANONYM) explains the differences on quality in comparison to anonymous groups. Further the p value indicates if the difference is significant. Findings will be used for the experimental validation of the second hypothesis (H2).

The ANOVA (omnibus test) simply checked the model's overall significance without specifying which means are different. Within the regression output this is possible by looking at the total effect in relation to the reference group. The regression output further informs about interaction effect of anonymity condition and Extraversion on quality of best idea. More specific on the significance of the moderating effect in strengthening or weakening the relationship between anonymity condition (IV) and quality of best idea (DV).

The methods described previously are suited for pairwise comparisons and lack concrete information about the nature of the effect. Therefore "simple slopes" are applied to test for

omnibus group differences at specific values of the moderator (Montoya, 2016). In detail predicted values of the independent variable (QUALITY) are calculated under different scores of Extraversion (Dawson, 2014), also known as "pick a point approach" (Bauer & Curran, 2005). Probing will be executed along the 16th percentile of the moderator variable (EXTRA) as well as the 84th percentile and the 50th percentile corresponding to the mean [Appendix B]. All probed points are within range of the observed data on the moderator [Appendix B] (Montoya, 2016).

4. RESULTS

The assumption that the data is normally distributed has been confirmed according to the Q-Q plots [Appendix C]. To use the one-way ANOVA test, equal variances are required. However, the test for homogeneity of variance rejects the null hypotheses for equal variances assumed ($F= 3.54$, $p= 0.03$) [Appendix D]. Therefore, an ANOVA with Welch statistics was applied. This method can be used even if the data violates equal variance assumption.

Table 3. Idea quality across groups

scenario	Mean (M)	Count	Standard deviation (SD)
1	4.0535	34	0.51891
2	3.9914	28	0.44912
3	4.0177	43	0.62497
Total	4.0223	105	0.54418

There's evidence [table 3] that the mean of best quality ideas generated within the three ideation groups differed. The anonymous group's best quality ideas had a mean score (M) of 4.05 and a standard deviation (SD) of 0.52, followed by non-anonymity ($M= 3.99$, $SD= 0.45$) and selective anonymity ($M= 4.02$, $SD= 0.62$). Yet no statistically significant differences between idea quality between at least two groups have been proven according to Welch F-test ($F(2,67)= 0.13$, $p= 0.9$) (table 4). The Welch test's results were additionally confirmed by an independent t-test, which found no significance. The subjects produced the same quality of ideas independently of the anonymity condition. There was no evidence found that selective anonymity generates a higher quality of ideas. The hypothesis H1 (*Selective anonymity will generate better quality ideas*) is therefore being rejected.

Table 4. Welch test statistic

	Statistic	df1	df2	Sig.
Welch	0.126	2	66.793	0.881

A moderation effect can be present even if the main effect is statistically insignificant (De Veaux et al., 2005). Hence a moderation analysis was run to determine whether the interaction between the type of anonymity and Extrovertiveness significantly predicts the outcome of idea quality [table 5] [Appendix E].

Table 5. Regression output

	coeff	se	t	p
Constant	4.2596	0.3763	11.3197	0.0000
X1	-0.1793	0.5221	-0.3435	0.7320
X2	-0.7792	0.4754	-1.6390	0.1044
EXTRA	-0.0482	0.0852	-0.5657	0.5729
Int_1	0.0297	0.1115	0.2668	0.7902
Int_2	0.1711	0.1063	1.6088	0.1108

The overall model was not significant, the independent variables in this model explain only roughly 4.18 % of the variance in the output variable $F(5.99) = 0.86$, $R^2 = 0.04$, $p > 0.1$. The independent variable non anonymity is not a significant predictor. Hence non anonymity is statistically insignificant ($b = -0.05$, $t(0.51) = -0.33$, $p = 0.74$), on the effect (when $M = 0$) of non-anonymity conditions on idea quality. The other independent variable selective anonymity is also not a significant predictor. This means that selective anonymity is equally statistically insignificant ($b = -0.02$, $t(0.51) = -0.13$, $p = 0.9$) on the effect (when $M = 0$) of selective anonymity conditions on idea quality.

As the second hypotheses is interested in the interaction effect, the predictor variables p-values and coefficients are not particular important by themselves. Rather the interaction variables (INT1, INT2) will inform about the effect of the third variable, extraversion.

The interaction effect of non-anonymity and Extraversion (INT1) on idea quality is not statistically significant ($b = 0.03$, $t(0.51) = 0.27$, $p = 0.8$). This means that non anonymity has no different effect on idea quality, depending on the level of Extraversion. Further the interaction effect of selective anonymity and Extraversion (INT2) on idea quality is also not statistically significant ($b = 0.17$, $t(0.51) = 1.6$, $p = 0.11$). As above selective anonymity seems to have no different effect on idea quality, depending on the level of Extraversion.

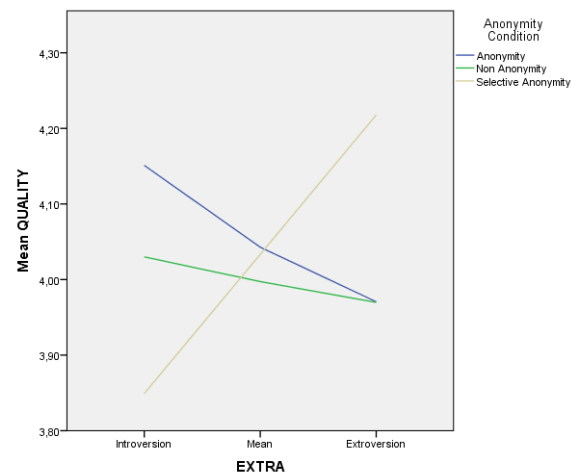
According to the results, individual differences were not proven to work as a significant moderating factor for brainstorm ideation performance. Extroversion could neither cause an amplifying or weakening effect between each anonymity condition and idea quality. The hypothesis H2 (*The relationship between the methods of Brainstorming and the quality of best idea produced is moderated by the degree of Extraversion of participants. A higher degree of extraversion results in greater idea quality*) is therefore also being rejected.

The test of highest order unconditional interaction, which measures the change in R squared (R^2) when the moderator extraversion is introduced, additionally showed no significance of the variable, extraversion (table 6). The R^2 change does not significantly changed with the introduction of the interaction term, ($R^2 = 0.033$, $F(2,99) = 1.7058$, $p = 0.1869$). This finding supports the insignificance of the interaction effect, previously identified in the regression analysis.

Table 6. Test of highest order unconditional interaction

	R^2 change	F	df1	df2	p
X*W	0.0330	1.7058	2	99	0.1869

Although the moderator appears to have no effect on the relationship between anonymity and idea quality, it is worth exploring how different moderator values affect the relationship. The chosen values corresponded to different percentiles of extraversion, see [3.4, p. 6]. Hayes process tool generated slopes for the three anonymity conditions predicting idea quality at different levels of extraversion [Graph 1]. In selective anonymity extraversion seems to have a significant impact on idea quality, indicated by a steep slope. However, the conditional effect of the focal predictor, selective anonymity, at different values of moderator, resulted in no statistical significance [Appendix H]. The smallest p values could be observed at the 16th ($b = -0.23$, $SE = 0.16$, $p = 0.16$) and 84th percentile ($b = 0.24$, $SE = 0.17$, $p = .15$). At the 50th percentile, the largest p value can be observed ($b = 0.007$, $SE = 0.11$, $p = 0.95$). Because the y axis only represents a small portion of the quality scale, the influence may appear to be significant in the graph but is insignificant in the regression analysis.

Graph 1. Conditional effect at different values of the moderator

5. DISCUSSION AND IMPLICATIONS

Ideation techniques play an inevitable role in the generation of innovative ideas, as stated in [1, p. 2]. The need for improved brainstorm techniques and a clear understanding of underlying social psychological processes influencing their performance has increased over the years (J. H. Jung et al., 2012).

Although a detailed investigation of the factors impacting brainstorm performance has been conducted, the accountability and occurrence of each factor is controversial within literature (Diehl & Stroebe, 1987). The review of relevant studies suggests that mainly two factors, the individual characteristic of extraversion and the anonymity condition, account for most of these inconsistent findings (J. Jung et al., 2012).

The overall aim of this study is to improve ideation processes by investigating the effect of different states of anonymity on idea quality. Further the influence of personality characteristic of extraversion, as a common diversity in groups, is to be explored. For this purpose, an experiment had been designed. 104 subjects were measured by their extroversion personality trait and asked to generate ideas in randomized assembled groups under different anonymity conditions.

The results of this study failed to demonstrate that anonymity condition has a significant influence on the quality of ideas

generated. This is contrary to most literature findings and this study's scientific approach (Cooper et al., 1998; Shepherd et al., 1995; Gallupe, 1992; Valacich et al., 2006). Although Schweisfurth (2019) supposes that selective anonymity is assumed to outperform both traditional anonymity conditions, this could not be supported. Even the two control groups, with the biggest difference in anonymity condition, show no significant differences. This is in accordance with findings by Pissarra & Jesuino (2005) and Shah et al. (2001).

A reason for no variation in idea quality may lie in the inability of anonymity to reduce the inhibiting factors as hypothesized by Furnham (2000) and Bordia et al. (2006). Further evaluation apprehension and free riding might not be the most influential factors on productivity loss. According to Steiner (1972) the productivity loss is to a large extent due to coordination losses and not motivation losses as free riding and evaluation apprehension. Further and most likely, explanatory factors may lie in the methodological design and execution, in particular the assessment of idea quality and a clearer orientation to a classic brainstorm method, see [5.3, p. 9].

Surprisingly and also contrary to the literature findings, a significant moderating effect of extraversion on the idea quality could not be proven. The assumed impact of individual differences in the personality characteristics of extraversion on ideation performance could therefore not be supported (Jung et al., 2012; Mauroner & Zschau, 2021; Bouchard, 1969; Furnham & Yazdanpanahi, 1995). The same can be stated for possible contributions of the explanatory approach by Eysenck (1967), which is supposed to be the causal factor of the moderating influence of extrovertiveness on idea quality. According to the results it appears as extroversion has no influence on strengthening or weakening the relationship between anonymity condition and idea quality. Whilst comparing the extreme points, see [3.4, p. 6], on the extraversion scale, the statistical relationship improves but still achieves no significance.

Measurement of extrovertiveness and the range represented by the subjects of the experiment are presumed to account for the observed results, see [5.3, p. 9].

5.1 Practical Contribution

This study contributes to existing research about Brainstorm techniques. What can be discerned is that Brainstorming still is an important ideation technique for organizations to secure economic success. The latest developments of new brainstorm techniques (electronic brainstorm, brainwriting) indicate that a lot of people believe in the potential of brainstorm and are eager to increase its effectiveness further. Moreover, the non-significance of the moderating variable in this study contributes to an understanding that there may be no highly specific personality characteristics that automatically guarantees a better ideation performance. A broad variety of individuals in groups might have thus the ability to produce high quality ideas. Therefore, organizations should feel encouraged to use the full potential of their existing staff. Brainstorming and creating innovation appears not to be a technique for specialists but rather everyone. Regarding the non-significance of the anonymity condition influence in this study it can further be stated that from a corporate point of view, it is of greater importance to put brainstorming into practice, than selecting specific anonymity conditions. Organizations may focus on an work environment that facilitates and enables the whole staff to contribute in ideation processes, for economic success.

5.2 Theoretical Contribution

This study delivers at least four main theoretical contributions. First it delivers a general contribution to the literature of brainstorm technique research and broadens its empirical base. It lines up with the overview of the evolution of Brainstorm research by Stroebe et. al (2010). Second, this paper contributes to brainstorm research especially concerned with aspects of anonymity. Whereas the assumptions by Shah et al. (2001) and Pissarra & Jesuino (2005) are being supported. Third the investigation contributes to research about personality differences within the Brainstorm field, where only scarce literature findings exist. It fits with the findings of Furnham and Yazdanpanahi (1995) who found no influence of a selected personality type on performance. However more importantly it broadens significantly the research base on social psychological mechanisms in relation to anonymity, a field where so far even fewer studies exist (J. H. Jung et al., 2012).

Fourth, this study delivers the first empirical research of a new ideation method, selective anonymity. According to Schweisfurth (2019) a concrete definition for this new technique as well as a contextual framework and an experimental design were developed. Schweisfurth's (2019) expectations could not be validated. Future research about selective anonymity can build upon the developments created by this paper. The further research question deals with if the expected influence of selective anonymity can be proved by using more sophisticated methods, see [6.1, p. 9], or the effect is not applicable.

5.3 Limitations

Limitations are important for interpreting the validity of the scientific results, see [4, p. 7], and ascribing a credibility level to the conclusions of published research (Ioannidis, 2007).

All subjects were university students in the Netherlands. Certain professions as well as countries were therefore neglected in this research. In particular business professionals, are expected to have higher thinking skills which could lead to different results. Moreover it has been statistically proven that the degree of Extraversion is different across cultures. Hence applied in another culture the moderation effect might look different.

The second limitation emerges out of the large portfolio of several brainstorm techniques. The ideation method chosen for this study incorporates elements from electronic brainstorm as well as brainwriting, hence a clear attribution is not possible. Thus, the literature findings and development of conceptual framework are based on findings related to different domains of brainstorm techniques.

It had been argued for that sample size is sufficient, in [3.3, p. 5], because of the assumed large effect size. However, this large effect could not be observed, see [4, p. 7]. Therefore, the small sample size affects the power of the study to draw conclusions. An increase in sample size would yield in more data, increasing the statistical power.

Idea quality as the output variable was measured by a quite simple method relying on a subjective scale of each individual rater.

The short version BFI-10, utilized to measure extraversion is controversial. Long instruments tend to have better psychometric properties (Gosling et al., 2003) as well as higher

effect sizes (Rammstedt, 2007). As time constraints weren't severely limited the long version (BFI-44) could have been equally implemented. As a result, there would be more questions that jeopardized the trait, resulting in a higher degree of conviction that individuals genuinely possess it. Moreover, is the reliability of the personality inventory influenced by the measuring scale. In this study the 7-point likert scale had been implemented. The middle point within the scale is often chosen by subjects that tend to disagree but are unwilling to admit (Kulas & Stachowski, 2013). The narrow range of extraversion weakens the statistical correlation.

5.4 Future Research

Future research projects should take the above limitations into account. A broader sample size with a higher diversity in represented social groups is expected to improve the representativeness of results. It appears to be crucial to give special emphasis on a wide range of the moderating variable (with a two-step sampling procedure), which is advised to be measured more sophisticated by including a more extensive personality inventory test as the BFI-44. In future research approaches it seems to be interesting to consider the arousal theory to create conditions which facilitate an improvement of ideation performance.

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REFERENCES

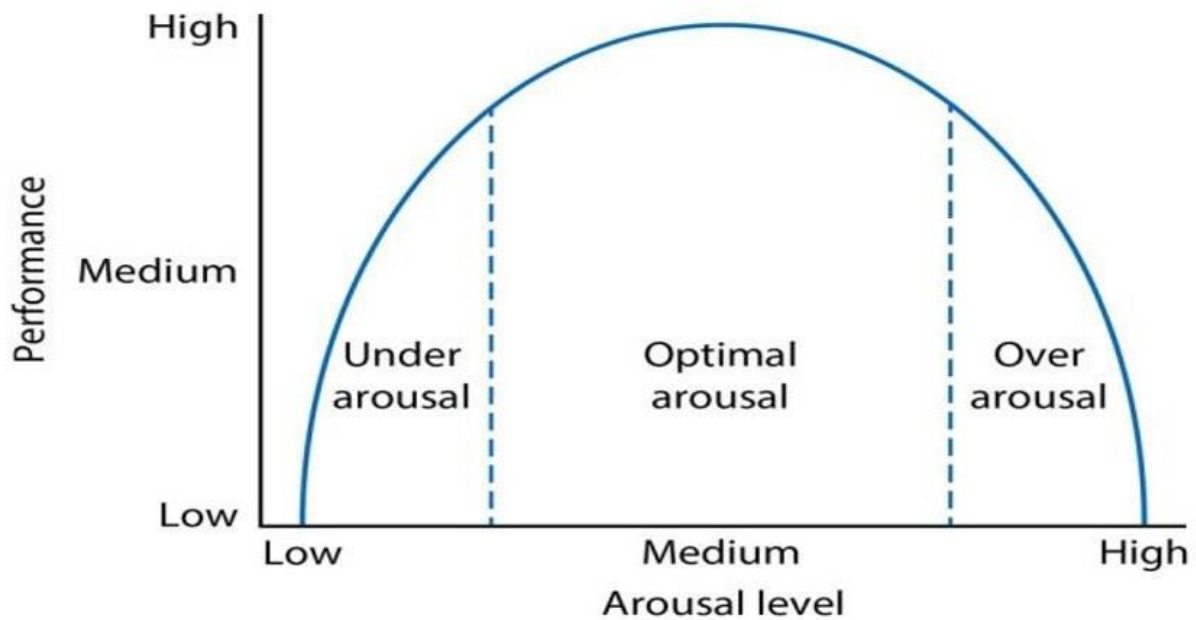
- Admin. (2021). *Primary Data vs Secondary Data: Advantage and Disadvantage Analysis*. pwwmarketresearch. Retrieved 09.05 from <https://pwwmarketresearch.com/primary-data-vs-secondary-data-advantage-and-disadvantage-market-research-analysis/>
- Albanese, R., & Van Fleet, D. D. (1985). Rational behavior in groups: The free-riding tendency. *Academy of Management review*, 10(2), 244-255.
- Alnuaimi, O., Robert, L., & Maruping, L. (2009). Social loafing in brainstorming CMC teams: The role of moral disengagement. 2009 42nd Hawaii International Conference on System Sciences,
- Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of personality and social psychology*, 43(5), 997.
- ANOVA. (2018). Retrieved 09.06.2022 from
- Aronow, P. M., Baron, J., & Pinson, L. (2019). A note on dropping experimental subjects who fail a manipulation check. *Political Analysis*, 27(4), 572-589.
- Baruch, Y. (1999). Response rate in academic studies-A comparative analysis. *Human relations*, 52(4), 421-438.
- Bauer, D. J., & Curran, P. J. (2005). Probing interactions in fixed and multilevel regression: Inferential and graphical techniques. *Multivariate behavioral research*, 40(3), 373-400.
- Bordia, P., Irmer, B. E., & Abusah, D. (2006). Differences in sharing knowledge interpersonally and via databases: The role of evaluation apprehension and perceived benefits. *European journal of work and organizational psychology*, 15(3), 262-280.
- Bouchard Jr, T. J. (1969). Personality, problem-solving procedure, and performance in small groups. *Journal of Applied Psychology*, 53(1p2), 1.
- Burmeister, E., & Aitken, L. M. (2012). Sample size: How many is enough? *Australian Critical Care*, 25(4), 271-274.
- Camacho, L. M., & Paulus, P. B. (1995). The role of social anxiousness in group brainstorming. *Journal of personality and social psychology*, 68(6), 1071.
- Campbell, D. T., & Riecken, H. (1968). Quasi-experimental design. *International encyclopedia of the social sciences*, 5(3), 259-263.
- Campbell, J. B., & Hawley, C. W. (1982). Study habits and Eysenck's theory of extraversion-introversion. *Journal of Research in Personality*, 16(2), 139-146.
- Chiang, Y.-H., Hsu, C.-C., & Shih, H.-A. (2017). Extroversion personality, domain knowledge, and the creativity of new product development engineers. *Creativity Research Journal*, 29(4), 387-396.
- Ciufolini, I., & Wheeler, J. A. (1995). *Gravitation and inertia* (Vol. 101). Princeton university press.
- Collaros, P. A., & Anderson, L. R. (1969). Effect of perceived expertness upon creativity of members of brainstorming groups. *Journal of Applied Psychology*, 53(2p1), 159.
- Connolly, T., Jessup, L. M., & Valacich, J. S. (1990). Effects of anonymity and evaluative tone on idea generation in computer-mediated groups. *Management science*, 36(6), 689-703.
- Cooper, W. H., Gallupe, R. B., Pollard, S., & Cadsby, J. (1998). Some liberating effects of anonymous electronic brainstorming. *Small Group Research*, 29(2), 147-178.
- Corcoran, D. (1964). The relation between introversion and salivation. *The American Journal of Psychology*, 77(2), 298-300.
- Dawson, J. F. (2014). Moderation in management research: What, why, when, and how. *Journal of business and psychology*, 29(1), 1-19.
- De Veaux, R. D., Velleman, P. F., Bock, D. E., Vukov, A. M., & Wong, A. C. (2005). *Stats: data and models*. Pearson/Addison Wesley Boston.
- Dennis, A. R., & Williams, M. L. (2005). A meta-analysis of group side effects in electronic brainstorming: More heads are better than one. *International Journal of e-Collaboration (IJeC)*, 1(1), 24-42.
- Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of personality and social psychology*, 53(3), 497.
- Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business & Economic Statistics*, 20(3), 339-350.
- Eysenck, H. J. (1993). Creativity and personality: Suggestions for a theory. *Psychological inquiry*, 4(3), 147-178.
- Furnham, A. (2000). The brainstorming myth. *Business strategy review*, 11(4), 21-28.
- Furnham, A., & Yazdanpanahi, T. (1995). Personality differences and group versus individual brainstorming. *Personality and Individual Differences*, 19(1), 73-80.
- Gallupe, R. B., Cooper, W. H., Grisé, M.-L., & Bastianutti, L. M. (1994). Blocking electronic brainstorms. *Journal of Applied Psychology*, 79(1), 77.
- Girotra, K., Terwiesch, C., & Ulrich, K. T. (2010). Idea generation and the quality of the best idea. *Management science*, 56(4), 591-605.
- Gosling, S. D., Rentfrow, P. J., & Swann Jr, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, 37(6), 504-528.
- Harari, O., & Graham, W. K. (1975). Tasks and task consequences as factors in individual and group brainstorming. *The Journal of Social Psychology*, 95(1), 61-65.
- Hasan, S., & Koning, R. (2019). Conversations and idea generation: Evidence from a field experiment. *Research Policy*, 48(9), 103811.
- Hebb, D. O. (1955). Drives and the CNS (conceptual nervous system). *Psychological review*, 62(4), 243.
- Hogan, R., Raza, S., & Driskell, J. E. (1988). Personality, team performance, and organizational context. In *Psychology and productivity* (pp. 93-103). Springer.

- Hox, J. J., & Boeije, H. R. (2005). Data collection, primary versus secondary.
- Ingham, A. G., Levinger, G., Graves, J., & Peckham, V. (1974). The Ringelmann effect: Studies of group size and group performance. *Journal of Experimental Social Psychology*, 10(4), 371-384.
- Ioannidis, J. P. (2007). Limitations are not properly acknowledged in the scientific literature. *Journal of clinical epidemiology*, 60(4), 324-329.
- Isaksen, S. G., & Gaulin, J. P. (2005). A reexamination of brainstorming research: Implications for research and practice. *Gifted Child Quarterly*, 49(4), 315-329.
- Jablin, F. M., Seibold, D. R., & Sorenson, R. L. (1977). Potential inhibitory effects of group participation on brainstorming performance. *Communication Studies*, 28(2), 113-121.
- Johns, R. (2010). Likert items and scales. *Survey question bank: Methods fact sheet*, 1(1), 11.
- Johnston, M. P. (2017). Secondary data analysis: A method of which the time has come. *Qualitative and quantitative methods in libraries*, 3(3), 619-626.
- Jung, J., Lee, Y., & Karsten, R. (2012). The moderating effect of extraversion-introversion differences on group idea generation performance. *Small Group Research*, 43(1), 30-49.
- Jung, J. H., Lee, Y., & Karsten, R. (2012). The Moderating Effect of Extraversion-Introversion Differences on Group Idea Generation Performance. *Small Group Research*, 43(1), 30-49.
<https://doi.org/10.1177/1046496411422130>
- Kasof, J. (1997). Creativity and breadth of attention. *Creativity Research Journal*, 10(4), 303-315.
- Kaspi-Baruch, O. (2019). Big Five personality and creativity: the moderating effect of motivational goal orientation. *The Journal of Creative Behavior*, 53(3), 325-338.
- Kaufman, J. C., Baer, J., Cole, J. C., & Sexton*, J. D. (2008). A comparison of expert and nonexpert raters using the consensual assessment technique. *Creativity Research Journal*, 20(2), 171-178.
- Kazdin, A. E. (2003). Methodology: What it is and why it is so important.
- Kerr, N. L., & Bruun, S. E. (1983). Dispensability of member effort and group motivation losses: Free-rider effects. *Journal of personality and social psychology*, 44, 78-94.
- Kichuk, S. L., & Wiesner, W. H. (1997). The big five personality factors and team performance: implications for selecting successful product design teams. *Journal of Engineering and Technology management*, 14(3-4), 195-221.
- Knoll, S. W., & Horton, G. (2011). The Impact of Stimuli Characteristics on the Ideation Process: An Evaluation of the Change of Perspective' Analogy'. 2011 44th Hawaii International Conference on System Sciences,
- Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of chiropractic medicine*, 15(2), 155-163.
- Kulas, J. T., & Stachowski, A. A. (2013). Respondent rationale for neither agreeing nor disagreeing: Person and item contributors to middle category endorsement intent on Likert personality indicators. *Journal of Research in Personality*, 47(4), 254-262.
- Le Hénaff, B., Michinov, N., & Le Bohec, O. (2018). Applying the SIDE model to brainwriting: The impact of intergroup comparison and anonymity on creative performance. *Journal of Applied Social Psychology*, 48(7), 351-359.
- Lhuillery, S. (2014). Marketing and persistent innovation success. *Economics of Innovation and New Technology*, 23(5-6), 517-543.
- Maginn, B. K., & Harris, R. J. (1980). Effects of anticipated evaluation on individual brainstorming performance. *Journal of Applied Psychology*, 65(2), 219.
- Mathers, N. J., Fox, N. J., & Hunn, A. (1998). *Surveys and questionnaires*. NHS Executive, Trent.
- Matthews, G., Davies, D. R., & Lees, J. L. (1990). Arousal, extraversion, and individual differences in resource availability. *Journal of personality and social psychology*, 59(1), 150.
- Mauroner, O., & Zschau, L. (2021). Idea Generation and Brainstorming under the Aspect of the New Groupthink-The Differences between Extraverts and Introverts. *Journal of Organizational Psychology*, 21(4), 41-62.
- McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience. *Journal of personality and social psychology*, 52(6), 1258.
- Meadow, A., Parnes, S. J., & Reese, H. (1959). Influence of brainstorming instructions and problem sequence on a creative problem solving test. *Journal of Applied Psychology*, 43(6), 413.
- Michinov, N. (2012). Is electronic brainstorming or brainwriting the best way to improve creative performance in groups? An overlooked comparison of two idea-generation techniques. *Journal of Applied Social Psychology*, 42, E222-E243.
- Montgomery, D. R., & Dietrich, W. E. (1992). Channel initiation and the problem of landscape scale. *Science*, 255(5046), 826-830.
- Montoya, A. K. (2016). *Extending the Johnson-Neyman procedure to categorical independent variables: Mathematical derivations and computational tools* [The Ohio State University].
- Mukahi, T., Chimoto, J., & Ui, T. (1998). A study on the influence of personality and anonymity on electronic brainstorming. Proceedings. 3rd Asia Pacific Computer Human Interaction (Cat. No. 98EX110),
- Mullen, B., Johnson, C., & Salas, E. (1991). Productivity loss in brainstorming groups: A meta-analytic integration. *Basic and applied social psychology*, 12(1), 3-23.
- Nunamaker, J. F., Dennis, A. R., Valacich, J. S., Vogel, D., & George, J. F. (1991). Electronic meeting systems. *Communications of the ACM*, 34(7), 40-61.
- Paulus, P. B., & Dzindolet, M. T. (1993). Social influence processes in group brainstorming. *Journal of personality and social psychology*, 64(4), 575.
- Paulus, P. B., Kohn, N. W., Arditti, L. E., & Korde, R. M. (2013). Understanding the group size effect in electronic brainstorming. *Small Group Research*, 44(3), 332-352.

- Petrovic, O., & Krickl, O. (1994). Traditionally-moderated versus computer supported brainstorming: a comparative study. *Information & Management*, 27(4), 233-243.
- Pinsonneault, A., Barki, H., Gallupe, R. B., & Hoppen, N. (1999). Electronic brainstorming: The illusion of productivity. *Information Systems Research*, 10(2), 110-133.
- Pissarra, J., & Jesuino, J. C. (2005). Idea generation through computer-mediated communication: The effects of anonymity. *Journal of Managerial Psychology*.
- Postmes, T., Spears, R., Sakhel, K., & De Groot, D. (2001). Social influence in computer-mediated communication: The effects of anonymity on group behavior. *Personality and Social Psychology Bulletin*, 27(10), 1243-1254.
- Preissler, R. (2021). *Investigating the association between extraversion and happiness: an experience sampling study* University of Twente].
- Proctor, B. (2018). *It's Not about the Money*. Gildan Media LLC aka G&D Media.
- Rammstedt, B. (2007). The 10-Item Big Five Inventory. *European Journal of Psychological Assessment*, 23(3), 193-201. <https://doi.org/10.1027/1015-5759.23.3.193>
- Rietzschel, E. F., Nijstad, B. A., & Stroebe, W. (2006). Productivity is not enough: A comparison of interactive and nominal brainstorming groups on idea generation and selection. *Journal of Experimental Social Psychology*, 42(2), 244-251.
- Ritter, S. M., & Mostert, N. (2017). Enhancement of creative thinking skills using a cognitive-based creativity training. *Journal of Cognitive enhancement*, 1(3), 243-253.
- Salas, E., Sims, D. E., & Burke, C. S. (2005). Is there a "big five" in teamwork? *Small Group Research*, 36(5), 555-599.
- Schweisfurth, T. (2019). *Anonymity in Brainstorming*. Innovation Growth Lab Retrieved 02.06.2022 from
- Shah, D. V., McLeod, J. M., & Yoon, S.-H. (2001). Communication, context, and community: An exploration of print, broadcast, and Internet influences. *Communication research*, 28(4), 464-506.
- Simms, A., & Nichols, T. (2014). Social loafing: a review of the literature. *Journal of Management Policy and Practice*, 15(1), 58.
- Steiner, I. D. (1974). Whatever happened to the group in social psychology? *Journal of Experimental Social Psychology*, 10(1), 94-108.
- Stelmack, R. M. (2004). On personality and arousal: A historical perspective on Eysenck and Zuckerman. *Personality: essays in honor of Marvin Zuckerman*, 17-28.
- Stroebe, W., & Frey, B. S. (1982). Self-interest and collective action: The economics and psychology of public goods. *British Journal of Social Psychology*, 21(2), 121-137.
- Stroebe, W., Nijstad, B. A., & Rietzschel, E. F. (2010). Beyond productivity loss in brainstorming groups: The evolution of a question. In *Advances in experimental social psychology* (Vol. 43, pp. 157-203). Elsevier.
- Trommsdorff, G., & Lamm, H. (1980). Future orientation of institutionalized and noninstitutionalized delinquents and nondelinquents. *European Journal of Social Psychology*, 10(3), 247-278.
- Valacich, J. S., Jung, J., & Looney, C. A. (2006). The effects of individual cognitive ability and idea stimulation on idea-generation performance. *Group Dynamics: Theory, Research, and Practice*, 10(1), 1.
- Van den Ende, J., Frederiksen, L., & Prencipe, A. (2015). The front end of innovation: Organizing search for ideas. *Journal of Product Innovation Management*, 32(4), 482-487.
- Webster, M. (2015). How Brainstorm got better In <https://www.merriam-webster.com/words-at-play/definition-of-brainstorming>
- Wood, W., Polek, D., & Aiken, C. (1985). Sex differences in group task performance. *Journal of personality and social psychology*, 48(1), 63.

APPENDIX

Appendix A



Appendix B

Statistics

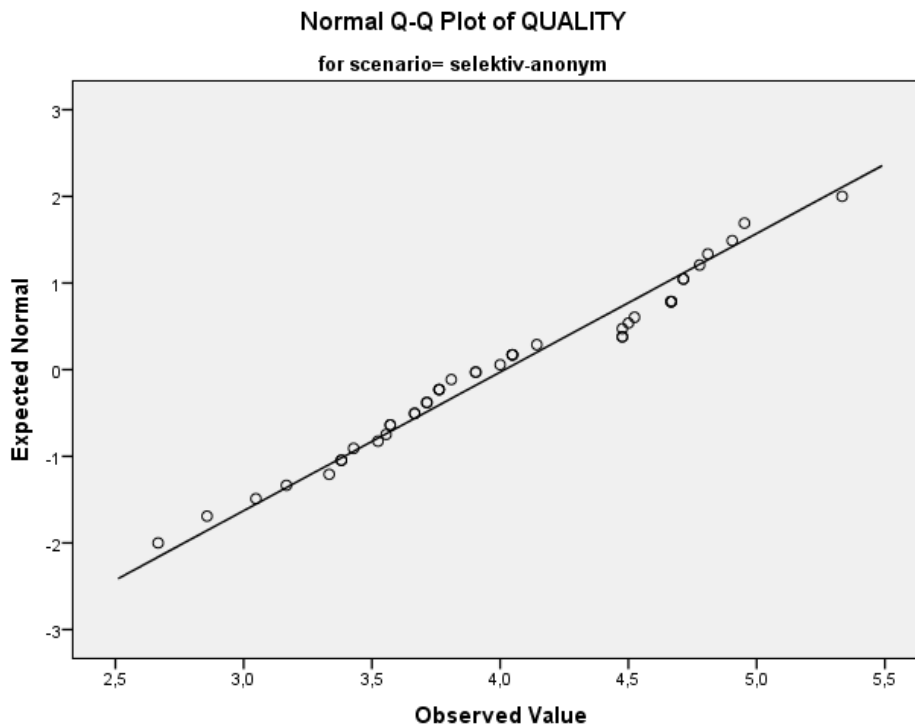
EXTRA

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	Missing	0
Mean		4,4619
Median		4,5000
Range		5,50
Minimum		1,50
Maximum		7,00
Percentiles	16	3,0000
	25	3,5000
	50	4,5000
	75	5,5000
	84	6,0000

EXTRA

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1,50	2	1,9	1,9
	2,00	3	2,9	4,8
	2,50	6	5,7	10,5
	3,00	6	5,7	16,2
	3,50	15	14,3	30,5
	4,00	18	17,1	47,6
	4,50	9	8,6	56,2
	5,00	16	15,2	71,4
	5,50	11	10,5	81,9
	6,00	8	7,6	89,5
	6,50	8	7,6	97,1
	7,00	3	2,9	100,0
Total	105	100,0	100,0	

Appendix C



Appendix D

Test of Homogeneity of Variances

QUALITY

Levene Statistic	df1	df2	Sig.
3,540	2	102	,033

Appendix E

Model Summary

R	R-sq	MSE	F	df1	df2	p
,2044	,0418	,2981	,8630	5,0000	99,0000	,5089

Model

	coeff	se	t	p	LLCI	ULCI
constant	4,0447	,0949	42,6134	,0000	3,8563	4,2330
X1	-,0466	,1426	-,3270	,7443	-,3295	,2363
X2	-,0159	,1264	-,1259	,9001	-,2667	,2349
EXTRA	-,0482	,0852	-,5657	,5729	-,2172	,1208
Int_1	,0297	,1115	,2668	,7902	-,1915	,2509
Int_2	,1711	,1063	1,6088	,1108	-,0399	,3821

Product terms key:

Int_1	:	X1	x	EXTRA
Int_2	:	X2	x	EXTRA

Appendix F

Intraclass Correlation Coefficient

	Intraclass Correlation ^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig.
Single Measures	,455 ^a	,366	,553	6,852	86	516	,000
Average Measures	,854 ^c	,802	,896	6,852	86	516	,000

Intraclass Correlation Coefficient

	Intraclass Correlation ^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig.
Single Measures	,148 ^a	,115	,184	2,213	397	2382	,000
Average Measures	,548 ^c	,477	,613	2,213	397	2382	,000

Intraclass Correlation Coefficient

	Intraclass Correlation ^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig.
Single Measures	,134 ^a	,103	,170	2,085	396	2376	,000
Average Measures	,520 ^c	,445	,589	2,085	396	2376	,000

Appendix G

Conditional effects of the focal predictor at values of the moderator(s):

EXTRA	Effect	se	t	p	LLCI	ULCI
3,0000	-,2289	,1600	-1,4303	,1557	-,5463	,0886
4,5000	,0072	,1077	,0666	,9471	-,2064	,2208
6,0000	,2432	,1681	1,4470	,1510	-,0902	,5766

Appendix H

Construct	Item Label (SPSS analysis)	Item	Item Definition	Scale Definition
Predictor Variables	SELECTIVE	Selective anonymity	The proposed ideation method by Schweisfurth (2019). The ideas will be evaluated and ranked anonymously. After the evaluation, information from this round of brainstorming will be revealed on this course's Canvas page only if the idea ranks among the top 10% of all ideas.	1= selective anonymity 0= other two anonymity conditions
	NONANONYM	Non Anonymity	The ideas will be evaluated and ranked anonymously. After the evaluation, ALL information from this round of brainstorming will be revealed on this course's Canvas page	1= non anonymity 0= other two anonymity conditions
	EXTRA	Extraversion	The personality characteristic of Extraversion that is measured according to the BFI- 10 (Big five inventory 10).	Ordinal scale ranging from (1) low extraversion to (7) high extraversion
Dependent variable	QUALITY	Quality of each subjects best idea	A quality score is being computed according to the rating on three dimensions (novelty, usefulness, purchase intent). For each subject the best quality score is being considered.	Ordinal scale ranging from (1) low overall quality to (7) highest overall quality