**Group Idea Generation and Selection:
The originality versus feasibility battle & intragroup competition**

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Abstract

Organizations often try to stimulate creative problem-solving by inducing competition among group members. This facilitative effect of intragroup competition lies in group members' enhanced motivation to outperform the others. Previous research, however, has mainly focused on idea generation, thereby overlooking the subsequent idea selection stage. In fact, groups are poor at selecting both original and feasible ideas (i.e., creative), which may be further exacerbated when group members compete against each other. Furthermore, while originality and feasibility are two key factors of creativity, people seem to have difficulty taking both into account. The current research investigated how intragroup competition, through incorporating a rewarding scheme, influences group idea generation and selection, and whether explicit instructions of focusing on either originality or feasibility (performance criteria) could steer groups' focus in the intended direction. An experimental study was conducted with 78 three-person groups. Results showed that overall, neither intragroup competition nor performance criteria influenced groups' generation and selection performance. Nevertheless, some interesting findings emerged. Originality and feasibility were indeed inversely correlated; idea quality at the generation stage predicted the idea quality at the selection stage; furthermore, certain group processes during the task might have indirectly linked the competition – selection performance relationship. Study limitations, theoretical and practical implications were discussed.

Keywords: group creativity, idea journey, idea generation, idea selection, group process

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Creativity – commonly defined as the production of novel and useful ideas (Amabile, 1996; Runco, 2004) – is of crucial importance to individuals, industries and societies, because entrepreneurs, enterprises and organizations often need creative ideas or breakthroughs to survive, innovate and prosper in an ever-changing environment (Anderson, Potočník, & Zhou, 2014). Although individuals are also capable of finding creative solutions to problems, more complex problems often require the integration of expertise and thinking skills of people working together (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Work organizations, scientists, political decision-makers and the like therefore often form groups to promote their creativity.

Given the importance of the topic, creative problem-solving in groups has gained increasing attention in research. Traditionally, researchers operationalize creativity by having people generate ideas and coding these ideas in terms of their quantity and creativity (Guilford, Christensen, Merrifield, & Wilson, 1978; Torrance, 1966). However, for creative problem-solving to be successful, in addition to idea generation, a subsequent step is crucial, i.e., idea selection. Because the number of ideas that can be implemented is often limited, the generation of potential solutions should be followed by a stage where the most creative solution is selected out of the pool of potential candidate solutions (e.g., Amabile, 1988; Basadur, Runco, & Vega, 2000; Montag, Maertz, & Baer, 2012; Mumford, Mobley, Reiter-Palmon, Uhlman, & Doares, 1991; Perry-Smith & Mannucci, 2017; Zhou & George, 2003).

Both idea generation and idea selection are crucial for problem-solving in groups. Good idea generation leads to a large set of promising problem solutions. If groups are unable to generate novel and useful ideas, there are no creative ideas to choose from and implement. Previous research indeed found that interactive groups are not necessarily good at idea generation, due to ineffective group processes. For instance, Putman and Paulus (2008) found that the ideas generated by interactive groups were on average less original than those generated by nominal groups, where people generate ideas individually. On the other hand, even a successful idea generation stage is rather meaningless if groups are subsequently unable to identify and select the most creative idea out of the pool of potential candidate solutions. In fact, selection performance rarely exceeds chance levels (Rietzschel, Nijstad, & Stroebe, 2010). Only when a promising creative idea is recognized, and approved within the group, can it later be championed to relevant parties and implemented successfully. Therefore, both group idea generation and idea selection are essential in predicting creative achievements in groups. However, the combination of both stages in groups is hardly studied and remains poorly understood.

Here, we study both idea generation and selection and identify intragroup competition and performance criteria as critical factors that determine creative performance across and within these two stages. Organizations often use competition to stimulate performance, including team creativity. Indeed, competition, when directed correctly, can motivate people to increase their task-related efforts, thereby enhancing creativity (Eisenberger & Rhoades, 2001). Through rendering individual contribution-based rewards within the group (namely, intragroup competition) as opposed to group-based rewards, individuals in groups may have

an increased motivation to outperform the other group members and thereby invest more effort in the task. However, while competition may work for idea generation (e.g., Munkes & Diehl, 2003), the coordination and constructive discussions that are needed for idea selection may suffer as a result of intragroup competition. Moreover, while intragroup competition may facilitate effort, specific performance criteria are needed to direct this effort, either focusing on originality and novelty or on feasibility and appropriateness (Bechtoldt, De Dreu, Nijstad, & Choi, 2010). Thus, the effects of intragroup competition on group creativity may depend on the specific stage of the creative problem-solving process, as well as the presented performance criteria focusing either on originality or on feasibility. By examining this possibility in a group experiment, the current research promotes our understanding of how intragroup competition and performance criteria influence performance in the two key stages of the group idea journey – idea generation and idea selection.

Creativity Dimensions and Performance Criteria

To assess creative performance in groups, researchers often consider fluency and idea quality. Fluency refers to the number of non-redundant ideas, problem solutions, and insights generated by the individual or the group. It is a measure of cognitive productivity irrespective of the idea quality. Regarding idea quality, previous literature on creative idea generation defines idea quality as the combination of originality and feasibility (e.g., Diehl & Stroebe, 1987), as creativity is traditionally conceptualized as the production of novel *and* useful ideas (Amabile, 1983). Originality is the intrinsic property of novelty – original ideas are typically nonconforming, novel, unique, unusual and unconventional (Runco & Charles, 1993); whereas feasibility is the utility of the idea in a particular context, it serves to solve a

problem, fit a situation, or accomplish some recognizable goal (MacKinnon, 1965). Consider a simple example, if people are instructed to ‘*list all the square things you can think of*’, an answer of ‘face’ would be an original but infeasible idea, ‘box’ would be an appropriate but rather common idea, ‘chessboard’ is comparatively original and appropriate (Runco & Charles, 1993). Although in principle originality and feasibility are separate dimensions of creativity, quite a number of studies observed negative correlations between these two dimensions (e.g., Beersma & De Dreu, 2005; Nijstad, De Dreu, Rietzschel, & Baas, 2010; Baas, Van Eijls, & Reiter-Palmon, 2019) and people seem to have difficulty taking both dimensions into account when generating and selecting ideas (Rietzschel et al., 2010; Runco & Charles, 1993; Baas et al., 2019).

Groups may value either originality or feasibility when generating and selecting ideas. The emphasis on either originality or feasibility could be due to implicit cultural norms. Implicit cultural norms influence the content of group members’ cognitive performance and steer groups toward a focus on originality and novelty or appropriateness and usefulness (Adarves-Yorno, Postmes, & Haslam, 2007). For instance, groups in individualistic cultures emphasize novelty and originality, whereas groups in collectivistic cultures tend to value usefulness and feasibility (Lubart, 1999; Noriko, Fan, & Van Dusen, 2001). In addition to implicit cultural norms, whether groups value originality or feasibility may also depend on the context. For instance, explicit instructions about the task’s performance criteria may steer people’s effort in the desired direction – originality or feasibility (Rietzschel, Nijstad, & Stroebe, 2014). Thus, highly original ideas emerge when the culture or context triggers a

focus on originality, whereas highly appropriate and feasible ideas emerge when the culture or context triggers a focus on feasibility (Bechtoldt et al., 2010).

Intragroup Competition

Intragroup competition exists when individuals in groups perceive their goal attainments as negatively related (Na'im, 2004). When one group member progresses toward his/her goals, it becomes less likely for the other members to reach their goals (Deutsch 1949; Tjosvold, 1984). Rewarding individually is one way of inducing intragroup competition. For example, organizations render individual incentives to recognize and award the contribution of individual employees in group projects. Another example comes from research groups, where researchers work together on research projects while simultaneously competing against each other for funds, status and promotion chances.

The effect of intragroup competition on creativity may depend on certain contingencies, such as the task characteristics (Miller & Hamblin, 1963). For instance, when attainment of a task depends on the coordinated effort among group members, intragroup competition might have a negative effect on group creativity because it undermines group coordination (Rees & Segal, 1984). As will become apparent below, the effect of intragroup competition may also depend on the creative problem stage: idea generation and idea selection.

Idea Generation

Idea generation is commonly defined as the process of generating novel and useful ideas (Diehl & Stroebe, 1987). Group creativity at the generation stage is determined to a

large extent by the creative input of its group members (Nijstad, 2009), where both cognitive and social processes are involved. From a cognitive perspective, groups have the potential to generate more (and more creative) ideas than single individuals, because groups have the opportunity to integrate, build upon, and improve the ideas generated by individual group members (Diehl & Stroebe, 1987). Exposure to ideas from others can stimulate associations that lead to the generation of additional creative ideas (Brown, Tumeo, Larey, & Paulus, 1998).

From the social process perspective, the creative production of groups also depends on crucial group processes. Groups that work together may suffer from process losses which makes them less effective than individuals that work separately and whose ideas are simply combined (Diehl & Stroebe, 1987; Girotra, Terwiesch, & Ulrich, 2010). Process losses stem from social loafing (e.g., free-riding), apprehension for evaluations from other group members, and production blocking (Goncalo & Krarse, 2010). Social-loafing is the process in which group members exert less effort to achieve a goal when working in a group. Social loafing occurs because group members perceive their individual contributions as less identifiable and more dispensable in groups than while working alone (Diehl & Stroebe, 1987, 1991). In terms of evaluation apprehension, group members feel inhibited to share original ideas, because they fear the negative evaluations from other group members (Diehl & Stroebe, 1987). Furthermore, production blocking is detrimental to group production, because only one person can speak at a time. Not being able to express their ideas instantly might result in a lower probability that the ideas are shared, and people might forget their ideas while listening to others.

Intragroup competition and idea generation

Intragroup competition is supposed to increase the effort that individual group members invest in idea generation. When individual performance within groups gets rewarded, individual group members may have an enhanced motivation and dedicate more effort to generate more (creative) ideas to outperform the others. Given that creativity is widely considered to benefit from people's effort and motivation (e.g., Baer, Oldham, & Cummings, 2003; Zhu, Gardner, & Chen, 2018), intragroup competition would thus facilitate idea generation of the individual group members (Dugosh & Paulus, 2005; Munkes & Diehl, 2003). Furthermore, because group creativity relies on the creative input of its group members, it is likely that group performance under intragroup competition will also rise.

Intragroup competition may also determine group creativity by influencing group processes. As already mentioned, process losses, including free-riding, evaluation apprehension, and production blocking diminish idea generation in groups. Consequently, reducing these process losses will lead to better idea generation in groups. Although intragroup competition might not eliminate all process losses (production blocking for instance), it is expected to reduce process losses that are due to motivation impairments (e.g., free-riding behavior), because individual contributions are then identified and incentivized. In terms of evaluation apprehension, although group members may still worry about the evaluation from others, members may be less inclined to withhold their ideas during intragroup competition, because contributing ideas in groups increases their chances to get noticed and win the reward. In other words, the greedy desire to win may override apprehension, which is expected to lead to the contribution of more ideas.

Furthermore, much work suggests that one way to reduce process losses and stimulate group ideation is to promote a climate in which the needs of individuals are prioritized over the needs of the group (Markus & Kitayama, 1991). For example, groups whose members attribute their success to individual achievement generate a wider range of creative ideas (Goncalo & Duguid, 2008). In this perspective, intragroup competition may foster a climate weighing winning individual incentives over group harmony and thereby result in better group idea generation through reducing process losses.

Importantly, the effect of intragroup competition may depend on the level of task interdependence that is required for good task performance (Hülshager, Anderson, & Salgado, 2009). Group performance might benefit from intragroup competition when the task interdependence is low, but might hinder performance under high task interdependence (Miller & Hamblin, 1963). Under high task interdependence, group members are required to collaborate by sharing knowledge and exchanging and integrating ideas for optimal task performance. Intragroup competition will mainly disrupt collaboration (Hargadon & Bechky, 2006; Hülshager et al., 2009). During idea generation, group members are moderately interdependent upon each other: members are influenced by, and may build on the input of others, but ideas can also be generated regardless of that input. Because idea generation is only mildly dependent on information sharing of group members and integration upon that, intragroup competition fuels individual effort. We thus expect that intragroup competition enhances fluency and group creative performance (the number of creative ideas per group) at the generation stage.

H1: Intragroup competition promotes (a) fluency (b) group creative performance (the number of creative ideas per group) at the generation stage.

Performance criteria and idea generation

Creativity is composed of originality and feasibility (Amabile, 1983). Previous research reported that people have difficulty taking both creativity dimensions into account when generating ideas (e.g., Manske & Davis, 1968). Indeed, much research has found a negative correlation between originality and feasibility; that is, scoring high on one dimension come at the expense of the other dimension (Beersma & De Dreu, 2005; Nijstad, et al., 2010; Baas et al., 2019).

Clarity of performance criteria is considered an important factor to influence creativity. It was argued that for competition to serve as a motivating force for creative performance, it is essential that competing people know what performance is expected and valued (Eisenberger & Rhoades, 2001). Furthermore, a meta-analysis found that creativity-contingent rewards tend to increase creative performance (Byron & Khazanchi, 2012). In this perspective, when the task's performance criterion (i.e., what creativity dimension is valued) is clearly given, people are supposed to perform better in line with that criterion, because they are then able to steer their focus and effort in the desired direction. For instance, Rietzschel and colleagues (2014) found that stressing the importance of coming up with creative, rather than ordinary ideas may help people to generate creative ideas. Bechtoldt and his colleagues (2010) found that implicitly priming creativity criteria (namely, originality vs. appropriateness norms) influenced groups' originality and appropriateness scores of the generated ideas. It is therefore hypothesized that performance criteria, via explicitly instructing groups to focus on

either originality or feasibility – will predict where groups direct their effort during idea generation.

H2: Originality and feasibility of the generated ideas depend on performance criteria. When performance criterion favors originality, generated ideas are more original than feasible; when performance criterion favors feasibility, generated ideas are more feasible than original.

In addition, it is expected that there is an interaction between intragroup competition and performance criteria on groups' creative performance (i.e., the number of creative ideas). Previous research found that originality scores were strongly and positively related to groups' creative performance, whereas feasibility scores were negatively related to groups' creative performance (Baas et al., 2019). In the originality criterion condition, the generated ideas are expected to score higher on originality, with more creative ideas as a result. With the presence of intragroup competition, group members devote more effort into idea generation, and those in the originality criterion condition would steer this effort to come up with more original ideas, and logically, more creative ideas (see Figure 1).

H3: Intragroup competition interacts with performance criteria to determine groups' creative performance (i.e., the number of creative ideas) at the generation stage, such that groups in the intragroup competition and originality criterion condition will generate the highest number of creative ideas groups.

Figure 1. Hypothesized results for the interactional effect at the idea generation stage

Idea Selection

Idea selection requires the systematic evaluation of an idea's potential and a decision which idea to further develop and implement (e.g., Perry-Smith & Mannucci, 2017; Baas et al., 2019). High productivity in the idea generation stage is not sufficient to lead to an effective selection (Rietzschel, Nijstad, & Stroebe, 2006). Groups need to select a solution that they deem the most promising and creative in the given context.

A disappointing fact is that groups are poor at selecting ideas. Higher productivity in the idea generation stage leads to higher availability of high-quality ideas, but not necessarily to the selection of creative ideas (Faure, 2004; Rietzschel et al., 2006). Rietzschel and colleagues (2006) reported a study in which participants in either interactive groups or in nominal groups generated and selected creative ideas. Even though nominal groups generated a larger number of ideas and the generated ideas were more original than those of interactive groups, these differences did not emerge in the selection stage: there were no differences between the two conditions in terms of the quality of their selected ideas. Higher availability of high-quality ideas did not yield better selection performance. What's more, the average quality of selected ideas was not higher than the average quality of the generated ideas

(Rietzschel et al., 2006). This striking finding indicates that selection performance did not exceed chance levels.

Selection effectiveness is dependent not only on the quality of the available ideas, but also on the quality of the group process during selection (Rietzschel et al., 2006). For those groups under intragroup competition, these group processes may be rather suboptimal.

Intragroup competition and selection effectiveness

Intragroup competition is expected to reduce groups' selection effectiveness for the following reasons. Firstly, during the intragroup competition, there is an incentive for putting one's own idea forward because it increases the chance to stand out and obtain rewards. Intragroup competition may thereby cause group members to derogate each other's ideas, promote their own idea and refuse to compromise even if others' ideas are better (De Dreu, Nijstad, & Van Knippenberg, 2008). Furthermore, previous research found that people may ignore good ideas suggested by other group members, because endorsing others' idea would make one look like a follower and threaten one's self-image (Menon, Thompson, & Choi, 2006).

In addition, it was already explained that intragroup competition is thought to be conducive to idea generation, because group members are more motivated to contribute ideas. However, this facilitative effect of intragroup competition is based on the contingency that task interdependence is relatively low for idea generation. However, when the task is highly interdependent, good task performance requires the various group members to share and combine knowledge, exchange perspectives, and integrate ideas (Hargadon & Bechky,

2006; Hülsheger et al., 2009). This is exactly the case in the idea selection stage. Unlike idea generation, idea selection requires group members to collaborate to reach an agreement.

However, with the presence of individual rewards (i.e., intragroup competition), everyone is motivated to promote one's own ideas, thereby reducing a collaborative atmosphere.

On the basis of these arguments, intragroup competition is expected to reduce a group's selection effectiveness – even though groups in the intragroup competition condition might generate more and more creative ideas, having the idea quality at the generation stage controlled, the quality of the ideas selected will be lower in the intragroup competition condition than in the control condition.

H4: Controlled for the quality of idea generation, intragroup competition undermines selection performance: the average quality of the selected ideas is relatively lower in the intragroup competition condition than in the control condition.

Performance criterion and selection effectiveness

One of the reasons that was raised for the poor selection performance would be a lack of clear selection criteria. Given that creativity is often considered as a rather vague concept (Sternberg & Lubart, 1999), it is plausible that people have no idea what performance is expected when no specific selection criteria are provided. Therefore, by providing selection criteria groups are expected to better direct their efforts.

Also, people have a bias in favor of practicality against novelty when selecting (Mueller, Melwani, & Goncalo, 2012) and prefer useful rather than original ideas (Rietzschel et al., 2014). Feasibility thus gets more weight in the selection process and originality is put

aside. Reducing this bias is expected to increase selection performance. Elucidating performance criterion through explicit instructions to focus on originality (vs. appropriateness) might reduce this bias and thereby steer creativity into the instructed direction. It is therefore hypothesized:

H5: Originality and feasibility of the selected idea depend on performance criteria. When the performance criterion focuses on originality, the selected idea will be more original than feasible.

It is hypothesized above that intragroup competition reduces selection effectiveness (i.e., quality of the selected idea) and that performance criteria will guide the selected idea towards either originality or feasibility. Whether there will be an interaction between intragroup competition and performance criteria on groups' selection effectiveness will be examined in an exploratory fashion.

In sum, the current research aims to answer two major questions. First, it will answer how intragroup competition influences group performance at the idea generation stage and idea selection stage of the idea journey. Secondly, it will answer whether the presented performance criterion (i.e., originality or feasibility) predicts where people direct their effort – towards the generation and selection of original ideas when originality is the criterion and towards feasible ideas when feasibility is the criterion. This topic is worthy of investigating, since individual incentives often (if not always) exist in applied settings, for instance, organizations often render (tangible or intangible) incentives in group problem-solving to foster group decision-making, yet the effect remains unclear. Furthermore, if performance

criteria are indeed predictors of the two creativity dimensions, then it is possible to direct groups' effort toward the desired direction. Below is a brief overview of the research model.

Figure 2. The overall research model

Exploratory Variables

Group processes

We hypothesized that intragroup competition will influence groups' creative performance mainly through group's social processes, we therefore included some group process measures to explore whether the presence of intragroup competition would undermine these processes and in turn affect groups' performance. The processes examined included team communication, intragroup conflicts, cooperative conflict management, and competitive conflict management. Furthermore, we examined the perceived task interdependence level at the idea generation and selection stages. The selection stage is of particular interest, since idea selection is a joint decision-making task which might be highly dependent on the group processes.

Method

Research Sample and Design

The study was a 2 (intragroup competition: with or without) $\times$ 2 (performance criterion: valuing originality or feasibility) between-team factorial design. Three-person groups were randomly assigned to one of the four conditions.

Participants were students recruited at a European university. For a two-way ANOVA, given an estimated medium effect size of $f = .25$, power ($1 - \beta$ error probability) = .80, $\alpha = .05$, 4 groups, numerator $df = 1$, at least 128 groups would be required. However, taking practical constraints of group research into consideration and the sample sizes reported in previous research as a reference point (e.g., Bechtoldt et al., 2010; Beersma & De Dreu, 2005), we aimed to recruit at least 240 participants, summing up to eighty 3-person groups. Ethics approval (from The Faculty Ethics Review Board (ERB)) was received. 267 participants (65 males, 202 females; mean age = 21 years) signed informed consent forms and finished the experiment; they received either course credit or 10 euro as compensation.

Manipulations

Intragroup competition. Intragroup competition was manipulated by introducing a monetary reward based on individual performance (contributions to the group performance) and for which the probability for each group member to win this reward was negatively related (Na'im, 2004). The manipulation was taken and adapted from Bechtoldt et al. (2010; Study 2). For the groups in the intragroup competition condition, instructions before idea generation began read that “*However, brainstorming is particularly effective if the individual*

group members are highly motivated to contribute. That is why we introduce a bonus. The member of your group that contributes most enters a lottery. This is tracked with an audio recorder. We will count how many unique ideas each group member contributes, and the person with the biggest number of unique [or useful, depending on the performance criterion condition, see below] ideas takes part in the lottery. At the end of the study, 10 participants will be randomly selected and get a bonus of €20. Thus, the probability of each group member to win the additional bonus is higher when he/she contributes a large number of unique [or useful, depending on the performance criterion condition, see below] ideas.” For the intragroup competition manipulation at the selection stage, instructions read that *“The person whose idea is ultimately agreed and selected within group is considered to make the highest level of contribution to problem-solving. Therefore, the group member that comes up with this solution during idea generation will receive another lottery ticket to enter into the random lottery selection. This would increase the probability of winning the bonus of €20.”*

In the control condition (no intragroup competition), instructions read that *“However, brainstorming is particularly effective if the individual group members are highly motivated to contribute. Therefore, try to contribute a large number of unique [or useful, depending on the performance criterion condition] ideas.”* There was no information about a reward at the idea selection stage in the control condition.

Performance Criterion. Performance criterion was manipulated with instructions that made explicit that either originality or feasibility was required. In the originality criterion condition, participants were asked to come up with, and select, ideas that are *unique, creative, different, original, and innovative*; in the feasibility criterion condition, participants were

asked to come up with, and select, ideas that are *useful, effective, feasible, reasonable, and practical*.

Procedure

Participants registered individually to participate in the experiment. They were told that they would be randomly assigned to groups for a brainstorming task. After they arrived at the lab, they were welcomed and seated in front of a computer in an individual cubicle. They were told that it would take around 25 min to complete the study. Informed consent forms were signed first, followed by a questionnaire that measured some demographic information as well as people's social value orientation.

Next came the group task. All of the instructions were given on a screen to exclude potential extraneous variables. Participants were instructed that they were going to come up with solutions to improve the teaching at the Department of Psychology at the current university, a topic that is involving to the current subject population (De Dreu, Baas, & Nijstad, 2008; Bechtoldt et al., 2010; Baas, De Dreu, & Nijstad, 2011). To further enhance participant involvement, we explained that their ideas might be selected and submitted to the teaching committee of the Psychology Department (cf. Bechtoldt et al., 2010). Then participants received idea generation instructions that belonged to our two manipulations and they were instructed that they would have 10 min to generate ideas, which according to previous studies, would be a reasonable time window (Bechtoldt et al., 2010). Next, participants in all conditions were asked to discuss with their group members and select a single idea they believed would be the best. Instructions repeated that the faculty board and teaching committee were looking for either *unique and original* [or *practical and feasible*,

based on conditions] ideas; in addition, the groups in the intragroup competition condition would receive relevant information how individual group members could earn lottery ticket for an extra reward (see above). There was no time limit for selection.

Upon finishing this procedure, participants were led back to their individual cubicles for some exit questionnaire. This included the manipulation check of performance criterion and experienced intragroup competition, as well as some group process measures (as mentioned above), namely, team communication, intragroup conflicts, team's conflict management style – cooperative style and competitive style during the group task. In the end, they were debriefed and thanked for participation. Participants were debriefed and received an explanation that each group member received a ticket and entered the random lottery in which 10 lottery tickets of €20 were randomly drawn.

Measures

Performance indicators

Fluency. Fluency was measured as the total number of non-redundant ideas generated in the group at the generation stage.

Flexibility. Flexibility was measured as the number of non-redundant categories of the ideas that were generated by the group at the generation stage. The categorization is based on the education category system of the idea generation task – *brainstorm ways to improve teaching at the department* (De Dreu et al., 2008; Bechtoldt et al., 2010; Baas, De Dreu, & Nijstad, 2011). There are six main categories – university environment, facilities for students, students, classes, teachers, and policy, each with a bunch of subcategories. For instance, an idea 'having more seats at the learning center' would belong to the main category 'facilities

for students' and subcategory 'improve educational facilities (library, computers, etc.)', an idea 'recording the lecture' would belong to the main category 'classes' and subcategory 'improve teaching format (lectures, training, discussion, etc.)'.

Idea quality. A trained rater who was blind to conditions coded all ideas for originality and feasibility (on a five-point scale, 1 = 'not original/feasible', 5 = 'highly original/feasible'). A detailed description for each point of the response scale was given (De Dreu et al., 2008; Rietzschel et al., 2006). For instance, for originality, ideas coded as 1 ('not original') refer to ideas that are mentioned often, that represent well known complaints, or concern measures that have already been taken (e.g., "more feedback"); in contrast, ideas coded as 4 ('original') often introduce a new element into the education program (e.g., "to introduce a mascot at the university"), and ideas coded as 5 ('highly original') refer to innovative applications of existing or even non-existing technology (e.g., follow psychologists with a camera and broadcast on university's TV channel). Coding for the feasibility dimension is similar as for originality. Ideas coded as 5 ('highly feasible') refer to ideas that can be implemented very easily, only involve a minor change of the existing situation and without large investments or complicated arrangements. An example would be "there should be more information on the online teaching environment of the class and test schedules".

To guarantee sufficient interrater reliability, the rater first received extensive training by practicing the coding and comparing ratings with that of an experienced rater. The two raters discussed the differences and adjusted in the next coding round. When the interrater reliability became high enough (Cronbach's alpha close to .80), one rater continued to code

the remaining ideas, while the other rater coded a subset of 279 ideas, which constituted 24.56% of the total pool of generated ideas. For this subset, the intra-class correlations – using a two-way mixed effects model and consistency definition – were .91 for originality and .96 for feasibility, which points to excellent interrater reliability. The average originality and feasibility of the ideas by each group were calculated.

Creative ideas. Creative ideas are considered to be both original and feasible, hence, ideas that have a minimum rating of 3 on both originality and feasibility dimensions were considered to be ‘creative ideas’, aligned with previous research (Cheng, Baas, & De Dreu, 2018). A total of 173 creative ideas were generated.

Selection effectiveness. Originality and feasibility scores at the idea selection stage were computed by using the same originality and feasibility score of the group’s generated idea for the group’s selected idea. Selection effectiveness concerns the quality of the selected ideas - both originality and feasibility - as well as summing the two dimensions into an aggregate idea quality measure (aligned with previous research, e.g., Rietzschel et al., 2010). The aggregate quality measure was used to quantify selection performance instead of using the number of creative ideas, because only a single idea can be selected in each group and number of creative ideas may not well represent selection performance.

Manipulation check measures

Performance criteria. For the manipulation check of performance criterion, three items (on a seven-point Likert scale) were used (1 = not at all, 7 = very much), such that a higher score reflected a stronger focus on usefulness. A sample item was “*In generating and selecting ideas, we valued practicality over originality.*” Cronbach’s α of the scale was .80.

Experienced competition. For the manipulation check of competition, four items (on a seven-point Likert scale) were used (1 = totally disagree, 7 = totally agree). A sample item was “*While generating ideas, we were competing with each other.*” Cronbach’s α of the scale was .89.

Exploratory variables: Group Process Measures

Team Communication. To measure team communication, we used a scale that was adapted after previous validated research (Keller, 2001). The scale consisted of eight items that were answered on a seven-point Likert scale (1 = totally disagree, 7 = totally agree). A sample item was “*We communicated well within our team.*” All items of the scale can be found in Appendix A. Cronbach’s α was .89 for the eight-item scale. Group-level scores were used for the group process measures by averaging members’ individual scores within each group.

Intragroup Conflict. To measure experienced conflict within the team, we used a scale that was adapted after previous validated research (Jehn, 1995). The scale consisted of eight items that were answered on a seven-point Likert scale (1 = very little, 7 = very much). A sample item was “*How much tension was there among members in your group?*” All items of the scale can be found in Appendix A. Cronbach’s α was .87 for the eight-item scale.

Cooperative conflict management. The way in which disputes and conflicts were handled during the execution of the group task was measured with a scale that was adapted after previous validated research (Somech, Desivilya, & Lidogoster, 2009). The scale consisted of six items that were answered on a seven-point Likert scale (1 = totally disagree,

7 = totally agree). A sample item was “*Team members collaborated to come up with a decision acceptable to us.*” All items of the scale can be found in Appendix A. Cronbach’s α was .88 for the six-item scale.

Competitive conflict management. To measure group members’ firmness, authoritarianism, competitiveness in conflict management during the group task, we used a scale adapted after previous validated research (Somech et al., 2009). The scale consisted of five items on a seven-point Likert scale (1 = totally disagree, 7 = totally agree). A sample item was “*Team members used their authority to make decisions in their favor.*” All items of the scale can be found in Appendix A. Cronbach’s α was .80 for the five-item scale.

Exploratory variable: Task Interdependence

To measure task interdependence levels at idea generation and idea selection stages, we used scales adapted after previous validated research (Van der Vegt, Van der Vliert, & Oosterhof, 2003). For both idea generation and selection stages, the scale consisted of three items on a seven-point Likert scale (1 = Not at all, 7 = very much). A sample item for the idea generation stage was “*To what extent was active collaboration among group members needed during idea generation.*” The whole items of the scales can be found in Appendix A. For the three items at the generation stage, Cronbach’s α was .831; for the three items at the selection stage, Cronbach’s α was .825.

Data processing

267 participants (65 males, 202 females; mean age = 21 years) (i.e., 89 three-person groups) took part in the study. Nine groups erroneously performed a group task from another, unrelated experiment (i.e., group number 15, 18, 31, 34, 37, 50, 53, 58, 61) and were therefore removed from analyses. We were then left with 80 groups.

Having looked into the audio-recordings and the experiment logbook, two groups (i.e., group number 41 and 45) were found to be problematic due to various reasons – (a) group member(s) not paying serious attention during the study or not contributing, (b) group members poor in English and did not understand instructions very well, (c) deviate greatly from experiment contents during the group task. Taken all these into consideration, the two groups were removed from analyses. Analyses were done using the remaining 78 groups, summing up to 234 participants (176 females (75.2%) and 57 males (24.4%), ages ranged from 17 to 33 with a mean of 21). The four conditions comprised 18 (intragroup competition + originality-focus condition), 18 (control + originality-focus condition), 20 (intragroup competition + feasibility-focus condition) and 22 (control + feasibility-focus condition) groups, respectively.

Results

Table 1 summarizes the correlations between the creativity performance indicators at the generation and selection stages (i.e., originality, feasibility, aggregate quality measures). As can be seen in Table 1, feasibility and originality scores were negatively correlated, whereas all other correlations tended to be positive.

Table 1

Correlations Between the Creativity Performance Indicators for Idea Generation and Selection

	1.	2.	3.	3.	4	5.
1. Originality at generation	1	-.26*	.63***	.31**	.01	.27*
2. Feasibility at generation		1	.59***	.03	.25*	.21
3. Idea quality at generation			1	.28*	.20	.39***
4. Originality at selection				1	-.22*	.68***
5. Feasibility at selection					1	.56***
6. Idea quality at selection						1

*, $p < 0.10$; **, $p < 0.01$; ***, $p < 0.001$.

Table 2

Means and Standard Deviations for All Measures as a Function of Criterion Condition and Competition Condition (at the Group Level)

Measure	Overall <i>M (SD)</i>	Originality condition		Feasibility condition	
		Competition <i>M (SD)</i> (N=18)	No	Competition <i>M (SD)</i> (N=20)	No
			competition		competition
			<i>M (SD)</i> (N=18)		<i>M (SD)</i> (N=18)
Generation stage					
Fluency	14.56 (6.38)	14.17 (5.36)	15.56 (6.07)	15.95 (8.90)	12.82 (4.34)
Flexibility	9.08 (3.10)	9.83 (3.57)	9.06 (2.31)	9.45 (4.10)	8.14 (1.96)
Number of creative ideas	2.22 (2.09)	2.78 (2.69)	2.61 (2.23)	2.20 (1.61)	1.45 (1.65)
Originality of generated ideas	1.98 (0.23)	2.06 (0.22)	1.98 (0.28)	1.91 (0.19)	1.98 (0.24)
Feasibility of generated ideas	3.62 (0.22)	3.57 (0.19)	3.64 (0.19)	3.69 (0.19)	3.57 (0.29)
Quality of generated ideas	5.60 (0.28)	5.63 (0.27)	5.62 (0.25)	5.60 (0.27)	5.56 (0.33)

Selection stage					
Originality of selected ideas	2.05 (0.62)	2.28 (0.57)	1.86 (0.76)	2.03 (0.52)	2.05 (0.58)
Feasibility of selected ideas	3.57 (0.54)	3.50 (0.51)	3.75 (0.43)	3.55 (0.60)	3.51 (0.59)
Quality of selected ideas	5.63 (0.72)	5.78 (0.73)	5.61 (0.87)	5.58 (0.75)	5.56 (0.59)
Group processes					
(group level)					
Experienced competition	2.16 (0.77)	2.61 (0.69)	1.75 (0.53)	2.21 (0.69)	2.08 (0.89)
Team communication	6.06 (0.54)	5.90 (0.52)	6.07 (0.51)	6.06 (0.37)	6.19 (0.69)
Intragroup conflict	1.74 (0.55)	1.80 (0.60)	1.63 (0.42)	1.78 (0.46)	1.74 (0.69)
Cooperative conflict management	5.92 (0.49)	5.78 (0.53)	5.89 (0.49)	5.82 (0.40)	6.14 (0.50)
Competitive conflict management	2.74 (0.71)	2.71 (0.85)	2.69 (0.67)	2.68 (0.64)	2.87 (0.72)
Task					
interdependence at generation	4.80 (0.89)	4.81 (0.86)	4.95 (0.76)	4.54 (1.08)	4.91 (0.83)
Task interdependence at selection	5.47 (0.79)	5.54 (0.60)	5.54 (0.67)	5.30 (1.00)	5.50 (0.82)

Manipulation Checks

Performance criteria. To verify whether the manipulation of originality versus feasibility focus was successful, we ran an independent sample t-test with performance criterion condition as independent variable and the performance criterion manipulation check measure as dependent variable (with higher scores representing a stronger focus on feasibility). The analysis showed a significant effect of performance criterion condition, ($t(214.3) = -2.65, p < .01$), participants in the feasibility-focus condition scored higher than those in the originality-focus condition, meaning they were more focused on the feasibility dimension ($M_{ori} = 5.16, SD_{ori} = 1.20; M_{fea} = 5.56, SD_{fea} = 1.04$). Despite that, simple one-

sample t-tests that tested the ratings in each condition against the scale's mid-point of the scale (4) indicated that people in both the feasibility-focus condition ($t(125) = 16.71, p < .001$) and originality-focus condition ($t(107) = 0.11, p < .001$) placed more value on feasibility than originality.

Experienced competition. To verify whether the manipulation of intragroup competition worked, an independent sample t-test was performed with intragroup competition as independent variable and the manipulation check measure of experienced competition as dependent variable. The analysis showed a significant effect of intragroup competition condition ($t(229.97) = 2.83, p < .01$), with stronger experienced competition in the intragroup competition condition than in the control condition ($M_{comp} = 2.40, SD_{comp} = 1.30; M_{control} = 1.93, SD_{control} = 1.24$). Notably, people in both the intragroup competition condition ($t(113) = -13.16, p < .001$) and control condition ($t(119) = -18.23, p < .001$) scored significantly lower than the mid-point of the seven-point scale (4), indicating that not much competition was experienced.

Confirmatory Analyses

Fluency (at generation)

Table 2 summarizes the means and standard deviations for all measures as a function of the experimental manipulations. A one-way ANOVA was performed to test Hypothesis 1a (i.e., *intragroup competition promotes fluency at the generation stage*). There was no significant difference in fluency between the intragroup competition condition ($M = 15.11$,

$SD = 7.40$) and control condition ($M = 14.05$, $SD = 5.30$), $F(1,76) = 0.53$, $p = 0.469$, $BF_{10} = 0.30$.¹ Hypothesis 1a was not supported.

Creative Ideas (at the generation stage)

A two-way ANOVA with intragroup competition and performance criterion condition as between-subjects factors, and the number of creative ideas as dependent variable was used to test Hypothesis 1b (*Intragroup competition promotes the number of generated creative ideas per group*) and Hypothesis 3 (*Intragroup competition interacts with performance criteria to determine groups' creative performance (i.e., the number of creative ideas) at the generation stage, such that groups in the intragroup competition and originality criterion condition will generate the highest number of creative ideas groups*). This ANOVA showed that the predicted interaction-effect between performance criterion and competition on the number of creative ideas was not significant ($F(1,74) = 0.38$, $p = .538$, partial $\eta^2 = .005$; $BF_{10} = 0.15$). Hypothesis 3 was rejected.

The main effect of competition was also non-significant ($F(1,74) = 0.949$, $p = .33$; partial $\eta^2 = .013$; $BF_{10} = 0.57$), indicating that there was no significant difference between the competition condition ($M = 2.47$, $SD = 2.18$) and control condition ($M = 1.98$, $SD = 1.99$) in terms of the number of generated creative ideas. Hypothesis 1b was not supported.

Notably, the main effect for performance criterion condition was marginally significant ($F(1,74) = 3.43$, $p = .068$; partial $\eta^2 = .044$; $BF_{10} = 1.10$), showing that groups in

¹ Bayes factor was first proposed by Jeffereys (1961). Lee and Wagenmakers (2013) modified it into a criterion weighing the strength of evidence comparing two competing theories. According to the criteria, Bayes factor $BF_{10} > 1$ indicates evidence for H_1 whereas $BF_{10} < 1$ indicates evidence for H_0 . Specifically, 1-1/3 indicates "anecdotal evidence for H_0 ", 1/3-1/10 indicates "moderate evidence for H_0 ", 1/10-1/30 indicates "strong evidence for H_0 "; 1-3 indicates "anecdotal evidence for H_1 ", 3-10 indicates "moderate evidence for H_1 ", 10-30 indicates "strong evidence for H_1 ". Here we specifically comparing our hypothesis to the null-hypothesis.

the originality-focus condition tended to produce a larger number of creative ideas ($M = 2.69$, $SD = 2.44$) than those in the feasibility-focus condition ($M = 1.81$, $SD = 1.66$).

Conditions & Dimension scores: originality vs. feasibility (at the generation stage)

It was predicted that the *originality and feasibility of the generated ideas would depend on performance criterion condition, with more original (feasible) than feasible (original) ideas when the performance criterion favors originality (feasibility)* (Hypothesis 2). To investigate whether performance criteria and competition conditions influenced originality and feasibility scores at the generation stage, a repeated measures ANOVA was performed, with competition and performance criterion conditions as two between-subject factors and originality versus feasibility scores as the within-subject dependent variables.

The predicted 2-way interaction between performance criterion condition and originality vs. feasibility scores of the generated ideas was non-significant ($F(1,74) = 1.49$, $p = .227$, partial $\eta^2 = .020$), meaning that group performances in the originality-focus and feasibility-focus condition did not significantly differ depending on whether originality or feasibility was measured (see Figure 3). Hypothesis 2 was therefore not supported. The 2-way interaction between competition condition and originality vs. feasibility scores of the generated ideas were also non-significant ($F(1,74) = 0.08$, $p = .780$, partial $\eta^2 = .001$).

Notably, results indicated that originality vs. feasibility scores of the generated ideas significantly differed from one another ($F(1,74) = 1626.13$, $p < .001$, partial $\eta^2 = .956$): all groups scored higher on feasibility ($M = 3.62$; $SD = 0.22$) than originality ($M = 1.98$; $SD = 0.23$) on their generated ideas. As Figure 4 shows, the distribution of originality scores

centered around 2 (lower end of the five-point scale) whereas the distribution of feasibility scores centered around 3 and 4 (which are relatively higher on the five-point scale).

Concerning the main effects of intragroup competition and criterion condition, the main effect of intragroup competition was not significant ($F(1,74) = 0.20, p = .659$, partial $\eta^2 = .003$), nor was the main effect of performance criterion condition ($F(1,74) = 0.51, p = .478$, partial $\eta^2 = .007$). These non-significant test statistics indicated that neither intragroup competition nor performance criteria condition affected group performances across the originality and feasibility dimensions.

Finally, results showed that the three-way interaction (i.e., intragroup competition * performance criterion condition * dimension scores) was marginally significant ($F(1,74) = 3.92, p = .052$, partial $\eta^2 = .050$). We then explored the nature of this 3-way interaction. Results suggest that in groups without intragroup competition, performance criterion condition did not significantly interact with the originality vs. feasibility scores of the generated ideas ($F(1,38) = .22, p = .64$, partial $\eta^2 = .006$); however, in groups in the intragroup competition condition, performance criterion condition significantly interacted with the originality vs. feasibility scores of the generated ideas ($F(1,36) = 7.82, p < .01$, partial $\eta^2 = .178$). Subsequent ANOVA test showed that in the presence of intragroup competition, performance criterion condition significantly affected the originality of the generated ideas ($F(1,36) = 4.74, p = .036$, partial $\eta^2 = .116$), such that groups in the originality-focus condition scored higher on originality ($M = 2.06, SD = 0.22$) than those in the feasibility-focus condition ($M = 1.91, SD = 0.19$); the effect of performance criteria on the feasibility of generated ideas was marginally significant ($F(1,36) = 3.54, p = .068$, partial η^2

= .090): groups in the feasibility-focus condition scored slightly higher on feasibility ($M = 3.69$, $SD = 0.19$) than those in the originality-focus condition ($M = 3.57$, $SD = 0.19$). These results suggested that groups tended to follow up on the performance criteria that were put forward in the manipulation, but only in the intragroup competition condition.

Figure 3. (a) Originality score distribution (b) Feasibility score distribution of the four conditions at the generation stage

Figure 4. (a) Originality score distribution (b) Feasibility score distribution based on performance criteria conditions at the generation stage

Selection effectiveness

It was predicted that '*controlled for the quality of idea generation, intragroup competition would undermine selection performance, with the average quality of the selected ideas being relatively lower in the intragroup competition condition than in the control condition* (Hypothesis 4).' An ANCOVA was performed, with intragroup competition and performance criteria as independent variables, idea quality at generation as a covariate, and idea quality at the selection stage as the dependent variable. ANCOVA results showed that idea quality at the generation stage – as a covariate – significantly and positively predicted idea quality at the selection stage ($F(1,73) = 12.96, p < .001$, partial $\eta^2 = .151$, $BF_{10} = 69.849$). However, neither the interaction effect ($F(1,73) = .33, p = .569$, partial $\eta^2 = .004$; $BF_{10} = 0.026$), nor the main effect for intragroup competition ($F(1,73) = .19, p = .662$, partial $\eta^2 = .003$; $BF_{10} = 0.271$), or the main effect for performance criteria ($F(1,73) = .26, p = .615$, partial $\eta^2 = .003$; $BF_{10} = 0.302$) was significant. In other words, study results showed that intragroup competition did not affect idea quality at the selection stage ($M_{comp} = 5.63, SD_{comp} = 0.72$; $M_{control} = 5.58, SD_{control} = 0.72$). Hypothesis 4 was not supported.

Conditions & Dimension scores: originality vs. feasibility (at the selection stage)

Concerning the originality and feasibility scores at the selection stage, it was predicted that *originality and feasibility of the selected idea would depend on the performance criterion condition, with the selected idea being more original (feasible) than feasible (original) when the performance criterion focuses on originality (feasibility)* (Hypothesis 5). To test this, again, a repeated measures ANOVA was performed, but then with originality and feasibility scores of the selected idea as the within-subjects factor.

The predicted 2-way interaction between performance criteria condition and originality vs. feasibility scores of the selected ideas was non-significant ($F(1,74) = 0.10, p = .753$, partial $\eta^2 = .001$, meaning that group performances in the originality-focus and feasibility-focus condition did not significantly differ depending on whether originality or feasibility was measured (as Figure 5 shows). Hypothesis 5 was not supported. The 2-way interaction between competition condition and originality vs. feasibility scores of the selected ideas were also non-significant ($F(1,74) = 2.30, p = .134$, partial $\eta^2 = .030$), groups' selection performances in the intragroup competition and control condition did not significantly differ depending on whether originality or feasibility was measured. See Figure 5 for the originality and feasibility score distributions in each condition.

Again, results indicated that originality vs. feasibility scores of the generated ideas significantly differed from one another ($F(1,74) = 225.03, p < .001$, partial $\eta^2 = .753$): all groups scored higher on feasibility ($M = 3.57; SD = 0.54$) than originality ($M = 2.05; SD = 0.62$) on their selected ideas. See Figure 6 for the originality and feasibility score distributions at the selection stage respectively.

Concerning the main effects of intragroup competition and criterion condition, the main effect of intragroup competition was not significant ($F(1,74) = 0.34, p = .564$, partial $\eta^2 = .005$), nor was the main effect of performance criterion condition ($F(1,74) = 0.56, p = .458$, partial $\eta^2 = .007$). The non-significant test statistics indicated that neither intragroup competition nor performance criterion condition affected group performances across the originality and feasibility dimensions at the selection stage.

Finally, the three-way interaction (i.e., intragroup competition * performance criterion condition * dimension scores) was close to the significant level ($F(1,74) = 3.12, p = .082$, partial $\eta^2 = .040$). Subsequent exploratory analyses suggested that in groups in the feasibility-focus condition, intragroup competition did not interact with the originality vs. feasibility scores of the selected ideas ($F(1,40) = .03, p = .86$, partial $\eta^2 = .001$); however, in groups in the originality-focus condition, intragroup competition significantly interacted with the originality vs. feasibility of the selected ideas ($F(1,34) = 5.58, p = .024$, partial $\eta^2 = .141$). Further ANOVA tests suggested that in the originality-focus condition, intragroup competition marginally significantly affected the originality of the selected ideas ($F(1,34) = 3.42, p = .073$, partial $\eta^2 = .092$), such that the ideas groups selected in the intragroup competition condition scored slightly higher on originality, compared to the control groups ($M_{\text{comp}} = 2.28, SD_{\text{comp}} = 0.57; M_{\text{control}} = 1.86, SD_{\text{control}} = 0.76$); the effect of intragroup competition on the feasibility of the selected ideas was non-significant ($F(1,34) = 2.51, p = .12$, partial $\eta^2 = .069$). These results suggested that when performance criteria asked to focus on originality when selecting, intragroup competition displayed a trend to promote the required originality-focus.

Figure 5. (a) Originality score distribution (b) Feasibility score distribution of the four conditions at the selection stage

Figure 6. (a) Originality score distribution (b) Feasibility score distribution at the selection stage based on performance criteria

Exploratory Analyses

Flexibility

For the idea generation stage, we already looked into effects on fluency and the number of creative ideas as creativity indicators. Another creativity indicator concerns the scope of surveyed categories during idea generation (Nijstad et al., 2010). To investigate whether competition and performance criteria expand groups' brainstorming scope,

flexibility (i.e., number of categories of the ideas generated) was considered as the dependent variable.

A two-way ANOVA with intragroup competition and performance criterion condition as independent variables and flexibility as the dependent variable showed that neither the interaction effect ($F(1,74) = .146, p = .704, BF_{10} = 0.076$), nor the main effects for competition ($F(1,74) = 2.216, p = .141, BF_{10} = 0.665$), or the main effect for performance criteria ($F(1,74) = .860, p = .357, BF_{10} = 0.354$) significantly influenced the flexibility during idea generation.

Group Processes

It was predicted that intragroup competition would undermine groups' selection performance since group members in this condition might focus more on pushing their self-generated ideas forward (even if these ideas would not represent the best idea of the group) to win individual rewards. That is why we measured self-reported group processes to explore the underlying processes of how intragroup competition might affect group performance. These process measures include *team communication*, *intragroup conflict*, *teams' conflict management style – cooperative style and competitive style*.

It is plausible that intragroup competition might undermine team communication, cooperative conflict management within groups, and increase group conflict and the firmness of how group members express themselves. The impaired group processes during the group task might then predict idea quality (i.e., originality, feasibility, and aggregate quality measure at the generation and selection stage).

Table 3

Pearson Correlations Between Group Processes and Group Performance Indicators

	Team communicati on	Experienced Competition	Intragroup Conflict	Cooperative conflict management	Competitive conflict management
Originality at generation	.01	.16	-.06	.09	-.09
Feasibility at generation	.17	-.06	-.17	.10	-.02
Idea Quality at generation	.15	-.08	-.19	.15	-.09
Originality at selection	.01	.14	-.07	.03	-.13
Feasibility at selection	.35**	-.04	-.21	.33**	-.02
Idea Quality at selection	.27*	-.09	-.22	.27*	-.12

*, $p < 0.10$; **, $p < 0.01$.

Table 4

*Means and Standard Deviations for Group Processes as Functions of Intragroup
Competition (at the Group Level)*

	Overall (N=78) <i>M (SD)</i>	Competition condition (cond 1+3, N=38) <i>M (SD)</i>	Control condition (cond 2+4, N=40) <i>M (SD)</i>
Group processes (group level)			
Experienced competition	2.16 (0.77)	2.40 (0.71)	1.93 (0.76)
Team communication	6.06 (0.54)	5.98 (0.45)	6.13 (0.61)
Intragroup conflict	1.74 (0.55)	1.79 (0.53)	1.69 (0.58)
Cooperative conflict management	5.92 (0.49)	5.80 (0.46)	6.03 (0.50)
Competitive conflict management	2.74 (0.71)	2.69 (0.74)	2.79 (0.69)

Table 3 summarizes the correlations between group process measures and performance indicator measures. As can be seen, team communication and cooperative

conflict management seem to be positively and significantly correlated with selection effectiveness (i.e., quality of the selected ideas).

Team communication. In terms of team communication, specifically, there was a significant correlation between team communication and feasibility of the selected idea ($r(78) = .35, p < .01$), as well as a significant correlation between team communication and idea quality at the selection stage ($r(78) = .27, p < .05$). Furthermore, team communication was significantly and negatively correlated with the degree to which groups reported the experience of competition during group task ($r(78) = -.38, p < .01$).

Table 4 summarizes the means and standard deviations for group process measures in each condition. As the table shows, although team communication at the group-level looks relatively good in both conditions (with a one-sample t-test showing that team communication was significantly higher than the mid-point score of 4 on the seven-point scale, $t(77) = 33.69, p < .001$), a one-way ANOVA test showed that the reported team communication in the competition condition ($M = 5.98, SD = 0.45$) did not significantly differ from that in the control condition ($M = 6.13, SD = 0.61$), ($F(1,76) = 1.51, p = .222$, $BF_{10} = 0.452$). Despite being non-significant, the competition condition scored slightly lower in team communication. This points to the possibility that the relationship between intragroup competition and creativity might be dependent on team communication. Namely, the experienced team communication might indirectly link experienced intragroup competition with idea quality at the selection stage.

Using a percentile bootstrap estimation approach with 5000 samples (implemented with PROCESS macro, Preacher & Hayes, 2014; Hayes, 2018), we tested a serial multiple

mediation model in which intragroup competition influences groups' selection performance through experienced competition and subsequent perceived team communication during the group task (see Figure 7). Results indicated that the specific indirect effect of intragroup competition on idea quality at selection through experienced competition and team communication in serial (i.e., $X \rightarrow M1 \rightarrow M2 \rightarrow Y$) was significantly negative, with the bootstrap confidence interval not including zero ($B = -.06$, $SE = .04$, 95% CI = $[-.157, -.007]$). Intragroup competition condition positively predicted group members' experienced competition, which affected their team communication in groups, which in turn influenced groups' selection effectiveness.

Figure 7. Serial multiple mediation: Experienced competition and team communication in serial linked intragroup competition and selection effectiveness

Cooperative conflict management. Furthermore, cooperative conflict management was significantly associated with groups' selection performance, namely, feasibility score at the selection stage ($r(78) = .33, p < .01$) and idea quality at the selection stage ($r(78) = .27, p < .05$). It was also negatively correlated with groups' experienced competition during the group task ($r(78) = .26, p < .05$). These results indicate that cooperative conflict management might also link the experienced intragroup competition – selection quality relationship.

Table 4 shows that although cooperative conflict management at the group-level looks relatively good in both conditions (with one-sample t-test showing that cooperative conflict management was significantly higher than the mid-point score of 4 on the seven-point scale, $t(77) = 34.31, p < .001$), a one-way ANOVA test also showed that cooperative conflict management in the intragroup competition condition was lower ($M = 5.80, SD = 0.46$) than in the control condition ($M = 6.03, SD = 0.50$), ($F(1,76) = 4.34, p < .05, BF_{10} = 1.499$). These results suggest that the relationship between intragroup competition and groups' selection performance might be dependent on cooperative conflict management within groups. Namely, cooperative conflict management might indirectly link intragroup competition with idea quality at the selection stage.

Using the same PROCESS macro as before (Preacher & Hayes, 2014; Hayes, 2018), we tested a serial multiple mediation model in which intragroup competition influences groups' selection performance through experienced competition and subsequent cooperative conflict management during the group task (see Figure 8). Results suggested that the indirect effect of neither experienced competition ($B = .06, SE = .05, 95\% CI = [-.042, .168]$) nor cooperative conflict management ($B = -.08, SE = .08, 95\% CI = [-.261, .030]$) separately was significant. The specific indirect effect of intragroup competition on idea quality at selection through experienced competition and cooperative conflict management in serial (i.e., $X \rightarrow M1 \rightarrow M2 \rightarrow Y$) was close to reaching the significance level ($B = -.03, SE = .03, 95\% CI = [-.094, .007]$): cooperative conflict management was positively associated with idea quality at the selection stage, and intragroup competition, through affecting group members'

experienced competition, showed a trend to undermine groups' cooperative conflict management.

Figure 8. Serial multiple mediation: Experienced competition and cooperative conflict management in serial linked intragroup competition and selection effectiveness

Task interdependence. A one-way ANOVA test showed that the level of task interdependence significantly differed between the idea generation and selection stages ($F(1, 154) = 24.31, p < .001$), such that task interdependence was higher at the selection stage ($M = 5.47, SD = 0.79$) than the generation stage ($M = 4.80, SD = 0.89$). Indeed, the selection task is a joint decision process, which requires more collaboration and coordinated effort of group members.

Discussion

Study recap

The current study aimed to uncover the effects of intragroup competition and performance criteria on group creativity at both idea generation and selection stages of the creative process (i.e., group idea journey). In a lab group experiment, groups generated and selected ideas for a complex problem while either competing with each other (or not) for monetary bonuses and while being instructed to focus particularly on originality (novelty) or

feasibility (usefulness). We expected that intragroup competition would enhance groups' idea generation whereas it would undermine the idea selection process, and that explicit instructions of performance criteria would steer group performance in the presented direction (originality in the originality focus condition and feasibility in the feasibility focus condition). However, none of these predictions was supported by our findings.

Interesting findings and theoretical implications

Nevertheless, despite that the predicted effects remained non-significant; some interesting results emerged from our exploratory analyses. Notably, under intragroup competition only, performance criteria significantly affected originality vs. feasibility scores of the generated ideas in the predicted direction; also, in the originality-focus condition, as compared to the control condition, intragroup competition marginally increased the originality score at the selection stage. With the presence of intragroup competition, groups tended to follow up on the performance criterion that was put forward. A possible explanation would be people's tendency to follow the path of least resistance (Finke, Ward, & Smith, 1992; Ward, Patterson, Sifonis, Dodds, & Saunders, 2002). Based on this theory, people tend only to generate ideas that come to mind relatively easy and give up when it becomes harder to generate ideas. The presence of intragroup competition, on the other hand, increased people's efforts to leave this path of least resistance. People were then more dedicated, engaged to come up with ideas that meet the criterion demand, even if these ideas were less accessible. Another explanation can be that people in the intragroup competition condition paid more attention to the task instructions. The possibility to win extra monetary

bonuses may have motivated them to read the instructions carefully and pay close attention to the required performance criterion.

Results showed that the two dimensions – originality and feasibility were indeed, in line with previous research, inversely correlated ($r_{\text{gen}} = -.26$, $r_{\text{sel}} = -.22$) (e.g., Beersma & De Dreu, 2005; Nijstad et al., 2010). The negative correlation applies to not only idea generation but also the selection stage. People have difficulty taking both conditions into account (Runco & Charles, 1993; Rietzschel et al., 2010; Baas et al., 2019).

Furthermore, people tend to focus more on feasibility than originality: the feasibility scores of generated and selected ideas were much higher than originality scores. Much previous research has suggested this bias in favor of feasibility against originality (e.g., Rietzschel et al., 2010; Mueller, Melwani, & Goncalo, 2012). Stroebe and his colleagues (2010) raised the potential discrepancy between researchers (hence also raters) and participants in their definition of “good” ideas. They argued that researchers define “good” ideas as ideas that are high in both originality and feasibility. Raters, therefore, evaluate ideas on these two dimensions jointly. It is implicitly assumed that people consider the same criteria when generating and selecting ideas, which is not necessarily the case. They further examined this possibility by asking participants to indicate how strongly they tried to select original ideas, feasible ideas, and desirable ideas (i.e., ideas which they thought should be adopted). Self-reported results indeed showed that participants tried to select feasible and desirable ideas, but not original ideas. Thus, participants appeared to consider “good” ideas as feasible and those they would like to be implemented (namely, ideas that can and should be adopted), originality was not a quality dimension that was considered (Rietzschel et al.,

2010). Therefore, poor selection performance could be due to the strong tendency to select feasible ideas, at the cost of originality. Results of the current study indicated that feasibility scores were much higher than originality scores (and hence were more valued) even under the originality-focus condition, at both the generation and selection stages. Apparently, the instructions to focus on originality did not change people's preferences for practical, rather than novel ideas.

Another finding lies in the idea journey – from idea generation to idea selection. Previous research has mainly focused on idea generation, thereby neglecting that the amount and quality of generated ideas do not necessarily proceed into the selection stage because groups are often poor at selecting ideas. The current research examined both the generation and selection stage and found that idea quality at generation positively predicted idea quality at the selection stage. This is aligned with previous research, such that the quality of the selected ideas is not related to idea quantity at all, but only to the average quality of the generated ideas (Rietzschel et al., 2006).

Last but not least, the effect of intragroup competition on groups' selection effectiveness may depend on group process contingencies. Results showed that intragroup competition enhanced people's perceived competition, which indirectly predicted lower idea quality at the selection stage through decreased team communication. Another group process variable – cooperative conflict management, albeit marginally significant, also showed a trend to link the relationship between perceived competition and groups' selection quality. Putting the methodological concerns of intragroup competition manipulation aside, this implies that intragroup competition itself is not necessarily bad. However, when (experienced) intragroup

competition undermines the collaborative atmosphere within groups, then group performances would suffer, especially when the selection task depends on the cooperative effort of each group member.

In the remainder of this discussion, we explain possible reasons for why our predictions were not supported, discuss study limitations, and highlight avenues for future research.

Interpreting the results: unexpected yet understandable

We attributed the non-significant results of performance criteria mostly to the topic and setting of the creative problem-solving task. People were asked to come up with ideas to *improve the teaching at the department of psychology*, and that the best ideas would be presented to the teaching board. People have a natural bias in favor of practicality against novelty (Mueller et al., 2012; Rietzschel et al., 2014) and the current topic and instructions may have exacerbated this bias, even when people were explicitly instructed to focus on originality. Results indeed showed that both generated and selected ideas were much more feasible than original. As previous research pointed out, coming up with novel ideas is more difficult with a realistic or relevant problem than with an unrealistic or irrelevant problem (Dillon, Graham & Aidells, 1972; Harari & Graham, 1975). Furthermore, stressing the personal relevance of the problem would lead to the generation of ideas that are less original, because people would tend to stick with safe ideas that come to mind easily (Rietzschel et al., 2014)

In terms of the non-significant influence of intragroup competition on performance in both the idea generation and selection stages, we interpreted that this was also due to the

creative problem-solving topic. Past literature raised the concept of goal interdependence, in addition to task interdependence (Hülsheger et al., 2009). Goal interdependence describes whether group members' goals and rewards are aligned with that of the other group members. Both task interdependence and goal interdependence are beneficial to group creativity, as both stimulate interpersonal interaction, communication, and cooperation within the team (Van der Vegt & Van de Vliert, 2002). Importantly, it was argued that goal interdependence might be more effective to encourage communication and cooperation (Hülsheger et al., 2009). With consistent goals in place, group members cooperate to perform effectively for the mutual good. In the current study, we expected that intragroup competition for extra monetary rewards would undermine the group processes at the selection stage. However, the group process measures indicated that the interactive process seemed quite good and that intragroup competition and control conditions did not differ that much on process measures – with *experienced competition*, *intragroup conflicts* and *members' competitive conflict management style* all being lower than median score of 4, whereas *team communication*, *cooperative conflict management* both being higher than the median score of 4. Intragroup competition was barely experienced. Indeed, many group participants reported to the experimenters after the study that there was little intragroup competition and no conflict at all, the discussion went rather smoothly as each group member was very devoted to improving the teaching at the department. Therefore, it is plausible that the intragroup competition manipulation was not strong enough and the experienced competition was rather limited. On top of that, the realistic and relevant cover story may have made group members' goal of improving teaching at the department outweigh the aim to individually win monetary

rewards. This would have made group members' goals overall aligned, and therefore did not yield negative processes and outcomes. Another similar explanation can be task orientation (also called climate for excellence) and vision (West, 1990). It describes a shared concern of group members with the excellence of quality of task performance in relation to a shared vision. Because group members have a common understanding of objectives (namely, come up with ideas to improve the department's teaching), the group interactions may have gone rather smoothly. However, it could also be that intragroup competition simply has no effect, regardless of the methodological concerns.

Limitations and future research directions

As mentioned above, we attributed the non-significant effect of performance criteria and intragroup competition to the realistic and relevant topic and cover story of the group creativity task. The task was chosen because it was considered suitable and involving for the student participants, and has been used very often in brainstorming research before (e.g., De Dreu et al., 2008; Bechtoldt et al., 2010; Baas et al., 2011). However, with this realistic and relevant task, an unintended side-effect could have been that participants put too much weight on practical and useful ideas that they liked to see them considered and implemented and overlook that originality could be the aim. Also, the realistic, and more importantly, self-relevant task topic may have made them so dedicated and engaged in the task with a shared goal that winning individual rewards is no longer the aim. The desire to improve the teaching thus may have outperformed the desire to win rewards and hence, our intragroup competition manipulation may have had a rather limited effect. From the manipulation check we did find that though being significant, intragroup competition and control conditions only slightly

differed on experienced competition within groups ($M_{comp} = 2.40$, $SD_{comp} = 1.30$; $M_{control} = 1.93$, $SD_{control} = 1.24$), and both conditions scored significantly lower than the mid-point of 4 on the seven-point scale, meaning that the experienced intragroup competition was rather low even in the competition condition. In future lab experiments with student samples, research could use other creative ideation tasks in addition to the current education topic to further investigate how intragroup competition influences group creativity, for instance, “How can one improve or maintain one’s health?”, “What can people do to protect the environment?” (Diehl, 1991). A good thing of using these topics is that there is no salient common goal for group members (unlike the common goal of improving the teaching), without which the intragroup competition manipulation may be strengthened.

Another limitation of the study can be attributed to the sample size, which is often the case for group research. A priori power analysis with a power .80 indicated that at least 128 groups were needed, yet in the current study, only 89 groups took the experiment, and 78 groups were included in the analyses. This is another reason why no significant main effects of competition and criteria were found and exploratory analyses often bordered on being significant. Ideally, future research should use bigger samples. Taking practical concerns of group research into account, with a limited sample size, Bayes factors (e.g., Lee and Wagenmakers, 2014) can serve as an addition to testing against the traditional p -value. By examining the ratio of likelihood of one particular hypothesis to the likelihood of another, it tells us the weight of evidence in favor of a given hypothesis. In the current research, most of the predictions were not supported based on the p -values, nevertheless, many of the Bayes factors fell between 1 to 1/10. This means that although the evidences were not in favor of

our hypotheses, they only gave anecdotal or moderate support to the null hypotheses.

Therefore, we shall take the imprecision of statistical estimations into account and make conclusions carefully, especially when Bayes factors point to only anecdotal evidence for whichever hypothesis.

The level of explicitness could also be varied (Runco, Illies, & Reiter-Palmon, 2005).

Using originality as the criterion, Runco and his colleagues found that there was a main effect for the level of explicitness. In their research, originality scores significantly differed for the low, moderate, and high explicit groups. Despite that manipulation checks indicated that our performance criterion manipulation worked – participants reported having focused more on feasibility in the feasibility-focus condition than in the originality-focus condition – this effect was rather limited. In fact, groups in both conditions focused more on generating and selecting feasible than original ideas. Group performances in the originality-focus and feasibility-focus condition did not significantly differ when either originality or feasibility was measured. Hence, it could have been that the explicitness of the performance criterion manipulation was not high enough. In the current study we only used different words in the running text (e.g., originality vs. feasibility) to distinguish the two criterion conditions. Future research in which performance criteria are manipulated could use a stronger manipulation, for example, using bold, italic and colorful words to raise enough attention in participants.

In addition, since we use *improving the teaching at the department* as groups' creative problem-solving task, it might be better to have the teaching committee actually evaluate the quality of the generated and selected ideas. However, we should note that the originality and feasibility ratings were based on the coding scheme that was developed locally where we

collected the data (i.e., in the Netherlands) by experienced institutional researchers and teachers (De Dreu et al., 2008; Rietzschel et al., 2006). Hence, coding validity can be assumed.

Still, the current study was a lab experiment with student participants. Hence, external and ecological validity are limited. Future research could examine the effects of intragroup competition in applied settings with employee samples. By having workplace employees fill out questionnaires measuring their perceived intra-team competition and their creative performance evaluated by the team manager, we could examine the effect of perceived intragroup competition on team creativity. Alternatively, field experiments could be conducted. A rough idea to operationalize intra-team competition would be to render contribution-based monetary rewards to those who are working on a same team project (e.g., brand marketing). By having all team members rate the originality and feasibility of each idea, the team member that is considered to make the biggest contribution would win the reward.

Importantly, intragroup competition concerns not only competing for extrinsic rewards but also competing for recognition, for status and power, for displaying self-competence and gaining control of resources, etc. (Abraham, McCusker, & Foti, 2019). There are different ways of operationalizing intragroup competition. Rendering contribution-based rewards (as was the case in the current study) is the most straightforward and involving approach. Future research could examine other motivators, for example, with questionnaire method or qualitative method like interviews to investigate the effect of competing for status, for recognition, etc.

Practical implications

Since originality and feasibility are inversely correlated, educators and problem-solving facilitators should take this into account and probably not expect students/employees to consider both originally and feasibly at the same time.

Now that the quality of groups' idea selection depends on groups' idea quality at the generation stage, problem-solving facilitators should bear this in mind and value teams' ideation quality over quantity. Although the effect of intragroup competition remains unclear (as methodological concerns existed in the current study), there is evidence suggesting that team communication and teams' cooperative conflict management skills are beneficial for idea quality at selection stage, and intragroup competition could possibly ruin these processes. Taken these together, problem-solving facilitators should empathize both idea quality when generating ideas as well as the group processes during the team task for the sake of selection effectiveness.

Conclusion

In conclusion, the current study failed to find main effects of intragroup competition; explicit instructions of performance criteria failed to predict peoples' focus on either originality or feasibility. The unsupported main effects can be traced back to methodological concerns: as groups experienced a low level of competition, it could be that the experimental manipulation was not strong enough. Despite that, results showed that in the intragroup competition condition, but not in the control condition, performance criteria significantly affected originality vs. feasibility scores of the generated ideas; also, under the originality-

focus condition, intragroup competition displayed a trend to increase the originality score of groups' selected ideas, with the result being marginally significant. The results suggest that groups in the presence of intragroup competition tended to follow up on the performance criterion that was put forward, especially when originality was the aim.

Furthermore, some interesting findings emerged and contributed to creativity research. These include, but are not limited to, the inverse correlation between originality and feasibility of both generated and selected ideas; and the finding that idea quality at generation predicted idea quality at the selection stage. Moreover, people put more much weight on feasibility than originality – possibly as previous research pointed out, people have a natural bias in favor of usefulness against novelty. In addition to this, the realistic and self-relevant group ideation task may have strengthened this biased focus.

While the direct relation between intragroup competition and group creativity remains puzzling, our findings did point out the possible existence of a serial mediation effect. Intragroup competition increased group members' experienced competition level, which then affected groups' selection quality through influencing team communication. Another group process variable – cooperative conflict management – was positively associated with groups' selection quality, and intragroup competition, through affecting group members' experienced competition, showed a trend to undermine groups' cooperative conflict management. These findings highlight the importance of group processes in groups' creative problem-solving. An important implication for problem-solving facilitators would be to both consider idea quality at the generation stage and team processes at the selection stage, so as to enhance selection effectiveness.

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Appendix. Measures

Manipulation Checks

Performance criteria

1. In generating and selecting ideas, we valued practicality over originality.
2. In generating and selecting ideas, we valued usefulness over novelty.
3. In generating and selecting ideas, we valued effectivity over creativity.

Experienced intragroup competition

1. While generating ideas, we were competing with each other.
2. While generating ideas, we felt that we were competing against each other.
3. While selecting ideas, we were competing with each other.
4. While selecting ideas, we felt that we were competing against each other.

Group Process Measures

Team communication, adapted from Keller (2001)

1. We carefully listened to each other's ideas.
2. We built on each other's ideas to improve them.
3. We integrated each other's different perspectives.
4. We communicated well within our team.
5. We collaborated well within our team.
6. There was a feeling of openness and trust in our team.
7. Team members felt free to give their honest opinions.
8. Team members respected each other.

Intragroup conflict, adapted from Jehn (1995)

1. How much friction was there among members in your group?
2. How much were personality conflicts evident in your group?
3. How much tension was there among members in your group?
4. How much emotional conflict was there among members in your group?
5. How much conflict about the work you did was there in your group?
6. To what extent were there differences of opinion in your group?

7. How often did people in your group disagree about opinions regarding the tasks being done?
8. How frequently were there conflicts about ideas in your group?

Cooperative conflict management

Adapted from Somech, Desivilya and Lidogoster (2009)

1. Team members tried to find a solution that was acceptable to all of us.
2. Team members came up with a decision jointly.
3. Team members exchanged accurate information to solve the problem together.
4. Team members tried to bring all our concerns out in the open so that the issues could be resolved in the best possible way.
5. Team members collaborated to come up with a decision acceptable to us.
6. Team members worked for a proper understanding of the problem.

Competitive conflict management

Adapted from Somech, Desivilya and Lidogoster (2009)

1. Team members used their influence to get their ideas accepted.
2. Team members used their authority to make decisions in their favor.
3. Team members used their expertise to make a decision in their favor.
4. Team members were generally firm in pursuing their side of the issue.
5. Team members sometimes used their power to win in a competitive situation.

Task interdependence

Adapted from Van der Vegt, Van der Vliert and Oosterhof (2003)

Idea generation

1. To what extent was active collaboration among group members needed during idea generation.
2. To what extent was a joint decision among group members needed during idea generation.
3. To what extent did group members rely on each other for good task performance during idea generation.

Idea selection

1. To what extent was active collaboration among group members needed during idea selection.
2. To what extent was a joint decision among group members needed during idea selection.
3. To what extent did group members rely on each other for good task performance during idea selection.