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TitleAre people working together inclined towards practicality? A process analysis of creative ideation in individuals and dyads

Article (Accepted version) (Refereed)

Are People Working Together Inclined Towards Practicality?

A Process Analysis of Creative Ideation in Individuals and Dyads

Abstract

Building on a sociocultural approach to creativity, the aim of this article is to examine the creative process in individuals and dyads in relation to the originality and practicality of their ideas and its temporal dynamic. The study reported here used two divergent thinking tasks and randomly allocated 39 participants between an individual condition (13 people) and a social one (13 dyads). The analysis was done in several steps, from a more traditional aggregate-based study of the number and quality of ideas to more complex, process-based comparisons of temporal order and participant interaction. We found that, while outcome-based comparisons showed little differences between the two conditions or placed individuals ahead of dyads – an expected finding for this type of research – temporal series and especially the study of how dyads members respond to creative ideas suggested that people working together might prefer practical ideas. This preliminary evidence of a possible 'practicality effect', we speculate, has something to do with the fact that practical ideas are easier to communicate and validate when collaborating. As such, creativity is not necessarily hindered by working with other people but takes on a different orientation (i.e., towards the feasible). Reflections on the importance of this dimension for theory and practice are offered.

Keywords: dyadic creativity, originality, practicality, divergent thinking, sociocultural psychology

The separation between what is individual and what is social within creativity is widespread (Glăveanu, 2015a). It is reflected in the traditional focus on individuals and psychological processes at the expense of social environments (Hennessey, 2003), in the sharp distinction between creative ideation and the social evaluation of ideas (Runco, 2015), and it also underpins a long-standing debate about whether individuals are more creative than groups (Paulus & Nijstad, 2003). Each one of these distinctions is grounded, we argue, in a pervasive focus on products rather than processes in creativity research. We propose in this paper to move from 'what' and 'how much' questions towards 'how' and we illustrate the benefits of this shift for examining individual and dyadic creativity.

Our approach in designing this research is sociocultural (see Glăveanu, Gillespie & Valsiner, 2015) and thus grounded in the idea of distributed creativity (Glăveanu, 2014; Clapp, 2016). This conception postulates that creativity cannot be reduced to a set of psychological processes, studied in isolation from their social, material, and temporal context. In fact, sociocultural psychology considers individual creativity as *already social* in terms of its origin, consequences, and forms of expression (Vygotsky, 1930/2004). Nonetheless, the question of creative performance in the case of people working alone versus together remains. Instead of answering it however only based on final outcomes (e.g., number of ideas and their quality), a sociocultural take encourages us to consider the temporal trajectory of creative ideation in both individual and group contexts (for similar concerns see Kurtzberg & Amabile, 2001; Harvey, 2014).

Our research examines whether and how the process of creativity varies between individual and dyadic idea generation in two tasks – Alternative Uses and Product Improvement – in particular in relation to the originality and practicality of ideas (the two main dimensions of creativity; Runco & Jaeger, 2012). While the study was meant to be exploratory in nature, results from the temporal analysis and especially the partner's response to creative ideas in the case of dyads offered grounds for assuming that dyads

might select more for practical ideas. This tendency was documented with the help of a combined, quantitative and qualitative analysis of dyadic interactions and remains a hypothesis to be confirmed by future research. Before outlining the study, however, we first review work done on individual, dyad and group creativity from both a sociocognitive and sociocultural perspective in order to ground the present research in the existing literature and justify its design.

Sociocognitive Approaches: Individual either/or Social

Sociocognitive approaches start from the clear separation between individual and group processes and outcomes. This orientation, dominant within group creativity research, separates intra-psychological processes that lead to creativity and social processes seen as 'adding to' or 'affecting' the former (Glăveanu, 2011). According to this logic, it becomes easy and necessary to compare situations in which individuals and groups work on the same creative task and assess their performance based on number and quality of ideas.

The interest in comparing the outcomes of individual and group creativity followed Osborn's (1957) claim that, by applying his method, brainstorming, "the average person can think up twice as many ideas when working with a group then when working alone" (Osborn, 1957, p. 229). The first attempt to empirically test his hypothesis came soon after it was formulated. In 1958, Taylor, Berry and Block compared the performance of brainstorming groups and nominal groups (created by putting together answers from people who brainstorm alone). What they found was that, on the contrary, nominal groups produced nearly twice as many ideas as interactive brainstorming groups. In an extensive review of the evidence, Lamm and Trommsoorff (1973) concluded that brainstorming groups produced fewer ideas than people brainstorming separately. However, they also concluded that the evidence was mixed regarding the quality, uniqueness and variety of ideas. Almost two decades later, Mullen, Johnson and Salas (1991), based on their meta-analysis, reported that brainstorming groups were less productive than nominal groups in

terms of both quantity *and* quality of ideas. Trying to understand the productivity loss in the case of brainstorming groups, researchers pointed from early on to multiple causes, such as, free riding, evaluation apprehension and production blocking (see Diehl & Stroebe, 1987). Only more recently have studies of team creativity started to consider it in its own right (e.g., Reiter-Palmon, Wigert & de Vreede, 2012).

There is, however, more 'optimism' when it comes to dyadic creativity. Dyads are interesting to study given the fact that they go beyond individuals and yet they are not teams (although teamwork often relies on dyadic organizing; Graen & Scandura, 1987). Given the fact that dyads include one stream of (bidirectional) social interaction, they are oftentimes easier to model. More than this, many everyday interactional contexts, from classrooms to workplaces, use both work in pairs and in groups in order to give participants a better chance at expressing their point of view (e.g., Wickett, 2000). Early conceptualisations by Henry A. Murray (1964) compared this type of interaction with "two people singing a duet and making up the music as they go along" (p. 639). But it was the research done by Cohen, Whitmyre and Funk (1960), Torrance (1971), and Pape and Bölle (1984) that started a wave of studies into the benefits of using two individuals for ideation tasks. What Torrance found, for example, using the Product Improvement Test, was that dyads attain higher levels of originality and experience stronger feelings of stimulation, enjoyment and originality of expression than individuals working alone. In fact, dyads might be ideally placed to harness the high potential of collaborative cognition while minimising the drawbacks of group interactions (McGrath, 2015). Past and present studies also point to ways in which dyadic creativity can be enhanced, for instance by training in the other person's point of view (Triandis, Hall & Ewen, 1965) or by using multiple communication media (Sha, Wu & Chang, 2012).

What is most interesting is the fact that recent studies pay close attention to the processes taking place within dyadic creativity, by videotaping and analysing the

interaction between partners (Won, Bailenson, Stathatos & Dai, 2014; Weinstein, Hodgins & Ryan, 2010). Contributing to this line of research, Howes, Healey, Panzarasa and Hills (2015) argue that studies of dyadic creativity often fail to acknowledge or investigate the contribution made by interaction itself. Employing the Alternative Uses task, they compared contexts in which participants were passively exposed to a dialogue and those in which they actively engaged in dialogue. While interactive participants didn't come up with more ideas, they produced more turns and built on each other's proposals, generating more complex ideas. These findings argue for going beyond a mere count of ideas and studying social interactions, a point sociocultural researchers certainly agree with.

Sociocultural Approaches: Individual and/as Social

Sociocultural research, instead of separating the individual and the social, starts from the premise of their inter-dependence (Shweder, 1990). The emphasis thus is on studying how the social permeates individual thinking processes; thought itself is a form of internalized dialogue (Marková, 2016), and thus social interaction re-configures participants' already dialogical minds (Bakhtin, 1981). The question of process takes centre stage and creative outcomes are understood as materialised markers of an unfolding activity. This is why, for instance, sociocultural researchers prefer to focus on naturally occurring collaborations rather than one-off groups formed for experimental purposes. Collaborative creativity is defined by complementarity, tension and emergence (Moran & John-Steiner, 2004) and these characteristics are well illustrated, for instance, by improvisation in real-life groups (Sawyer, 2000; Montuori, 2003). The artificial nature of the laboratory tasks and testing situations have been repeatedly criticised and held accountable for the finding that nominal groups consistently outperform interactive ones (Glăveanu, 2011).

The sociocultural approach would thus approach the issue of individual and group creativity by asking about the 'how' of the creative process rather than the 'how much' of

creative outcomes (Hawlina, Gillespie & Zittoun, 2017). This resonates with an old criticism of divergent thinking tests formulated by Barron and Harrington:

> "process is precisely what is invisible in the usual DT [divergent thinking] test used in creativity research. A problem is set, and a written answer is obtained. What happens in between is anybody's guess, except the respondent's, who hasn't been asked" (Barron & Harrington, 1981, p. 443).

Several calls have been made to correct this outcome bias. Lamm and Trommsoorff (1973) reflected on the importance of analysing the exchanges between brainstorming participants and observing the temporal succession of their answers. Taking the example of cognitive inter-stimulation in groups, they formulated several questions for future research: "Does it occur mainly in later phases? What about the temporal lag involved between a stimulating utterance and the reaction to it?" (p. 383). They also recognised these questions sound simple but answering them poses new methodological challenges. More recently, Kohn, Paulus and Choi (2011) pointed to the fact that, despite decades of studying brainstorming, there is little to no research on how exactly people build on each other's ideas in a brainstorming context. One of the few examples of applying process analysis to ideation in brainstorming groups is offered by Wang and Rosé (2007). What is particularly interesting in their study is the fact that they examined the temporal characteristics of idea generation and idea failure with a focus on whether cognitive interference in groups has only a temporary effect and whether, as time passes, cognitive stimulation becomes stronger. What they observed, for instance, was an exponential decay in idea productivity over time with "roughly half of the unique ideas contributed during the 30 minute brainstorming session [being] generated within the first 5 minutes" (p. 1632). Taking this evidence into account, the authors cautioned against focusing too much on summative

measures of idea generation. There is added value in performing a process analysis and taking time into account. This observation and the sociocultural premises mentioned above guided the design of the present exploratory study.

Research Questions

The present study builds on this sociocultural emphasis on process to study the temporal dynamic of different dimensions of creativity (originality, practicality, surprise) in the case of individuals and dyads. Previous research (Runco, Illies & Eisenman, 2005) concluded, for instance, that originality and practicality (or appropriateness) are ambiguously related to each other. Four exploratory questions exploring this relationship in the case of individual and dyads guided the investigation:

1. How do individuals and dyads perform in terms of the originality, practicality, surprising quality and overall creativity of the ideas they produce?
2. What happens, in time, to the originality, practicality, surprising quality and overall creativity of ideas, as individuals generate ideas alone or together with others?
3. In a social condition, how exactly are highly original, practical, surprising or overall creative ideas responded to by partners?
4. More specifically, what kinds of dialogue follow the formulation of highly practical or highly original ideas in the social condition?

Method

Participants

The study had 39 participants, randomly allocated between the individual condition (13 people) and the social condition (13 dyads). The overall sample included 12 male and 27 female participants with an average age of 23.5 and standard deviation of 3.44. They came from 16 different countries and were all studying at London universities. Participants were recruited using student email lists and online forms. They were compensated for their participation in the experiment (£10), which lasted for up to half an hour.

Measures

The experiment included two divergent thinking tasks: Alternative Uses and Product Improvement (see Torrance, 1966). While both tasks are supposed to tap into similar processes, an open question of the study is whether there are differences between them given that Product Improvement potentially invites more practical ideas. The tasks were randomly presented. The Alternative Uses task, which we will refer to as the 'brick task', asked participants to '*list as many different uses you can think of for an ordinary brick*'. The Product Improvement task, which we will refer to as the 'elephant task', asked participants to '*list as many different ideas as you can for how to improve a stuffed toy elephant to make it more fun for children to play with*'. For both tasks, in both conditions, material support was offered during ideation (see Figure 1) and participants were told that '*this is a creativity test so try to generate as many ideas as possible and especially many different and original ideas*'. These instructions were written down and both individuals and dyads were given 10 minutes to complete each task.

---------- Insert Figure 1 Here ----------

Procedure. All the participants gave written consent to take part in the study and were informed about their rights and fully debriefed. Participants agreed to wear small cameras that recorded audio and video the situation from their perspectives (for details about this technology and its previous use in creativity research see Glăveanu & Lahlou, 2012). Both individuals and dyads were given a double page, with the instructions written on top, to record their answers. They were left alone during ideation and the lead researcher returned only to collect their answer after the time had finished.

The 13 individuals wrote down, in total, 178 ideas for the brick task and 163 for the elephant task. The 13 dyads wrote down, in total, 331 ideas for the brick task and 249 for the elephant task (the elephant task data for one dyad was excluded because they misunderstood the instructions and kept generating alternative uses). In order to check for

productivity loss in dyads, whereby ideas are formulated but don't end up being written on paper, the videotapes were watched and the database completed with an additional 36 ideas for the brick task and 22 ideas for the elephant task.

All the ideas were evaluated by three expert coders from the London School of Economics, who participated in dozens of other projects in which they rated creative ideas and also received training for this on a regular basis. They coded ideas for originality (defined as uniqueness or rarity; brick α = .80, elephant α = .77), practicality (defined as the possibility to put the idea into practice; brick α = .72, elephant α = .74), and surprise (defined as the potential of the idea to evoke a 'wow' type of response, to be non-obvious; brick α = .74, elephant α = .74). Based on these three scores, an overall creativity score was calculated by multiplying these three indices.

Data analysis included four stages, corresponding to the four research questions:

1. An analysis of outcomes, comparing the scores on originality, practicality, surprise and overall creativity in the two conditions.
2. An analysis of process, comparing the temporal dynamic of originality, practicality, surprise and overall creativity in the case of individuals and dyads.
3. An analysis of 'first responses' in dyads, based on the coding of the first response of the partner as either promoting, inhibiting and no dialogue. Promoting dialogue included instances of agreement (e.g., 'oh yeah', 'that's true', 'absolutely'), elaboration (adding detail or clarity), enthusiasm (e.g., higher pitch, laughter, clapping, exclamations), and seeking explanations (e.g., questions to clarify the idea, curiosity about it). Inhibiting dialogue comprised instances of objecting to the idea (e.g., presenting counter-arguments, doubts), questioning it (e.g., scrutinising the feasibility), or replacing it. Finally, no dialogue included those instances in which the idea was met by silence, a shrug, signs of doubt ('hmm') or was deliberately ignored.

4. A qualitative analysis of dyad conversations, aiming to further examine the discussions between partners about highly practical and highly original ideas. The focus of this thematic analysis (Braun & Clarke, 2006) was to identify: a) the ways in which proposers present their ideas; b) how idea validation is expressed in the dyad, including any discussion of criteria used; and c) the ways in which ideas are elaborated on in dyads.

Results

Descriptive statistics and correlations between this study's variables are presented in Table 1. Consistently with the predictions, the Product Improvement task (elephant) resulted in higher practicality than originality and surprise, while in the Alternative Uses task (brick) the average ratings were more similar (although also in this case practicality dominated: $p < .001$). For both, practicality negatively correlated with originality and surprise, but again this effect was stronger in the case of the elephant task than brick task. It must be noted that originality and surprise were very highly positively correlated. Although we proceeded with a global creativity score by multiplying the three criteria at hand (*Originality x Practicality x Surprise*), we notice that this index is skewed toward originality and surprise rather than practicality. Therefore, in the next steps we examine both the composite creativity score as well as the three criteria taken separately.

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The obtained scores can be analysed at two levels, namely, individuals/dyads or separate ideas as nested within individuals and dyads. As we were primarily interested in possible differences in the processes observed among individuals and dyads, we focused on the nested ideas level. We started by comparing individuals and dyads in terms of average scores obtained on originality, practicality, surprise, and overall creativity (see Figure 2). At the aggregated level we were also able to include fluency scores, measured as a number of ideas generated. We conducted two separate multivariate analyses of variance (MANOVA), one for a brick task and one for an elephant task, with condition (individual

versus dyad) as a between-level factor and originality, practicality, surprise, as well as total creativity score and its log-transformed conversion as dependent variables[1].

---------- Insert Figure 2 Here ----------

For the brick task, individuals and dyads did not differ in the case of overall originality of ideas: $F(1, 24) = 1.67$; $p = .21$, but individuals outperformed dyads in the case of practicality: $F(1, 24) = 29.67$; $p < .001$; $\eta^2 = .53$, surprise: $F(1, 24) = 4.96$; $p = .04$; $\eta^2 = .17$, and overall creativity score: $F(1, 24) = 11.94$; $p = .002$; $\eta^2 = .33$. Dyads obtained significantly higher fluency: $F(1, 24) = 26.75$; $p < .001$; $\eta^2 = .53$.

In the case of the elephant task, individuals and dyads did not differ in terms of originality: $F(1, 24) = 0.27$; $p = .61$, practicality: $F(1, 24) = 2.63$; $p = .12$; surprise: $F(1, 24) = 0.16$; $p = .69$, and overall creativity score: $F(1, 24) = 0.05$; $p = .82$. The only significant difference in favour of dyads was observed in the case of fluency: $F(1, 24) = 12.68$; $p = .002$; $\eta^2 = .36$.

In summary, aggregated results are in line with the general finding that individuals tend to outperform dyads in the number of generated ideas (fluency), but the differences in

[1] We emphasize that this analysis was exploratory and driven by our decision to illustrate the more general differences between conditions, before we move to more process-based explorations. Indeed, as an anonymous reviewer highlighted, the statistical power of this analysis, given small sample size was suboptimal. Gpower (Erdfelder, Faul, & Buchner, 1996) indicated that given typical α level (so $\alpha = .05$) and usually recommended β level (so at least $\beta = .80$), the required sample size to find strong effect size (Cohen's $d = 0.80$) is 21 per group (using one-tailed test), so slightly more than in our study. As the post-hoc estimated power was indeed suboptimal ($\beta = .75$ for $d = 0.80$ and $\beta = .31$ for $d = 0.40$), we decided to complement our estimations with Bayesian analysis (Dienes, 2014) and calculated Bayes Factors (BF) for these comparisons. Although rarely used in creativity studies (but see Katz-Buonincontro, Hass, & Friedman, 2017 for an exception), Bayes Factor presents a useful alternative to inferential statistics and quantifies the likelihood that the directional hypothesis is more likely given the data than null (in the case of BF_{10}). Importantly BF works well with small sample size (Rouder, Speckman, Sun, Morey, & Iverson, 2009) BF_{10} higher than 1 but less than 3 indicate anecdotal support for directional hypothesis, BF_{10} above 3 but less than 10 indicates moderate support and $BF_{10} > 10$ indicates strong support. We calculated Bayes Factors using JASP statistical software (version 0.8.3.1., JASP Team, 2017). In the case of brick, the obtained BF_{10} for a brick were as follows: originality, $BF_{10} = 0.67$, practicality, $BF_{10} = 1153.74$, surprise, $BF_{10} = 2.06$, fluency, $BF_{10} = 632.99$ and creativity (log-transformed) $BF_{10} = 4.10$. Therefore, we conclude that we observe a strong support for directional hypotheses (assuming differences between individuals and dyads) in the case of fluency and practicality, moderate support in the case of global creativity index and a weak (anecdotal) support in the case of surprise. Bayes factors estimated for an elephant task were: originality, $BF_{10} = 0.41$, practicality, $BF_{10} = 0.94$, surprise, $BF_{10} = 0.39$, fluency, $BF_{10} = 20.37$, and log-transformed creativity index $BF_{10} = 0.42$. We therefore conclude that apart from a strong support for higher fluency scores in dyads than individuals, other estimates should be considered inconclusive – they do not allow to decide whether dyads and individuals differed or not.

the remaining aspects of divergent thinking are much less systematic. For a creative ideation task based on the production of functional ideas (the elephant), there were no differences in average scores, except for fluency, while in the brick task individuals outperformed dyads also in case of practicality, global creativity and (less conclusively, as Bayes Factor demonstrated) – surprise. Importantly, the originality of the ideas generated in both conditions was virtually the same.

In order to examine differences between individual and dyads in a processual way, we proceeded with multilevel analyses at the level of ideas. To explore the character of the process in the case of brick and elephant, we created four multilevel regression models with each of our criteria: originality, practicality, surprise, as well as overall creativity scores regressed on temporal dimension (idea number), condition (individuals versus groups) as well as the interaction between these two, to asses potentially differing characteristics of the processes among individuals and dyads. As the models were characterized by growing complexity, i.e., each subsequent model was nested within the previous, subsequent models were compared to each other to examine whether adding new parameters improved the fit. Table 2 presents a comparison of -2 log-likelihood (-2LL) functions values across models. As -2LL denotes a misfit of the model, the lower the value, the better the model fit.

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The results of the multilevel modelling in the case of the brick task are presented in Table 3. In the case of originality, surprise and the general creativity score, the most complex model was characterized by better fit as comparing to its alternatives. There was a significant curvilinear trend, taking a reversed-U shape in the case of originality, surprise and general creativity index; all these first increased with subsequent ideas, then their level decreased (see Figure 3, panels A, C and D). Second, there was a significant, negative effect of condition, showing that individuals generated more original, surprising and

creative ideas than dyads. The interaction term of the observed pattern and condition was also statistically significant, thus showing that the processes tended to differ across dyads and individuals.

In the case of practicality, the temporal dynamic was characterized by a reversed pattern; initial ideas were found to be very practical and the level of practicality dropped to a certain point with time, and then only slightly increased (see Figure 3, panel B). Also in this case, a statistically significant effect of condition was observed, with individuals generating on average more practical ideas than dyads. The interaction of pattern and condition was not significant however, thus showing similar temporal effects in practicality in individuals and dyads.

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In the case of an elephant task, the curvilinear links were generally replicated (see Table 4; due to the general similarity with the brick task, a figure was not generated). There was a reversed-U pattern, showing that originality and creativity first increased to a point, then decreased, while in the case of surprise it was a reversed-J relationship – the surprise generated by ideas first increased, then after a certain point became stable. The practicality of generated ideas first linearly decreased with time, then became stable. Similarly, as in the analysis at the aggregated level, no effect of condition was observed. In neither case there was a *Pattern x Condition* interaction, which suggests that in the elephant task the process ideation was more similar across individuals and dyads than the one observed in the brick task.

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In summary, the process analysis revealed for both tasks, overall, a contrasting temporal dynamic between originality, surprise and creativity on the one hand, and practicality on the other. Although there were no significant differences between

individuals and dyads when it came to the sequencing of practical ideas, the patterns do suggest relative differences, encouraging us to explore further why, in the case of dyads, there seems to be a less sharp decrease in practicality and even an increase of it with time.

This observation led us to focus on the dynamic between the partners within the dyads. To analyse the partner's reaction toward generated ideas, we proceeded with additional multilevel models, regressing originality, practicality, surprise and creativity on observed partner reactions (Figure 4 and Figure 5). The first step of the analysis was to collect all the ideas formulated by dyad partners but not written down and compare them with ideas that were written down. In the case of the brick task, as illustrated on Figure 4 (panel A), ideas that were not written down were significantly less original (B = -2.75, SE = 0.35, $p < .001$), practical (B = -3.81, SE = 0.30, $p < .001$), surprising (B = -2.63, SE = 0.35, $p < .001$), and consequently also less creative (B = -2.32, SE = 0.18, $p < .001$) than the ones recorded on paper. Similarly, it was demonstrated that, in general, more creative ideas promoted dialogue (B = 0.54, SE = 0.17, $p < .001$) and were more intensively discussed (B = 0.76, SE = 0.22, $p < .001$) (Figure 4, panel B). Interestingly, looking at the agreement or lack of agreement within dyads, it became clear that it was especially related to the practicality of ideas. Ideas that were agreed with had, on average, significantly higher practicality scores (B = 1.41, SE = 0.29, $p < .001$).

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A slightly different picture emerged in the case of the elephant task. As illustrated in Figure 5, differences were observed mainly in the case of practicality – the more practical the ideas, the more they were likely to be written down (B = 5.40, SE = 0.41, $p < .001$) (panel A), be met by promoting dialogue (B = 1.60, SE = 0.40, $p < .001$) (panel B), and result in an agreement between dyads members (B = 1.24, SE = 0.42, $p = .004$).

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In summary, a closer analysis of dyadic interaction based on first responses supports the assumption that, despite a general lack of significant differences in aggregated outcomes and temporal dynamic (which is hard to expect in any case with a relatively small sample), there are indications of a social promotion mechanism for practical ideas. Since we don't have comparable data for individuals, we cannot rule out a similar social dynamic playing out in their case as well, albeit internalised. However, what we can do is explore dyadic conversation further and map up the concrete ways in which practical ideas are promoted in this context.

The last analytical step was thus a qualitative analysis of conversations between dyad members. The first finding refers to the way in which ideas are expressed within dyads. Both the intonation (suggesting a question raised for the other to consider) and the presence of linguistic markers for doubt and openness (e.g., 'maybe', 'what about…', 'could we…', 'I don't know') denote the fact that ideas are formulated as *proposals*. They are treated as 'pre-inventive forms' (see the Geneplore model; Finke, Ward & Smith, 1992) in need of validation from the other person. In this sense, the cycle of generating and exploring ideas suggested by the Geneplore model is externalised within dyads, with both partners having the double role of proposing and evaluating ideas. Moreover, there are clear indications in the data that proposers are, themselves, the first evaluators of their own ideas and this becomes evident in how proposed ideas are often simultaneously proposed, judged, and justified:

> "I was thinking, this is weird as well but you know how you get, like, ice lollypops, you can make them in the shape of these [pointing to the holes in the brick], put ice in them" (Dyad 1, brick)
>
> "You could have it like a short of game (smile), like… hitting it, may be quite dangerous" (Dyad 8, brick)

"Maybe you can pull something out if it, I don't know what … a baby (laughter), it can be an educational toy! It's kind of creepy for a child" (Dyad 3, elephant)

"It could be a very wacky handbag" (Dyad 2, elephant)

The examples above illustrate a process of taking evaluative distance from one's own idea and placing oneself in the position of the other person, considering it as the other person might (Gillespie, 2006; Glăveanu, 2015b). The use of perspective taking is evident when participants anticipate negative reactions from others (e.g., "I don't know, uses of a brick… we have to be creative"; Dyad 12, brick) and also in the frequent use of laughter. In fact, one of the most common instances in which participates used laughter to diffuse judgement was when the idea of harming or killing someone with the brick came up (e.g., "I don't think we should be thinking in that direction", Dyad 3; "one of my favourites!", Dyad 7; "hope you don't have to", Dyad 10; "A weapon? Someone had to say it!", Dyad 13; "knocking someone out… sorry, I am not a violent person", Dyad 11). Humour is similarly used, at times, in the case of the elephant (e.g., "Maybe the tusks could be removable and then you can make jewellery? Just kidding, just kidding"; Dyad 13). This use of humour allows participants propose their idea while simultaneously giving their partner an acceptable reason to ignore it. The knowledge that the other implicitly occupies an evaluator position is also overtly 'played with' in dyad interactions, as exemplified by the passage below:

P1: "I know it sounds bizarre but it's… pour wine on it and suckle on it so it changes the… you can flavour up the wine!" (laughter)

P2: "Wine enhancer?"

P1: "Yeah! Very good" (laughter)

P2: “I have a really crazy idea… You could use with other bricks to build like a wall” (laughter) (Dyad 8, brick)

This example points to evaluation apprehension in brainstorming ideas with others (Diehl & Stroebe, 1987) but our data also indicates a double-evaluation cycle taking place in dyads. First, proposers assess their ideas either before or as they formulate them, then comes the reaction of others and, in some case, further justification and the use of humour. This cycle might offer one explanation why practical ideas tend to be promoted in the dyads: they are easier to communicate and thus be accepted by others.

In this regard, physical demonstrations of ideas are also useful. Even when they are not asked for, which is most often the case, participants felt compelled to demonstrate whichever uses of the brick could be directly exemplified. This arguably testifies, again, to the practicality of the ideas proposed. Figure 6, captures one such example from Dyad 3, with one of the participants saying “I wonder…”, while repositioning the brick, then placing a pencil in it and adding triumphantly “Ha! It can be a pencil holder”, and the other partner replying: “That’s smart”. Other times it is the partner who makes the demonstration when the proposer doubts his/her own idea (e.g., Dyad 2 when discussing whether the holes in the brick and be used as a vase or to pot plants).

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Another drive towards practicality is represented by the tendency to return to the task and establish common evaluation criteria. For the brick task, this involved asking if they should consider only the brick “in its final state” (Dayd 12) or whether they need to use “only one brick” (Dyad 11). For example, in the case of the elephant toy, several dyads returned to the instructions and the idea of making a toy that is fun for children.

[Make the elephant fly] “But then you are also restraining the age group for the kids, it would be more heavy, it would be hard to manage” (Dyad 9, elephant)

P1: “Oh, I know! It doesn’t have to be realistic does it?”; P2: “It should be fun”; P1: “Put wings on it and…”; P2: “Have it fly”; P1: “Have it fly!” (Dyad 11, elephant)

P1: “It has to improve a stuffed toy elephant so it has to stay as a stuffed toy elephant”; P2: “Does it?”; P1: “Yeah…” (Dyad 11, elephant)

Just as the double-evaluation mentioned above suggests this task is shared in an interactive context, some of the most productive dyads in terms of the quantity and quality of their ideas illustrated another interesting feature: idea formulation as a shared task. They achieved this by raising not an idea but a question or half-idea and inviting the other, verbally or non-verbally, to answer or complete it. This contributes to lowering the risk of evaluation apprehension while, in addition, promoting the co-construction of ideas:

P1: “What if we made it interactive somehow?”; P2: “Like Furby” (Dyad 13, elephant)

P1: “Could we break it apart and use the…”; P2: “Spread the rubble…”; P1: “For?...”; P2: “Gravel, painting”; P1: “Yes, exactly” (Dyad 13, brick)

P1: “You can break it and teach people maths”; P2: “How? Fractions?”; P1: “Yeah, yeah, you can teach fractions” (Dyad 11, brick)

P1: “Make it like a water container”; P2: “Like a water gun?” [both ideas are then written down] (Dyad 11, elephant)

Of course there were other types of dynamic encountered as well and, for instance, a visibly detrimental one for creative production was to constantly question the ideas of others (“what do you mean by…?”, “do you think so?”, “people won’t understand that”;

Dyad 4). This continuous questioning was meant to make sure the ideas formulated were highly applicable but it likely suppressed the tendency to voice more unusual ideas (i.e., promoting practicality by suppressing original ideas). However, dyads can collaboratively encourage practicality while not selecting out original ideas and this was the case for those dyads in which ideas were not only formulated but also *defended* by their proposer:

> [Brick used as binoculars] P1: "But then you would need to put lenses in it"; P2: "Yeah, we can do it" [the idea is written down] (Dyad 10, brick)
>
> P1: "Have eyes"; P2: "It already has"; P1: "It can have better eyes" (Dyad 10, elephant)
>
> P1: "We can give it as a present"; P2: "No you can't" (laughter); P1: "I will write it if you are not keen on writing it" (Dyad 12, brick)

In summary, the qualitative analysis revealed different ways in which practicality is encouraged in dyads, namely, double-evaluation, exemplification, common criteria. At the same time, it suggested that, through co-construction of ideas, humour and defending one's point of view, the promotion of practicality doesn't necessarily inhibit originality.

Discussion

This study has shown that, without using the nominal groups technique, dyads produced more ideas than individuals working alone; and this not counting ideas that were formulated in the discussion but didn't get written down. The fact that unwritten ideas exist, together with findings from our qualitative analysis, suggest that evaluation is inbuilt in the social condition of ideation. Indeed, ideas not written down were less original, practical, surprising and overall creative than the ones recorded on paper, demonstrating the fact that dyads were effective at filtering out low quality ideas (which contrasts with previous studies; Faure, 2004; Rietzschel, Nijstad & Stroebe, 2006).

When it comes to aggregated quality indicators though, our findings are in line with the general trend showing that individuals tend to produce more creative ideas. This tendency was task-specific though and applied to the brick rather than the elephant item. This is, perhaps, another indication of the fact that, when the task at hand is oriented towards practicality, the advantage usually held by individuals disappears.

These findings are seen in a new light when considering the temporal dynamic of creative ideation. In the case of both the brick and elephant tasks we observed, on the whole, peaks and marked declines for individuals and a more 'uniform' performance for and dyads. In particular, the patterns showed a sharp decline in the practicality of ideas when it comes to individuals and a more steady performance on this dimension for dyads (tendencies that did not reach, however, statistical significance). Does this mean that dyads systematically select out original ideas in order to keep only highly practical ones? The analysis of first responses to ideas in dyads doesn't support this idea. In the case of the brick, highly unique and surprising ideas are less ignored (i.e., met by silence) while there is a positive association between practicality and promoted dialogue (and a negative one between practicality and inhibiting dialogue and silence). In the case of the elephant task, there is no significant relation between increased originality and a particular response but, again, a significant and positive association between practicality and agreement (and negative one with negation and silence). These findings suggest a 'practicality effect' might be at work within social conditions but that doesn't mean that dyads reject original or surprising ideas, they just don't promote them consistently.

Finally, the qualitative analysis revealed some of the ways in which members of dyads foster practicality, among them the existence of double-evaluation, the use of physical demonstrations of ideas, and the recurrent discussion of task requirements. This analysis also pointed to the fact that participants formulate ideas as proposals and, being sensitive to how they are received, often use humour or invite the other to co-create. Based

on these findings, taken together, we hypothesise that practical ideas promote more 'common ground' between participants and are also easier to communicate and discuss than highly unique or surprising ideas that build, by definition, on less shared elements (see also Sternberg, Kaufman, & Pretz, 2002). Practicality enforces commonality and this is prised in a social context. Practical ideas are more likely to have high inter-rater reliability (i.e., a greater chance of reaching consensus) and, ultimately, of being written down or, in other contexts, of being acted upon. Our findings add to some previous research showing that nominal groups generate more original but less feasible ideas than interactive groups (Rietzschel et al., 2006) and that groups also prefer feasibility to novelty when asked to select for best ideas (see Putman & Paulus, 2009; Rietzschel et al., 2010; Kohn et al., 2011). It also offers further support to the finding that idea evaluation is itself a generative process, one that does not impede group creativity (see Harvey & Kou, 2013). Our research not only supports these findings, but shows that the processes above also work at the level of dyads.

These results have both theoretical and practical implications. At a theoretical level, they argue against the easy conclusion that people working together are 'less' creative than individuals ideating alone; they are 'different' creative. As mentioned earlier in the paper, this statement reflects a sociocognitive logic that draws an over sharp distinction between what is 'individual' and what is 'social' within creativity and tends to prioritise outcomes over processes. In contrast, the sociocultural approach adopted here encouraged us to pay attention to process, time, and social interaction. Going beyond aggregated outcomes, we found preliminary evidence of the social promotion of practicality in the social condition, which doesn't mean dyads (and possibly groups, a hypotheses that remains to be tested) are less creative but might actually create *in a different way*. By cultivating the practical dimension of creativity, dyads and potentially groups go against a strong cultural assumption, at least in the West, associating creativity first and foremost with novelty and

originality (Tanggaard & Wegener, 2016). On the other hand, there are voices nowadays arguing for the importance of convergent, functional creativity (Cropley & Cropley, 2010).

At a applied level, these findings suggest that, when we aim to have more original or surprising ideas working alone could be favoured while, for more practically oriented ideation, individuals could be asked to team up. We should remember here though that there is a different dynamic at play in collaboration between individuals who just met (the case in our study) and those who have a history of working together (John-Steiner, 2000).

This leads us to reflect on limitations and future research. First of all, it is hard to assess the process of individual ideation (e.g., how idea evaluation shapes it) without using a version of the think-aloud protocol and this could be used next in order to compare the selection of practical ideas in the two conditions. Second, data from our study indicates a high degree of task specificity with Product Improvement (in our case the elephant task) leading to less ideas overall but also inviting more practical ones. This is something that could be explored further, especially in view of the practicality effect. The existence of this possible effect at the level of groups should also be empirically tested in the future. Most of all, while our findings, based on a relatively small sample, suggest we should pay more attention to the dynamic of practicality in comparing individuals and dyads, the methodological steps used here should be applied in studies using other types of tasks and larger samples. This research is a first example of process analysis systematically included in the study of creative ideation; revealing a methodological approach that can expand our understanding beyond creative outputs towards the process of creating itself.

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Table 1. Descriptive Statistics and Correlations between Variables

	Min	Max	M	SD	1	2	3	4	5
Brick									
1: Originality	1	10	5.69	2.30	1	-.12**	.94***	.84***	.86***
2: Practicality	1	10	6.80	2.15	.11	1	-.06	.27***	.27***
3: Surprise	0	10	5.08	2.34	.94***	.30	1	.89***	.86***
4: Creativity	0.00	812.00	223.51	161.78	.80***	.61**	.90***	1	.84***
5: Creativity(log)	0.00	6.70	4.95	1.24	.90***	.47**	.93***	.90***	1
Elephant									
1: Originality	1	9	3.28	1.62	1	-.31***	.91***	.86***	.84***
2: Practicality	1	10	7.92	2.20	-60**	1	-.21***	.01	.09*
3: Surprise	0	9	3.22	1.74	.94***	-.45*	1	.90***	.89***
4: Creativity	0.00	648.00	97.29	91.15	.90***	-.29	.95***	1	.83***
5: Creativity(log)	0.00	6.48	4.07	1.18	.91***	-.27	.95***	.90***	1

Note. Correlations above diagonal are given at the idea level (n = 509 in the case of brick and n = 412 in the case of elephant). Correlations below diagonal are given at the individual / dyad level (n = 26).

*p < .05; **p < .001; ***p < .001

Table 2. Model Fit Parameters (-2LL Function) Across Task and Multilevel Models of Growing Complexity

	Brick (Generate)				Elephant (Elaborate)			
	Orig	Prac	Sup	Creat	Orig	Prac	Sup	Creat
M1 (Linear)	2391.42	2228.26	2399.61	6953.28	1580.56	1873.53	1671.12	5121.54
M2 (Quadratic)	2366.90	2190.23	2384.64	6946.73	1574.80	1870.86	1667.91	5115.41
M3 (Condition)	2356.89	2176.53	2372.22	6931.82	1573.95	1870.76	1664.27	5113.75
M4 (Different processes)	2339.76	2175.39	2359.43	6920.42	1573.62	1870.71	1664.11	5113.55
Models comparisons ($\Delta df = 1$)								
Δ M2 vs. M1	24.52***	38.03***	14.97***	6.55**	5.76*	2.67	3.21	6.13**
Δ M3 vs. M2	10.01**	13.7***	12.42***	14.91***	0.85	0.10	3.64	1.66
Δ M4 vs. M3	17.13***	1.14	12.79***	11.4***	0.33	0.05	0.16	0.20

Note. Orig = Originality, Prac = Practicality, Sup = Surprise, Creat = Creativity index.

*$p < .05$; **$p < .001$; ***$p < .001$

Table 3. Multilevel Models Testing the Temporal Changes in Originality, Practicality, Surprise and Creativity of Generated Ideas in the Brick Task

Multilevel Models	Originality *B (SE)*	Practicality *B (SE)*	Surprise *B (SE)*	Creativity *B (SE)*
Model 1				
Linear trend	.05 (.01)***	-.06 (.01)***	.04 (.01)***	1.93 (.72)***
Model 2				
Linear trend	.08 (.01)***	-.09 (.01)***	.07 (.01)***	3.05 (.84)***
Quadratic trend	-.004 (.001)***	.004 (.001)***	-.003 (.001)***	-.13 (.05)***
Model 3				
Linear trend	.09 (.01)***	-.09 (.01)***	.07 (.01)***	3.47 (.85)***
Quadratic trend	-.004 (.001)***	.004 (.001)***	-.003 (.001)***	-.14 (.05)***
Condition (*0 = individual, 1 = dyad*)	-1.13 (.32)**	-1.29 (.31)***	-1.37 (.34)***	-120.79 (26.30)**
Model 4				
Linear trend	.07 (.01)***	-.08 (.01)***	.05 (.01)***	2.04 (.94)***
Quadratic trend	-.02 (.003)***	.007 (.002)**	-.02 (.003)***	-.90 (.23)***
Condition (*0 = individual, 1 = dyad*)	-1.85 (.36)***	-1.13 (.35)**	-2.01 (.38)***	-.161.31 (29.21)***
Quadratic x Condition	.02 (.004)****	-.003 (.003)	.01 (.004)***	.83 (.25)**

**$p < .001$; ***$p < .001$

Table 4. Multilevel Models Testing the Temporal Changes in Originality, Practicality, Surprise and Creativity of Generated Ideas in the Elephant Task

Multilevel Models	Originality *B (SE)*	Practicality *B (SE)*	Surprise *B (SE)*	Creativity *B (SE)*
Model 1				
Linear trend	.07 (.01)***	-.07 (.01)***	.06 (.01)***	2.61 (.56)***
Model 2				
Linear trend	.09 (.01)***	-.08 (.02)***	.08 (.01)***	3.55 (.68)***
Quadratic trend	-.002 (.001)*	.002 (.001)	-.002 (.001)	-.11 (.04)*
Model 3				
Linear trend	.09 (.01)***	-.08 (.02)***	.08 (.01)***	3.75 (.69)***
Quadratic trend	-.002 (.001)*	.002 (.001)	-.002 (.001)	-.11 (.04)*
Condition (*0 = individual, 1 = dyad*)	-.21 (.22)	-.10 (.30)	-.44 (.22)	-15.49 (11.94)
Model 4				
Linear trend	.09 (.01)***	-.08 (.02)***	.08 (.01)***	3.64 (.74)***
Quadratic trend	-.004 (.003)	.003 (.005)	-.003 (.004)	-.20 (.19)
Condition (*0 = individual, 1 = dyad*)	-.28 (.25)	-.06 (.35)	-.50 (.26)	-.18.71 (13.91)
Quadratic x Condition	.002 (.003)	-.001 (.005)	.002 (.004)	.09 (.21)

*$p < .05$; **$p < .001$; ***$p < .001$

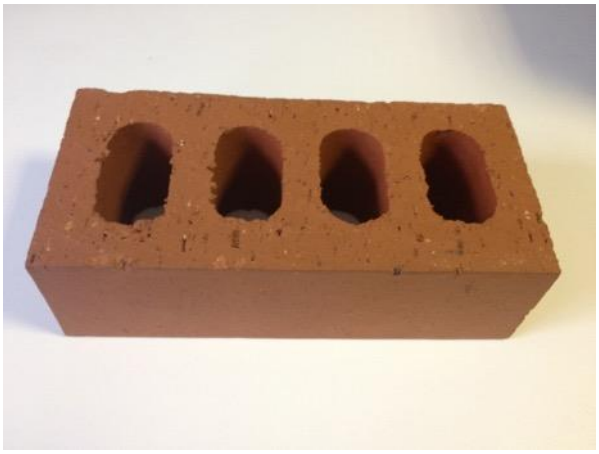


Figure 1. Material support for ideation tasks

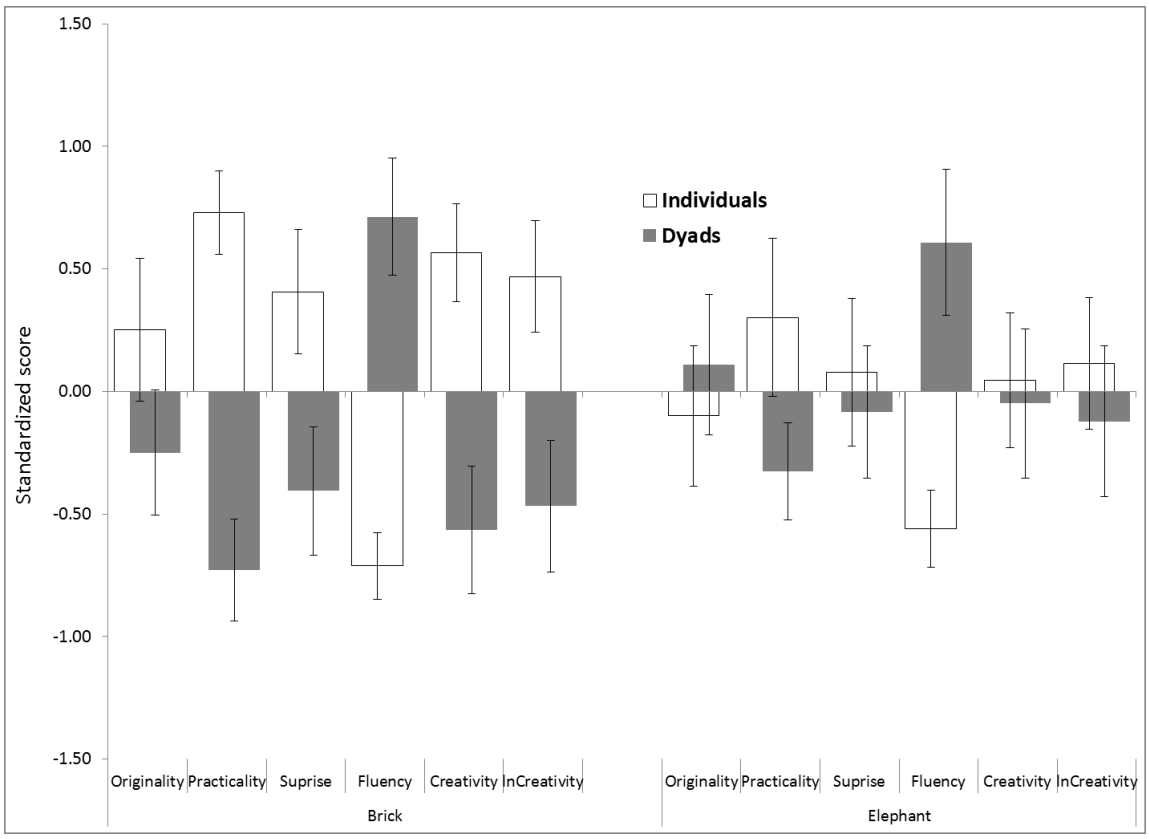


Figure 2. Comparisons of obtained scores between conditions (individuals versus dyads) and tasks (brick versus elephant). Error bars denote standard errors.

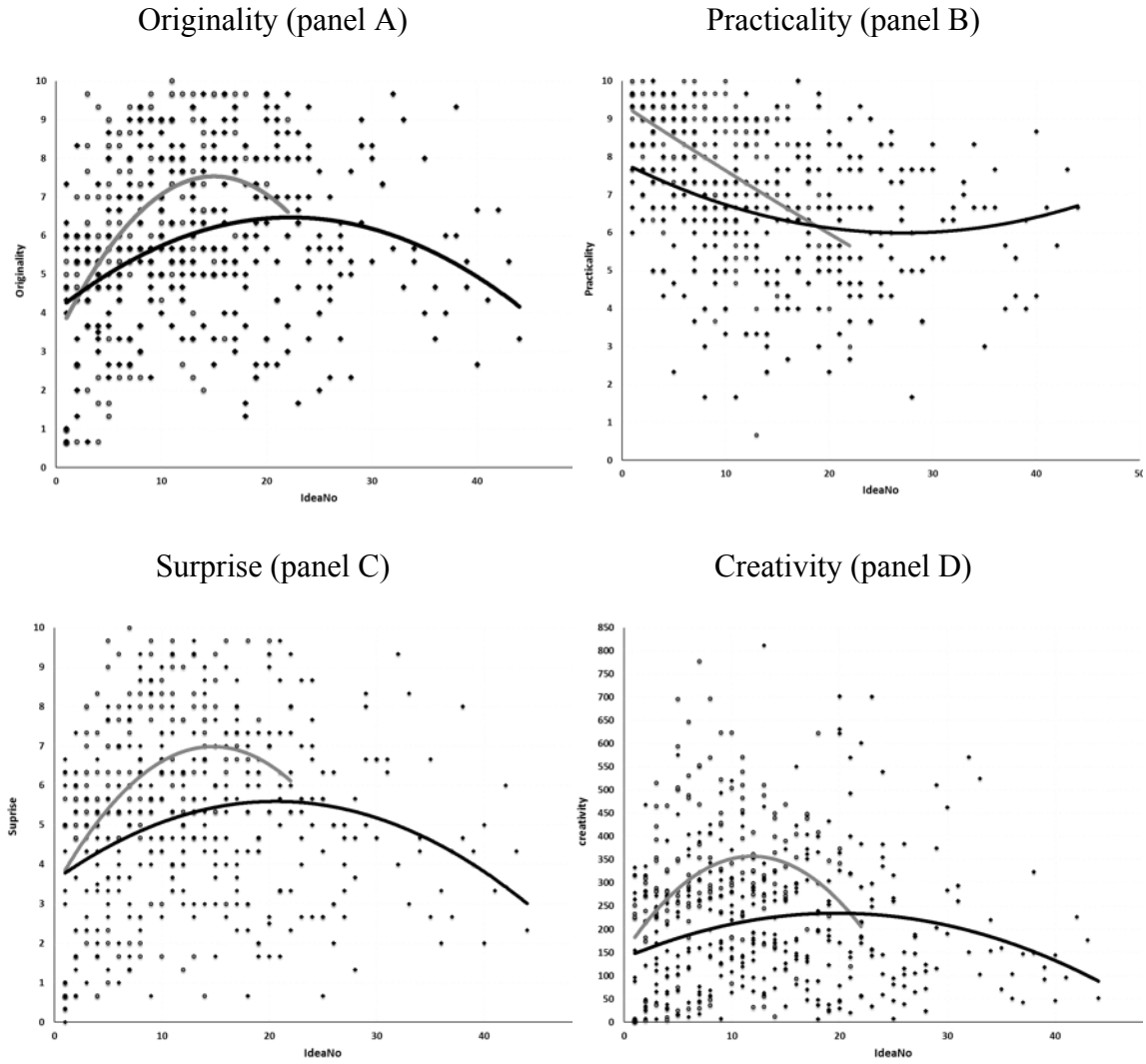
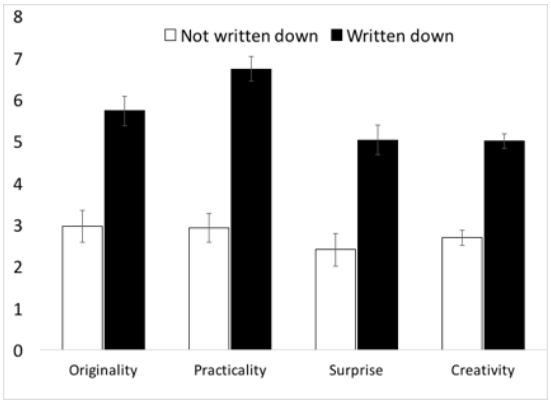
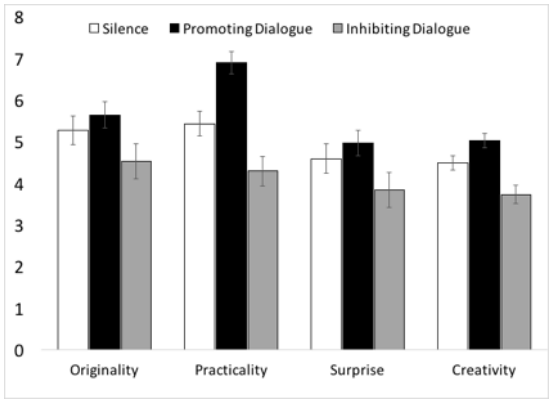


Figure 3. Patterns of the temporal changes in originality (panel A), practicality (panel B), surprise (panel C) and overall creativity index (log-transformed, panel D) among individuals (grey line) and dyads (black line) solving the brick task.

Panel A: Written versus non-written



Panel B: Dialogue versus no-Dialogue



Panel C: Agreement vs. Disagreement

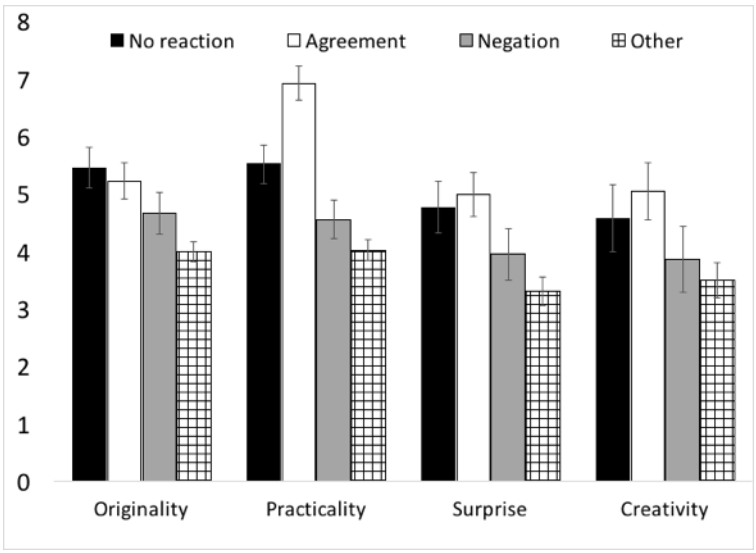
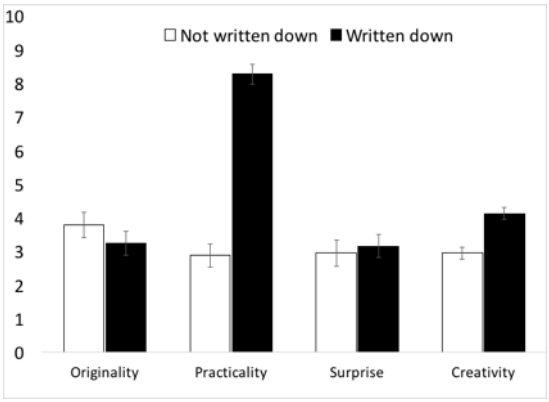
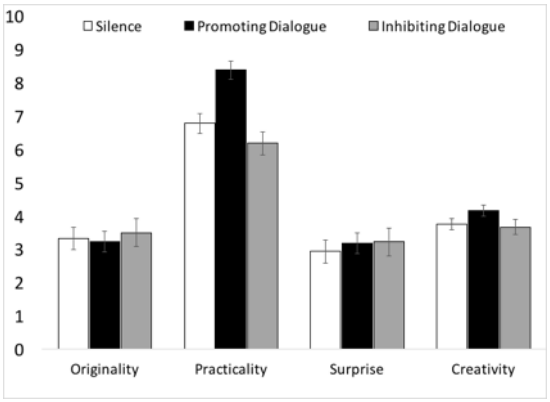


Figure 4. The relationship between different reactions toward ideas observed in dyads and ideas originality, practicality, surprise and creativity in a brick task. All values were estimated in multilevel models controlling for nesting ideas within dyads. Error bars denote standard error of measurement.

Panel A: Written versus non-written



Panel B: Dialogue versus no-Dialogue



Panel C: Agreement vs. Disagreement

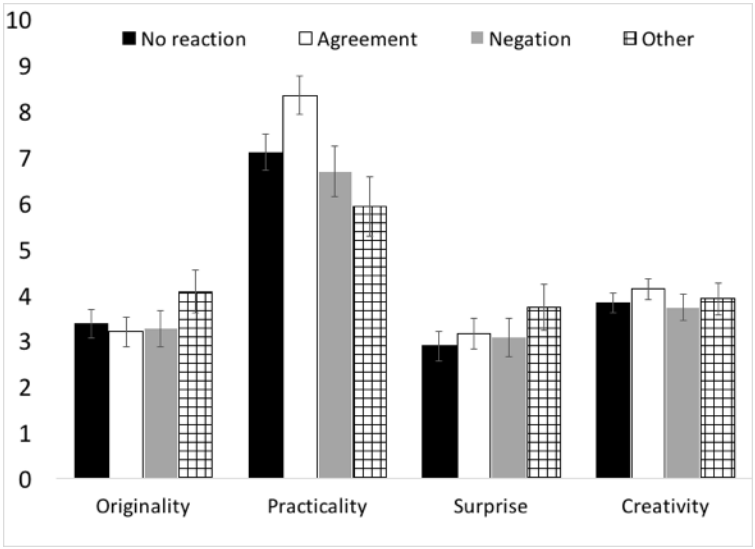


Figure 5. The relationship between different reactions toward ideas observed in dyads and ideas originality, practicality, surprise and creativity in an elephant task. All values were estimated in multilevel models controlling for nesting ideas within dyads. Error bars denote standard error of measurement.

Figure 6. The demonstration of practical ideas: the brick as a pencil holder (Dyad 3)