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Research Paper

An experiment on creativity in virtual teams

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ABSTRACT

The organization of work and the characteristics of tasks have undergone considerable changes in recent years. The developments include (i) an increased relevance of virtual teams and (ii) a higher demand for non-routine tasks in organizations, including creativity. Existing research on creative teams focuses on one-shot or existing teams, overlooking the importance of the formation phase of teams. This formation phase is particularly relevant for teams working in a virtual workplace setting, where communication and coordination may be constrained by the environment. Next to virtual work, hybrid working models ascend, also for teams. Therefore, we examine the influence of workplace settings and changes in these settings on creative performance of teams. We also investigate whether the individuals' ability to choose their workplace affects creative performance. We answer those questions by conducting a 2-phase experiment with dyadic teams in the lab and online to model a presence and a virtual workplace setting and account for the formation phase of teams. We implemented the "Unusual-Uses Task" as non-routine creative task. Our results showed that teams working in presence outperform those working online. Interestingly, working at least one phase in presence induces higher creative performance than entirely working online, underscoring the relevance of hybrid workplace settings. Moreover, no significant effects of self-selection on performance were found.

1. Introduction

The organization of work and characteristics of tasks have considerably changed over recent years. We observe a general increase in technologies enabling virtual communication and other forms of virtual work (Brenan, 2020). This, coupled with the demand for a global workforce (Kharroubi, 2021) and accelerated by Covid-19 pandemic restrictions, results in an increasing demand for virtual team work (Barrero et al., 2021). A second, still ongoing, change in the workplace is the high demand for solving non-routine tasks such as creative tasks (Autor et al., 2003; Englmaier et al., 2024). According to the World Economic Forum's Future of Jobs Report 2023, creativity is the second most important skill employers seek in employees. It is projected to become the top skill in coming years which may also be due to creativity being a driver for innovation and thus competitive advantage (e.g. West and Sacramento, 2023). These developments result in (i) an increased relevance of virtual teams and (ii) a higher demand for creative work in organizations as part of non-routine tasks.

It is reported that virtual teams often face challenges, especially in communication and with that in efficiency, at the beginning of their virtual work (De Guinea et al. 2012). However, research mainly focuses on existing virtual teams, or those that work together for a single period. Consequently, issues concerning the formation phase of a team have not explicitly been addressed, but rather implicitly

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with regard to outcomes related to trust, communication and coordination (Abi Saad and Agogué, 2023; Vuchkovski et al., 2023).

Existing research already investigates the effectiveness of (i) virtual teams and (ii) incentives for creativity in teams (e.g. Bradler et al., 2019; Brucks and Levav, 2022; Englmaier et al., 2024). Previous studies, which were mainly conducted before the Covid-19 pandemic and the general increase and familiarization of digital work, provide mixed findings concerning the effect of virtual work on performance in general and creative performance of individuals and teams (e.g. Giambatista and Bhappu, 2010; Kennedy et al., 2010; Dutcher, 2012; Alsharo et al., 2017). Several influential factors on the performance of teams have been assessed in earlier research, i.e. socio-demographic diversity; heterogeneity in abilities, and the physical workplace design (e.g. Martens, 2011; Dutcher and Rodet, 2022; 2024; Auer et al., 2024). Though, the effect of specific workplace settings on teams interacting repeatedly over multiple phases has not yet been analyzed.

Particularly, hybrid working models, in terms of switching between working in presence and online, gain in importance and were found to beneficially influence self-reported job performance (Iqbal et al., 2021; Naqshbandi et al., 2023). Therefore, we implement two working phases and also focus on these hybrid working models. This allows us, for example, to investigate whether an initial working phase in presence enhances the subsequent performance of a team that later works online.

Thus, our study contributes to (and links) two different strands of research. First, non-routine creative tasks and performance of (newly-formed) teams. Second, the influence of different workplace settings (i.e. on-site and virtual) as a consequence of their increased importance in teams.

In organizational reality, employees often select a company offering certain work settings and respective policies based on their preferences. Hence, considering the effect of self-selection seems essential for designing effective workplace settings for teams. Therefore, we also analyze whether the individual's ability to choose where to work impacts the creative performance of teams.[1]

To conclude, we aim to shed light on the following research questions:

1. Are teams more creative in presence than they are in an online setting?
2. What is the impact of the initial workplace setting for subsequent creative performance of teams?
3. Does the ability to self-select into a workplace setting affect the creative performance of a team?

To approach these research questions and fill the current gap regarding teams working on non-routine tasks in specific and changing workplace settings, we conducted an (online) experiment with dyadic teams working on creative tasks, varying the workplace setting over two experimental phases one week apart, thus accounting for the formation phase of teams and extending the literature of one-shot creative teams (e.g. Charness and Grieco, 2019; Grözinger et al., 2020; Dutcher and Rodet, 2022; Englmaier et al., 2024). The two experimental phases were either conducted at university or online in six experimental treatments. The implemented non-routine task to measure creative performance of teams was the *Unusual Uses Task* (UUT), in which participants have to list creative uses for a given object, covering the field of divergent thinking (Torrance, 1966).

2. Definitions and previous literature

2.1. Creativity in teams

Complementarities among team members are a crucial issue for implementing team work (e.g. Brown et al., 2004). The argument has been applied to our context in the additive model of creative thinking, which posits that team members complement each other when searching for new ideas (Kurtzberg, 1998; Kurtzberg and Amabile, 2001; Yuan et al., 2022)[2]. Similarly, the combinatory theory of creativity suggests that combining individuals to creative teams can foster creativity through active creating, diversity and experience (Feinstein, 2011; 2023).

Creativity, defined by Amabile (1988) as the production of novel and useful ideas by an individual or a group of individuals working together, is essential for innovative solutions. When focusing on creative work in teams, the concept of team-specific human capital (TSHC) is of importance. TSHC refers to the skills and knowledge individuals develop through interacting with one another (Blair, 1999) and a better understanding of tasks (Gerrard and Lockett, 2018). The development of TSHC is particularly crucial during the team formation phase. As TSHC increases with the time and quality of interaction between team members, it increases the effectiveness of coordination, trust and knowledge flow (McEvily et al., 2003; Gerrard and Lockett, 2018). In this sense, TSHC can be seen as a booster of complementarities in teams as described above.

Creative thinking has been distinguished between convergent and divergent thinking.[3] Convergent thinking covers generating a

[1] For studies allowing individuals to select teamwork or individual work and payment schemes see for example Eriksson et al. (2009) and Kuhn & Villeval (2015).

[2] Dutcher and Rodet (2024) provide evidence for this concept in an experimental study, demonstrating that highly creative individuals can enhance the future creative performance of individuals with less creative individuals by sharing creative capital through team collaboration.

[3] The concept of idea generation via divergent thinking is viewed as a suitable indicator for creative potential (Runco & Acar, 2012) and as starting point of many creative processes as referred to in our contribution. Different approaches on measuring divergent thinking emerged over recent years (i.e. Weisberg, 2006; Reiter-Palmon et al., 2019) including imagining a future city or storytelling (e.g. Charness & Grieco, 2019). Note that convergent thinking complements this in terms of idea conceptualization and implementation (Mumford, 2003; Reiter-Palmon et al., 2019; Sternberg et al., 2024).

single best idea and implementing it, whereas divergent thinking focuses on generating as many new ideas as possible (Guilford, 1950). We contribute to the literature on divergent thinking and apply the *Unusual Uses Task* (UUT, Torrance, 1966). Solving the UUT, individuals have to generate as many creative and useful ideas as possible for everyday objects, such as a tin can. A creative use is a use for which the object was not designed for. The task is predominantly used for exploring the creativity of individuals (Dutcher, 2012; Bradler et al 2019). Corresponding research on teams is limited to a context where team members work on the task in a one-shot game (e.g. Dutcherand Rodet, 2022, 2024). As an exception, Grund et al. (2024) recently investigated the difference in creative performance between dyadic teams and individuals using the UUT. Dyadic teams performed significantly better regarding the quality of creative ideas than individuals. Thus, we conclude that communication and complementarity in skills may beneficially foster creativity in teams compared to individuals in a WFH setting. Therefore, face-to-face (FtF) interaction in presence might further enhance team creativity due to direct and rich communication available. We build on the previous studies and apply the UUT to the team context with varying workplace settings. Section 3 explains the experimental design as well as the treatments and measurement of creativity in further detail.

2.2. Workplace setting and creative teams

The importance of working from home (WFH) as one specific dimension of virtual work has drastically increased over the past decades (Kurland and Bailey, 1999). Certain WFH arrangements can have beneficial effects for both employers (e.g. because of increases in productivity or cost reductions because of less office space being required), and employees in terms of an increase in satisfaction, commitment and work-life balance (Bloom et al., 2015; Kaduk et al., 2019; Nakrošienė et al., 2019). In practice, the work setting can rotate between WFH and working in presence, leading to a hybrid model of work switching between FtF and computer-mediated communication (CMC) such as chats or video conferences (Barrero et al., 2021).

The social presence theory (Short et al., 1976) states that CMC leads to less effective relational communication as in FtF communication. Media-richness theory (Daft and Lengel, 1986) applies this concept to team communication and indicates that the more complex the message to be communicated, the richer the medium used should be. Here, FtF is the richest form of direct communication which can be strengthened through additional materials provided during the communication. Rich communication is characterized by the number of communication channels available, the speed of a possible response and the perceived social presence of the partner.

Early experimental results indicated that communication via chats induces weaker collaboration (Brosig and Weimann, 2003), quality of idea generation (Kerr and Murthy, 2004) and efficient transfer of creative capital between individuals (Dutcher and Rodet, 2024) compared to FtF communication. More recent research focusing on creative teams includes video conferences as an additional way of CMC. In sum, results indicate for better performance of video conferences compared to chats and worse results in comparison to FtF (Grözinger et al., 2020; Dutcher and Rodet, 2021; 2024; Brucks and Levav, 2022). In contrast to these one-shot lab experiments, Coenen and Kok (2014) hint for the particular relevance of the setting within the formation phase in teams in their field study.

We add to the literature by addressing the formation phase during repeated interaction in different workplace settings (working indeed from home vs. in presence). We also consider effects of switching between these settings like in hybrid working models.

2.3. Self-selecting into a workplace setting

Self-selection into certain workplace settings is relevant in practice and imply the issues regarding which options are chosen and whether self-selected individuals perform better. Previous contributions on teams study the role of selecting teamwork or individual work (e.g. Kuhn and Villeval, 2015). Our experimental design enables us to take the decision to work in presence or online into account, as enforced work arrangements can have negative effects on employee's (Kaduk et al., 2019). Granting autonomy to select a work setting may have positive effects on individuals' motivation as they may choose the setting that fits their preferences best and the autonomy itself may enhance individuals' intrinsic motivation as indicated by self-determination theory (Amabile, 1983; Deci and Ryan, 1987).

To sum up, few studies investigating creative performance of teams and the role of the workplace setting exist. But – to the best of our knowledge – experimental research on the formation phase of a team and their creative performance with respect to different workplaces is missing. Therefore, our experimental study contributes to this literature by uncovering potential effects of the workplace settings and the sequence of those on creative performance of dyadic teams. Additionally, we approach the question of whether the autonomy to select a workplace setting has measurable positive effects on creativity.

3. Experimental design, treatments and measures

To approach our research questions, we conducted an experiment, using the lab of the RWTH Aachen University. Our experimental design consisted of two phases which took place one week apart from each other to account for repeated interactions over a longer time frame and to be able to analyze the formation process of a team over two working phases. In each phase, participants had to solve 4 UUTs together with one teammate. Additionally, subjects individually answered several questionnaires. Group composition did not

change over the course of the experiment. Groups had 8 min for each UUT and were automatically forwarded to the following task or questionnaire afterwards. As we are interested in the influence of the workplace settings, we implemented the design in two different settings. First, we chose an online experiment via the video communication platform Zoom to account for the WFH setting[4]. In existing research, it has been argued that CMC inhibits creative idea generation but this is often still measured in the lab and not in a real home office setting (e.g. Dutcher and Rodet, 2021; Brucks and Levav, 2022); therefore, we aim to alter this in our experiment. Second, to account for work in presence, the experiment was executed in a PC lecture hall of the RWTH Aachen University. This setting allowed several groups to work simultaneously without disturbing each other (Appendix-A, Fig. A1).

Fig. 1 shows the experimental procedure. Before the work in randomly assigned teams began, the participants got a first questionnaire and the instructions were presented on the screen, as well as read out loud by the experimenter[5]. Next, they worked individually on a first UUT which had two functions. First, the participants got to know the task and second, the results of this first task were used as a measure for the creative ability of an individual. The experimental screen of the ability check task can be found in the Appendix-A, Fig. A2.

Subjects were then randomly assigned to dyadic teams. We used the following items for the UUTs in the experiment: brick, hanger, sheet of paper and cord in phase 1, as well as umbrella, knife, table cloth and cap of a plastic bottle in phase 2, as well as a tin can as ability check. In a pre-test we checked for the difficulty of the used items and divided them such that they are somewhat comparable concerning their difficulty over the four items across the two phases. Note, however, that difficulty differs across items in general so that a performance increase over time cannot be derived individually but only across groups. Additionally, the participants were given a short instruction what the intentional use of those items is (e.g. tin can: container for food) and that this use is not counted as a valid answer. It was highlighted that they should be creative and the structure of the experiment as well as evaluation of answers and payment scheme was presented to them.

Participants had to answer several questionnaires individually (Appendix – C). In the beginning of the first phase, before the ability check, they were asked about their demographic data. This was implemented before the actual experiment as we aimed to gather demographic information of the participants, even if they would drop out in the later course of the experiment. After the ability check and the 4 UUTs of the first phase the participants received another questionnaire. With this questionnaire we asked whether participants knew each other before the experiment and for their levels of trust and sympathy towards the other team member, as those factors can play a major role in the process of teamwork and creative work.

The participants also received a questionnaire after the 4 UUTs of the second phase. They were virtually asked the same questions as at the end of phase 1, as we are interested whether sympathy and trust have changed over the course of the repeated interaction. Afterwards we implemented 15 items regarding the Big 5 personality traits (the BFI-2-XS; Soto and John, 2017). Besides, they were asked about their experience with mobile work, their current situation of employment, the level of joy they felt during the experiment, and effort they needed to conduct the experimental tasks.

To evaluate the given answers of the participants and their performance, we used the objective evaluation method of Bradler et al. (2019), assessing three indicators of creativity: validity, flexibility and frequency (Guilford, 1959). The participants were evaluated as a team in the four team tasks per phase and individually in the ability task in phase 1. Table 1 shows the different measures of creative performance used. The objective measurement method allowed us to form two measures of creative performance of teams. Firstly, a quantitative measure consisting of the number of the valid answers given during one UUT was computed, assigning one performance point to each valid answer, which is in line with Bradler et al. (2019). Secondly, a qualitative performance measure consisting of the number of different categories covered and frequency of answers was computed. The subjects received one point for each valid answer, one for each category covered (such as sport, cooking, animals, etc.), two points for rare answers, which are answers that are given only three times, and four points for very rare answers, which are answers that were only given once or twice by the participants when solving the specific UUT. We chose to assign those weights to rare and very rare answers, oriented on the weighting of Bradler et al. (2019) who doubled the weighting of the very rare answers in contrast to rare ones, as they are the main indicators for creativity. Those evaluations are conducted manually by student assistants.[6] The frequency of an answer as well as the validity were determined with the given answers of another study with 154 participants, which was conducted beforehand and is following the same procedure and UUTs. A rare answer was then equivalent to a usage which was named by approx. 2 % of participants and a very rare answer corresponded to 0.6 %-1.3 % of participants who gave this answer. The evaluation scheme was presented to the participants via the instructions. Participants received €0.08 for each performance point earned, along with a fixed payment of €4 for their overall

[4] The participants had to confirm that they actually participated form their home.

[5] In PR as well as in HO, the instructions were read out loud either in presence or via Zoom and the experimenter was directly available for questions. Thereafter, all communication between subjects and experimenter was conducted via an implemented chat-tool on the screens of the experiment, such that there are no differences regarding the exchange between participants and the experimenter.

[6] Two student assistants worked separately on the evaluation of answers for one UUT. When they disagreed, a third rater was consulted. As we used the catalogue of another study to evaluate the answers, some answers from participants of the current study were not given in the other study. If this was the case, the assistants categorized the new answer, counted its frequency, and implemented it in the catalogue of the given data collection period. In the next collection period, the pre-existing, unchanged, catalogue was used again. We opted for human raters instead of using latent semantic analysis (e.g. Beaty et al., 2022; Dutcher & Rodet, 2024), as LSA – as it was available for us – might help streamline analysis but may not fully address the specific need to identify the frequency of individual ideas within a category – a key aspect of our analysis. While LSA can estimate how often a category is mentioned, it may not readily distinguish how uncommon or unique individual ideas are within that category, as the stated answers in one category were sometimes again grouped together when indicating similar uses (e.g. sword, saber or dagger in the category weapon).

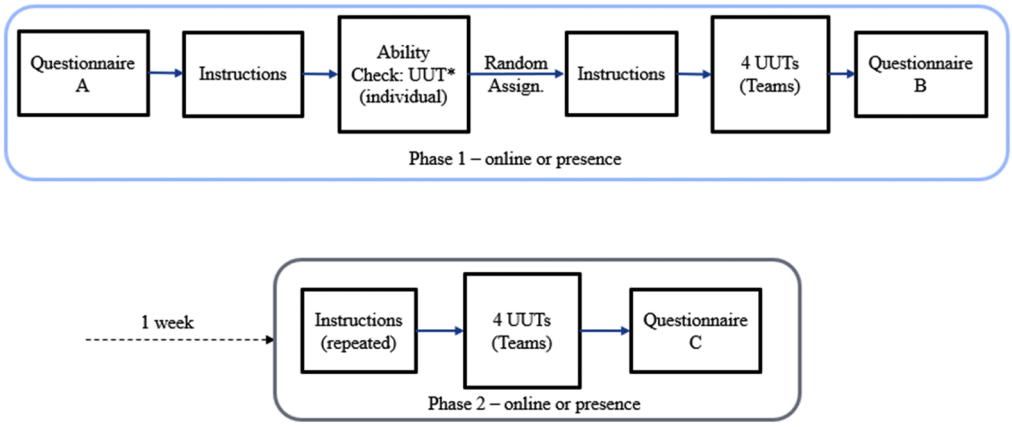

Fig. 1. Experimental procedure.

Table 1
Measures of creativity

Measure	Weight	Description
Quantitative Performance		Sum of generated points for valid answers
	1 point	Given for answer net of answers that are counted as invalid, because they were given twice, are not understandable or include the intended and common usage of an object
Qualitative Performance		Sum of the generated points by covered categories, rare and very rare answers
Categories	1 point	Given for each category covered with the answers for one UUT. In total, 29 categories were determined beforehand during a pre-test. Categories are for example: sports, animals, cooking, construction, fabric or crafting.
Rare answers	2 points	Given for rare answer, i.e. answers that were given only three times for one specific UUT (given by 2 percent of subjects in a pre-test).
Very rare answers	4 points	Given for very rare answer, i.e. answers that were given maximum twice for one specific UUT in the pre-test (1.3 percent in a pre-test).

participation in the experiment.

As we are interested in the effect of virtual workplace settings on the creative performance of teams, we implemented treatments, in which we varied the workplace setting between virtual work from home (HO) and work in presence (PR) and changed the sequence of workplaces in the two-phases. We used *HOHO, PRPR, HOPR*, and *PRHO* as notation for our four treatments, where *PRHO* indicates a setting, in which subjects worked in presence during the first phase and then switched to the WFH setting in phase 2. Additionally, we also wanted to investigate the effect of being able to self-select whether one wants to work in a virtual or presence workplace setting together with the other team member. The self-selection option was implemented via a question in the invitation mail for the experiments. The participants had to choose in their email whether they wanted to participate in presence or online and click on the corresponding option, which lead to two additional treatments *HOHO-endo* and *PRPR-endo*. Afterwards all participants, independent of the treatment, were forwarded to the registration page where they were shown the optional timeslots, whereas for the endogenous treatments, the slots corresponded to their decision made previously. After the registration for a specific timeslot, the participants of the exogenous treatments got a follow-up email with the information where the experiment would take place (online or in presence) in both phases. So, they knew beforehand whether they would work online or in presence and if the workplace changed for the second phase. Table 2 gives an overview of the workplace settings and their order for the six treatments.

4. Hypotheses

Addressing our research questions, we have already hinted for the relevance of social presence, media richness and TSHC in section 2. Following social presence and media-richness theory, the positive effects of more and richer communication channels and therefore the general quality of communication should be higher in a PR setting than in HO (Giambatista and Bhappu, 2010; Boland et al., 2022; Naotunna and Zhou, 2022; Nemiro, 2002). Next to changes in social presence, the effects of peer-pressure on the level of coordination in a team can differ between HO and PR. The literature on peer-pressure indicates that being observed may positively influence productivity and task focus in the context of team-based pay (Kandel and Lazear, 1992; Bishop, 2006; Georganas et al., 2015). Therefore, such positive effects of observability diminish in WFH compared to working in presence.

Focusing on the formation phase of teams, the development of TSHC might be positively influenced by direct communication in PR as the understanding of the task as well as collective learning can be positively affected by this form of communication leading to increased creative performance (Dutcher and Rodet, 2024). This relation may be explained by the level of coordination and trust in a team interaction (Peñarroja et al., 2013). As the social presence theory (Short et al., 1976) indicates, less perceived presence of team members through CMC in HO and thus social isolation might lead to slower development of trust between team members compared to interaction in presence (Abi Saad and Agogué, 2023; Ficapal-Cusí et al., 2023). This in turn influences the knowledge flow between members (Gerrard and Lockett, 2018; McEvily et al., 2003), which is crucial for the creative output of divergent thinking tasks (Kurtzberg and Amabile, 2001). Similarly, the combinatory model of Feinstein suggests that experience and active creating in teams, through direct interaction and communication, fosters creativity (Feinstein, 2011; 2023). Therefore, communication as in face-to-face interactions can have a general beneficial impact on creative teams.

Following those arguments, we expect higher TSHC in teams working in presence compared to those working online. Therefore, as TSHC influences the necessary coordination and flow of knowledge between team members working on a divergent thinking task, we expect significantly higher creative performance in the *PRPR* treatment when being compared to *HOHO* (H1).

Moreover, we extend existing research by investigating hybrid working models, simulated by the *HOPR* and *PRHO* treatments. Rather than focusing on comparing the two hybrid treatments or determining an optimal sequence of hybrid work, our emphasis is on treatments with different initial modalities, allowing us to examine the influence of first interaction on subsequent creative performance in a different workplace setting. First, we examine the performance in phase 2 between *HOPR* and *PRPR*. As argued above, the level of TSHC is higher after having worked in presence in the first phase. Therefore, subjects can build on this and reach higher creative performance in the second phase in *PRPR* than in *HOPR* (H2a). Besides, subjects do not need to readjust in *PRPR* between phases, which also speaks for a higher performance in *PRPR*. Similarly, we can compare *PRHO* and *HOHO*. Although, a readjustment is necessary in *PRHO*, we expect that the positive TSHC effect of PR in the first phase dominates. Therefore, the creative performance during the second experimental phase of the *PRHO* treatment should be significantly higher than that of *HOHO* (H2b).

As the rationale behind implementing the self-selection option is that participants select themselves into the workplace where they expect to perform best – as they knew that payment is performance-based. We expect that participants are familiar with both workplace settings and are, thus, able to self-select according to their preferences and performance expectations. Moreover, the individual need for autonomy is positively influenced by the option to choose the workplace setting (Deci and Ryan, 1987). Thereby, increasing intrinsic motivation which is crucial for performance in general (e.g. Baard et al., 2004; Gagné and Deci, 2005; Benz and Frey, 2008) and creative performance in particular (Amabile, 1983). Therefore, the performance of the endogenously assigned treatments should be significantly higher than of the exogenously assigned treatments, as participants should follow this rational of utility maximization (H3)[7]. Table 3 provides and overview of our hypotheses[8].

5. Data collection and sample

The data were collected between February and November 2023. In total, we conducted 33 sessions, each consisting of the two phases one week apart. The sample consisted of 122 dyadic teams[9], leading to 244 subjects, who participated in both phases of the experiment. In total, 459 participants were registered for the experiment from which 147 did not show up. Dropouts, first, include 17 participants who did not finish the first phase. Additional, 68 subjects did not participate in the second phase, i.e. dropped out after finishing the first phase [10].

Quantitative and qualitative performance of teams, as described above in Section 3, serve as dependent variables. The treatments, differing in the workplace setting and self-selection option, are the main independent binary variables. The data gathered through the questionnaires are used as controls and for further analysis. The average qualitative performance in all treatments amounts to 99.75 points (SD=46.46) in the first phase and 138.44 points (SD = 65.72) in the second. For the measure of quantitative performance, the average is 86.49 points (SD = 29.09) in the first phase and 94.11 points (SD = 33.39) in the second. On average over all treatments, the first experimental phase took about 58 min and the second about 45 min and the average total payment per participant amounts to €37.84, ranging from €33.52 to €41.42 across treatments.

The average quantitative ability of a participant, measured with the ability-checking UUT at the beginning of the first phase, amounts to 14.38 points (SD = 5.71) and 17.33 points (SD = 8.07) for the average qualitative ability over all treatments (see Appendix-B, Table B2 for the ability of the different treatments). We checked that average points do not differ significantly across treatments using Kruskal-Wallis Tests ($p = 0.694$).

[7] It needs to be remarked that individuals are only able to self-select and decide for a specific option when they know what to expect (Kuhn, 2017). Therefore, the assumption must hold that participants of the self-selection treatments are familiar with WFH and working in presence to be able to self-select into their preferred workplace, which is reasonable, as not only work but studying too is moved towards a digital environment.

[8] The experimental design, treatments, and the corresponding hypothesis of the study are preregistered at *AsPredicted* (AsPredicted #144051).

[9] Table B1 in Appendix-B shows the distribution over the six treatments regarding the average age of participants, the distribution of gender and their educational background.

[10] We address potential selection effects of those dropouts when focusing on regression analysis in section 6.

Table 2
Treatments

Treatment	Workplace 1. Phase	Workplace 2. Phase	Self-selection option
HOHO	Virtual	Virtual	No
PRPR	Lab	Lab	No
PRHO	Lab	Virtual	No
HOPR	Virtual	Lab	No
HOHO-endo	Virtual	Virtual	Yes
PRPR-endo	Lab	Lab	Yes

Table 3
Hypothesis

Nr.	Hypothesis	Treatment
	Presence vs. WFH	
1	The creative performance in a team that is exogenously assigned to work in presence is higher than in a team that is exogenously assigned to work at home.	*PRPR* vs. *HOHO*
	Impact of the initial workplace setting on subsequent performance	
2a	After working from home in a first phase teams yield a lower creative performance in presence in a second phase compared to having worked in presence also in the first phase.	*HOPR* vs. *PRPR*
2b	After working in presence in a first phase teams yield a higher creative performance at home in a second phase compared to having worked at home also in the first phase.	*PRHO* vs. *HOHO*
	Impact of self-selecting into a workplace setting	
3	Teams where the team members have assigned themselves to a work setting show higher creative performance than those that were exogenously assigned.	*PRPR-endo* vs. *PRPR* *HOHO-endo* vs. *HOHO*

6. Results

In the following section, the results considering the hypothesis of this study are reported. We conducted pairwise comparisons between treatments, using non-parametric Mann-Whitney U-Tests. The results are calculated and presented on a team level, focusing on the joint team performance across treatments. Table 4 shows the average points achieved in the two experimental phases and performance categories of the four exogeneous treatments together with the number (*N*) of dyadic teams per treatment. We aimed to raise at least 21 dyadic teams per treatment, in line with power calculation (Cohen, 1988: ANOVA with significance of 0.1, 6 treatments and power of 0.8). Qualitative performance is measured as the sum of the different categories generated and the frequency of given answers by the participants per UUT (see also Table 1 above).

Fig. 2 shows the average qualitative performance and standard deviations (SD in parentheses) over the two phases of the experiment, together with the absolute differences in performance between the two phases of the four exogenous treatments. At first sight, this figure points towards a beneficial impact of a phase being conducted in presence compared to the *HOHO* treatment.

We found meaningful differences across treatments rather for qualitative (presented in the sections below) than for quantitative performance. Our analysis and hypotheses testing concentrates on the qualitive measure of creative performance as main indicator for creativity and innovative ideas by covering the aspects of flexibility and frequency of ideas. Besides, no difference is found regarding qualitative performance in the first experimental phase, using Mann-Whitney U-Tests for pairwise comparison (p-values ranging between 0.251 and 0.952). Obviously, advantages of the social presence and media richness cannot alone explain differences between working in presence and working from home in our setting. The effects of different workplace settings only materialize when it comes to repeated interaction in the same team. As argued above, TSHC builds up faster in presence during phase 1 and can blossom in phase 2.

Results on pairwise comparisons between treatments using Mann-Whitney U-Tests, indicate significant differences between the exogeneous treatments of the experimental study[11]. The following text presents those results and is structured along our research questions.

6.1. Are teams more creative in presence than online?

Firstly, the question is addressed, whether working fully in presence outperforms fully working online when concentrating on dyadic teams working on creative tasks. This question is answered by testing hypothesis 1, expecting a beneficial impact of working in

[11] Please keep in mind that the treatments did not differ in their creative ability of participants, such that the significant differences in creative performance presented in the following sections are not due to different levels of general ability to solve the UUT. See also the multivariate analysis below.

Table 4
Average quantitative and qualitative performance of the exogenous treatments in both phases with standard deviations in parentheses below

	N	Quantitative Performance			Qualitative Performance		
		Phase 1	Phase 2	Sum	Phase 1	Phase 2	Sum
HOHO	24	87.54	91.29	178.83	92.35	98.04	190.96
		(23.08)	(27.52)	(46.87)	(28.79)	(37.23)	(55.87)
PRPR	22	91.86	99.55	191.41	111.05	151.95	263
		(32.12)	(39.24)	(68.79)	(48.27)	(76.88)	(117.31)
PRHO	24	85.33	99	184.33	109.08	153.15	241.54
		(34.36)	(39.07)	(69.75)	(53.56)	(66.72)	(113.29)
HOPR	21	87.43	95.71	183.14	112.67	161.52	274.19
		(28.02)	(32.74)	(58.96)	(46.24)	(62.61)	(104.27)

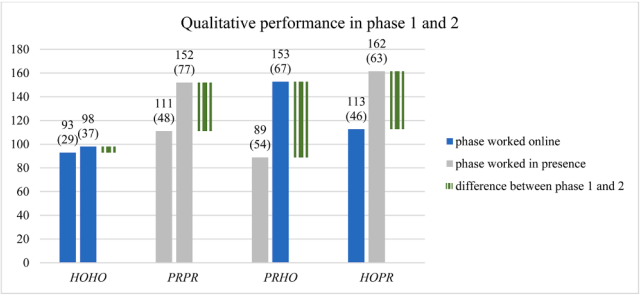

Fig. 2. Average qualitative performance and SD in parentheses of the exogenous treatments in phase 1 and 2 and the absolute difference of performance between those two phases

presence as a team compared to dyadic teams working online. Table 5 shows the corresponding test results. All following p-values of the non-parametric tests are one-sided as the hypotheses under investigation are directional. Comparing the *HOHO* and *PRPR* treatments, they differed significantly in the measures of creative performance from each other such that the qualitative performance of the second phase was higher in the *PRPR* treatment. This result is in line with hypothesis 1.

Further, we compared the *HOPR* and *PRHO* treatments with the treatments that did not change the workplace setting to check for the effect of working in presence during the second interaction. We found a significant difference between *HOPR* and *HOHO*, such that the performance of the second phase was significantly higher when it was conducted in presence indicating a beneficial effect of working in presence in a dyadic team, when being compared to teams who never worked in presence. The corresponding Mann-Whitney U-test for phase 1 (Table 5) just miss conventional significance levels. However, multivariate analysis including controls for socio-demographics as well and sympathy and trust show significant differences (see Appendix-B, Table B3), hinting towards a positive impact of the consideration that the second phase is conducted in PR. As *PRHO* and *PRPR* did not differ in their performance of the second phase, it does not exist a negative connection of the second phase being online with performance compared to the second phase in presence, as long as the first interaction was held in presence.

When comparing the absolute differences of the qualitative performance of the four treatments (Fig. 2), it becomes visible that the difference of the *HOHO* treatment is the lowest. This finding also holds when comparing treatment differences pairwise by using Mann-Whitney U-Tests, i.e. the performance increase from phase 1 to 2 is significantly lower in HOHO than the increase in the other three. Therefore, the three treatments containing at least one experimental phase that is worked in presence, shows a larger increase, pointing towards potential benefits from interacting at least once in a non-virtual environment. Therefore, our first guiding question is confirmed for our setting as teams show higher creative performance in presence than online.

6.2. *What is the impact of the initial workplace setting on subsequent performance of teams?*

As stated earlier, hybrid working models where employees switch between working in presence and online increased drastically over recent years. Therefore, the next section investigates the effect of those workplace variations in a team with focus on the performance in the second experimental phase, thus focusing on hypotheses 2a and 2b. Table 6 shows the results of the Mann-Whitney U-Tests conducted to test for the hypothesis.

Hypothesis 2a tests for a difference between the *HOPR* and *PRPR* treatment, as the *HOPR* treatment interacted at first in an online work setting before switching to the same setting as *PRPR*. Because of the difference in the first interaction, the two treatments might differ in their creative performance of the second phase as the level of coordination and TSHC can differ. Though, there was no such

[12] r denotes the effect size $r=\sigma_y$of the difference between the two groups. Tested with Mann-Whitney U-Tests.

Table 5
Results of pairwise comparisons of the qualitative performance using Mann-Whitney U-Test to test for the first hypotheses

H1	Treatments	Phase 1	Phase 2	Sum
	PRPR vs. *HOHO*	n.s. (one-sided $p = 0.205$)	*** (one-sided $p = 0.006$), $r = 0.41$[12]	** (one-sided $p = 0.017$), $r = 0.31$
	HOPR vs. *HOHO*	n.s. (one-sided $p = 0.125$)	*** (one-sided $p = 0.000$), $r = 0.59$	*** (one-sided $p = 0.001$), $r = 0.46$
	PRHO vs. *PRPR*	n.s. (one-sided $p = 0.358$)	n.s. (one-sided $p = 0.354$)	n.s. (one-sided $p = 0.407$)

significant difference, showing no significant negative nor positive effect of working online when the second interaction was in presence, compared to working both phases together in presence[13]. Thus, rejecting hypothesis 2a.

Hypothesis 2b of this study expects higher performance of the *PRHO* treatment in the second experimental phase, when being compared with the *HOHO* treatment, as working the first phase in presence should have a beneficial impact on the creative performance of the second phase. The two treatments differed significantly as expected in the second phase, such that the creative performance of the *PRHO* treatment exceeded the performance of *HOHO*. The results are in line with hypothesis 2b, indicating a beneficial effect of meeting in presence in the first phase.

To further test for the influence of working in presence, as well as for other influential factors on creative performance of dyadic teams, a regression analysis is required[14]. We made use of a hierarchical OLS estimation to test stepwise for the treatment effects, with *HOHO* being the baseline, and other influential variables. Table 7 shows the results of the regression analysis for the four exogenous treatments on the qualitative creative performance of the second phase[15]. The first model shows highly significant treatment effects of *PRHO, HOPR* and *PRPR* on the creative performance of the second phase, with *HOHO* being the reference treatment. The highly significant effect of *PRHO, HOPR* and *PRPR* in comparison to the *HOHO* treatment remains robust for Model 1 to 5. For the following models we integrated stepwise further variables, such as the average ability of a team (Model 2) which highly correlates with the dependent variable.

Moving from Model 2 to Model 3, we incorporated the qualitative performance of the previous phase. This approach allows us to account not only for the subjects' ability to solve the task but also how well they functioned as a team in the previous phase. The model demonstrates strong treatment effects even after considering previous performance, indicating performance improvements from phase 1 to phase 2.

In Model 4 sympathy and trust were introduced as additional explanatory variable for the creative performance of the second phase. Considering the measures of sympathy and trust between team members, Table B4 in Appendix-B reports sympathy and trust towards the interaction partner after the first and second phase at an individual level, separately for the six treatments. A performance enhancing effect of sympathy and trust was expected, as individuals who felt more sympathy and trust during the interaction should have a better level of coordination and communication patterns. When testing for this assumption in Model 3, no significant direct influence of sympathy and trust is found. Besides neither trust nor sympathy are able to explain treatment differences so that we do not find evidence for this particular theoretical argument presented above.

In Model 5 we implemented two variables of team composition: the difference in ability between team members and the gender composition of teams, as gender effects and in general heterogeneity can influence the level of cooperation and thus the creative output. No significant effect for the gender composition of a team was found, whereas the difference in ability has a highly significant positive, but rather small, influence on the creative performance, thus showing that heterogeneity in terms of ability might positively affect team coordination when working on a creative task.

We already hinted for the relevance of dropouts in Section 5 above. This is particularly relevant in the HO setting. Table B5 (Appendix-B) reports mean ability and first phase performance of dropouts compared to our sample. We have checked that our results are robust with respect to a Heckman 2SLS estimation and are not biased due to sample selection (see Table B6 in Appendix-B).

We further tested for possible interaction effects of sympathy, trust, difference in ability and gender composition (see Appendix-B, Table B7) in teams with the treatment effects to check for moderation. No significant interaction effects for sympathy nor trust and differences in ability are found. The gender composition of teams does not a show a robust significant interaction effect with the treatments.

Additionally, we conducted Poisson-Regression analysis, with frequency (rarity of answers), flexibility (covered categories) and validity (quantity) as dependent variables (see Table B8, Appendix-B). The models show that the treatment effects are mainly driven by very rare answers (answers which were only given once or twice), thus, being a main indicator fur unusual innovative thoughts occurring in the exogeneous treatments which implement some form of working in presence.

[13] The participants knew before the first phase that they would interact the second phase in presence. This might influence the level of coordination and TSHC.

[14] The conditions to assume normal distributions are checked, with the result that normal distribution of the performance measures needs to be rejected. Therefore, an OLS regression with robust standard errors is applied. Our results are robust, when using bootstrapping of the standard errors or with the log of performance as the dependent variable.

[15] The regression analysis focusing on the first experimental phase can be found in Appendix-B Table B3.

Table 6
Results of pairwise comparisons of the qualitative performance using Mann-Whitney U-Test to test for the second hypotheses

Hypothesis	Treatments	Phase 2
2a	*HOPR* vs. *PRPR*	n.s. (one-sided $p = 0.219$)
2b	*PRHO* vs. *HOHO*	*** (one-sided $p = 0.001$), $r = 0.43$

Table 7
Multivariate OLS regression analysis on the qualitative creative performance of the second phase of the exogeneous treatments

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
Treatment (Base: HOHO)					
PRPR	53.91***	63.96***	39.85***	40.01***	43.18***
	(18.06)	(16.64)	(13.22)	(13.81)	(13.78)
PRHO	54.67***	47.52***	37.62***	36.62***	41.15***
	(15.61)	(15.49)	(11.85)	(11.88)	(11.89)
HOPR	63.48***	70.04***	46.93***	44.97***	45.24***
	(15.62)	(14.05)	(10.83)	(10.93)	(11.59)
Average Ability		3.574***	1.000	0.978	0.916
		(0.892)	(0.586)	(0.595)	(0.632)
Qualitative Performance in Phase 1			0.931***	0.942***	0.887***
			(0.134)	(0.130)	(0.139)
Sympathy				-0.330	-0.679
				(10.00)	(10.16)
Trust				6.078	5.041
				(5.069)	(5.488)
Difference in Ability					0.593
					(0.340)
Gender composition (Base: Two Males)					
Mixed					-6.950
					(10.25)
Two Females					-4.731
					(16.78)
Constant	98.04***	29.02	-7.777	-7.806	-8.410
	(7.610)	(18.02)	(15.02)	(15.32)	(18.84)
Observations	91	91	91	91	91
Adj. R-squared	0.120	0.317	0.610	0.606	0.605

Trust and Sympathy are centered around the mean
Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * p< 0.1

6.3. Does the ability to self-select into a workplace setting influences creativity?

Moreover, we tested whether implementing the option to choose the workplace setting influences the creative performance. The first finding is that there seems to be a low preference for selecting into a fully presence workplace setting, as the *PRPR-endo* treatment only consists of 18 individuals, out of 62 participants in both endogenous treatments, who preferred working in presence than online

Table 8
Average quantitative and qualitative performance of the endogenous treatments in both phases with standard deviations in parentheses below

	N	Quantitative Performance			Qualitative Performance		
		Phase 1	Phase 2	Sum	Phase 1	Phase 2	Sum
HOHO	24	87.54	91.29	178.83	92.35	98.04	190.96
		(23.08)	(27.52)	(46.87)	(28.79)	(37.23)	(55.87)
HOHO-endo	22	78.50	84.55	163.05	88.82	123.57	212.36
		(25.67)	(27.23)	(50.11)	(37.39)	(54.81)	(87.06)
PRPR-endo	9	91.00	94.89	185.89	117.50	157.56	273.78
		(34.48)	(34.53)	(67.91)	(48.50)	(83.14)	(129.59)
PRPR	22	91.86	99.55	191.41	111.05	151.95	263
		(32.12)	(39.24)	(68.79)	(48.27)	(76.88)	(117.31)

throughout multiple sessions of the experiment conducted over the course of 10 months, whereas each session contained the two experimental phases. Therefore, the results of the *PRPR-endo* treatment need to be treated with caution. Table 8 shows the quantitative and qualitative performance of the endogenous treatments over the two phases, as well as for comparison those of *PRPR* and *HOHO* again, also showing an increase in both measures of performance from the first to the second experimental phase.

Hypothesis 3 suggests that the creative performance of dyadic teams is higher in the endogenous treatments, as the participants should self-select into their preferred work setting, depending on where they expect to perform best, as the performance directly influences the payoff. Regarding the two *HOHO* treatments, the hypothesized relation holds for the qualitative performance of the second experimental phase (** (one-sided $p = 0.046$), $r = 0.24$). For the two *PRPR* treatments, no significant differences exist, although qualitative performance is slightly higher in the endogenous treatment. Although we find an indication for a positive effect of self-selection in the online treatment we can hardly confirm the third hypothesis.

Lastly, we can reconfirm the results of hypothesis 1 by comparing the *HOHO-endo* treatment with the *PRPR-endo* treatment. A weak significant difference for the qualitative creative performance of the second phase is found in favor of the *PRPR-endo* treatment (* (one-sided $p = 0.089$), $r = 0.25$).

7. Discussion and conclusion

Our study contributes to the existing literature on virtual teams and creative teams by examining the impact of workplace settings on creative performance. Our results indicate that working together as a team on a creative task in presence beneficially influences performance when comparing to teams working entirely online. It becomes apparent that the positive effects of working together in presence spill over to subsequent online work phases compared to a pure online setting. This is particularly important considering hybrid working models: A team's initial working phase in presence provides a favorable basis for working online later. This is of special importance for teams engaged in ongoing creative tasks rather than one-shot brainstorming sessions. Over the course of the two experimental phases, solving creative tasks can be optimized by team members, leading to an established habit on how to work on the UUT, fostering the accumulation of TSHC and its favorable influence on performance (Gerrard and Lockett, 2018) over time. The results are robust to situations in which subjects can endogenously choose the workplace setting instead of being allocated by the experimenter, indicating that the intrinsic value of interaction in presence holds regardless of the method of workplace assignment

Interestingly, when focusing on the initial workplace setting's influence on subsequent performance, no significant differences between teams that began in presence and those that transitioned from online to presence setting was found. There does not seem to be a harmful nor a beneficial effect of working online in the first phase as long as the following phase takes place in presence. Though, we found significant positive effects of getting to know each other in person in the first (formation) phase of the team on subsequent performance online. We conclude that a beneficial effect of interacting in presence first can spill over to the subsequent work phase and place.

As the factors of sympathy and trust, as channel for TSHC, did not yield significant results in the regression analysis, we posit that other mechanisms driving the difference between treatments have to be relevant. A possible explanation for those results can be found in the pre-experimental awareness of participants whether they get to interact in presence at least once. Therefore, if an individual expects that he or she will have to interact in presence with the other member, reciprocal behavior and social norms may have an influence here. For example, participants probably will be more inclined for communication within their team when sitting directly next to the other team member, whereas in the online setting few turned off the camera, muted the microphone and needed active intervention of the experimenter to start communicating. Furthermore, enacting unfriendly or uncooperative during the first phase might be sanctioned by the team member through direct negative reciprocity in the next phase, which can be more unpleasant in presence Consequently, FtF interaction, or even the anticipation thereof, can enhance the level of coordination between team members through reciprocal behavior and social norms. This could induce higher intensity of task focus, knowledge flow, and thus an increase in performance.

Moreover, anticipating FtF interaction might lead participants to develop a different perception of the team and their team affiliation, leading to higher pre-engagement and team commitment (Sheng et al., 2010). This can, in turn, have beneficial effects on team performance, as evidenced in Table B3. Here, we observe differences between fully online work and a hybrid model that begins with online work, facilitated by the developed TSHC through shared knowledge and active communication in FtF interactions (Liu et al., 2011; Neininger et al., 2010; Dutcher and Rodet, 2024).

Those findings strengthen the notion that working in presence might not only provide the best technology for team interaction through FtF communication, but it also increases TSHC leading to high creative performance in subsequent interaction.

We conjectured that group performance is higher, if individuals were allowed to self-select into a workplace setting following their preferences. Nonetheless, the results showed no robust significant differences in performance between the exogeneous and endogenous treatments within the same workplace settings. Notably, a majority of participants opted for the online setting, likely due to its comfort and flexibility. As theory about self-selection states, one can only decide rationally between options if one is familiar with all alternatives. We, therefore, asked participants for their experience with working online. Data indicates that participants selecting the online experiment were rather familiar with virtual work (65 %) compared to those preferring the setting in presence (40 %) (being in line with findings in the field from Nguyen, 2021 and Labrado Antolín et al., 2024). Thus, the interplay of familiarization with WFH and convenience when working online may have influenced the selection of the online setting which resulted in lower payoffs.

We provide an important forward towards a deeper understanding regarding the (switches in) workplace settings of teams and their performance for the case of creative tasks. Current tendencies of companies to rethink workplace policies should consider the effect of the work setting of teams particularly if creativity is essential. At least some joint time working together in person is found to be

important for creative teamwork. This can occur in an initial phase, like a typical onboarding day or week, or a subsequent stage within the team formation process, as long as in-person interaction is communicated in advance. To support the effective formation of a team, incorporating at least one in-person collaboration session during the onboarding period may yield valuable benefits for team dynamics. Such in-person interaction can enhance team performance in later stages, regardless of whether future collaboration occurs remotely or in person.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2025.106926.

Appendix – A

Figs. A1 and A2.

Fig. A1. Experimental setting in presence

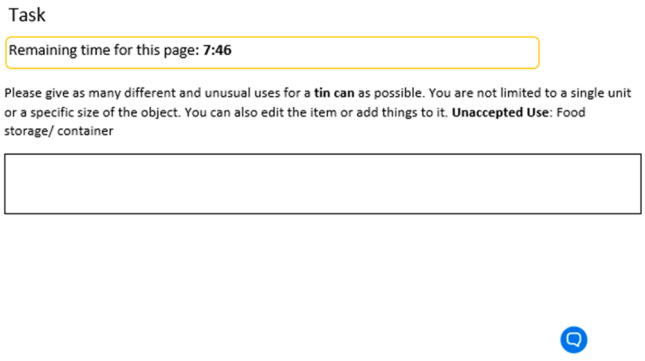

Fig. A2. Experimental screen of the Task

Appendix – B

Tables B1–B8.

Table B1
Sample characteristics of dyadic teams for all treatments

Treatment	N	Mean Age	Gender = women	Non-Bachelor	Bachelor
HOHO	48	25.94	22	21	27
PRPR	44	23.00	15	32	12
PRHO	48	22.58	18	35	13
HOPR	42	24.38	13	26	16
HOHO-endo	44	25.27	26	27	17
PRPR-endo	18	22.28	7	13	5
Whole Sample	244	24.13	101	154	90

Table B2
Average creative ability and standard deviation in parentheses, measured on the individual level

	Creative Ability	
	Quantitative	Qualitative
HOHO	13.33	17.98
	(7.99)	(11.67)
PRPR	14.75	16.5
	(6.36)	(8.01)
PRHO	13.42	18.25
	(6.34)	(11.08)
HOPR	13.71	17.71
	(6.69)	(11.46)
HOHO-endo	12.59	14.61
	(5.97)	(10.79)
PRPR-endo	13	18.22
	(5.45)	(10.67)

Table B3
Multivariate OLS regression analysis on the qualitative creative performance of the first phase of the exogeneous treatments

VARIABLES	Model 1	Model 2	Model 3	Model 4
Treatments (Base: HOHO)				
PRPR	18.13	25.90**	25.17**	26.80**
	(11.85)	(11.38)	(11.79)	(11.90)
PRHO	16.17	10.64	8.917	15.31
	(12.43)	(11.83)	(12.16)	(11.87)
HOPR	19.75*	24.83**	23.71**	20.92*
	(11.66)	(10.57)	(10.96)	(12.03)
Average Ability		2.764***	2.770***	2.479***
		(0.544)	(0.553)	(0.509)
Sympathy			4.047	4.850
			(6.483)	(6.662)
Trust			-0.181	-4.844
			(5.349)	(5.833)
Difference in Ability				0.792***
				(0.287)
Gender composition (Base: Two Males)				
Mixed Team				-10.15
				(10.70)
Two Females				-0.722
				(12.63)
Constant	92.92***	39.53***	40.32***	36.54***
	(5.884)	(12.32)	(12.47)	(13.81)
Observations	91	91	91	91
Adj. R-squared	0.001	0.256	0.241	0.269

Trust and Sympathy are centered around the mean
Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$,

Table B4
Average Sympathy and Trust in both phases for all treatments

	Sympathy		Trust	
	1	2	1	2
HOHO	4.48	4.56	3.54	3.69
PRPR	4.61	4.48	3.36	3.61
PRHO	4.88	4.63	3.88	3.88
HOPR	4.71	4.69	3.50	4.17
HOHO-endo	4.41	4.39	3.18	3.41
PRPR-endo	4.78	4.67	4.00	4.11

Table B5
The potential role of selection effects due to Dropouts

	Groups in Phase 2			Dropouts after Phase 1		
	N (Groups)	Mean Ability	Performance Phase 1	N (Groups)	Mean Ability	Performance Phase 1
Whole Sample	122	18.73	106.12	34	19.21	91.12
HOHO	24	17.98	92.35	12	22.17	93.83
PRPR	22	16.5	111.05	4	19.75	89.5
PRHO	24	18.25	109.08	6	14.67	105.5
HOPR	21	17.71	112.67	3	29.33	98.33
HOHO-endo	22	14.61	88.82	8	14.63	78.25
PRPR-endo	9	18.22	117.50	1	15	60

To further test for potential effects of selection through dropping out, we conducted a Heckman 2SLS regression with robust standard errors and included the difference in age between team members as an additional new variable in the selection model (Table B6). Age diversity can influence dynamics such as collaboration, motivation, and continuity, which in turn impacts both team performance and individuals' preferences for team engagement. These effects can arise if different age groups bring distinct perspectives, work styles, and expectations, which can affect cohesion and the overall working atmosphere (e.g. Wegge and Schmidt, 2009; Wegge et al., 2012). In this context, age difference might serve as a predictor of participants' willingness to continue in a team-based experimental setup. Research suggests that greater age diversity can sometimes lead to friction or differences in communication and decision-making preferences, potentially making collaboration less appealing or more challenging for team members (Paoletti et al., 2020). Consequently, age difference could affect participants' initial selection or dropout decisions. This is descriptively found in our study, using Mann-Whitney U-Tests comparing the dropouts with the final sample as indicated above. The Heckman 2SLS model shows that the treatment effects are robust. Besides, evidence for a selection bias cannot be found (insignificant inverse Mills ratio).

Table B6
Heckman 2SLS selection model

VARIABLES	Qualitative Performance Phase 2	Prob. Participation in Phase 2
Treatment		
(Base: HOHO)		
PRPR	51.28***	0.617
	(16.08)	(0.381)
PRHO	48.61***	0.449
	(15.12)	(0.352)
HOPR	55.73***	0.741*
	(17.85)	(0.407)
Average Ability	0.781	-0.00924
	(0.671)	(0.0191)
Qualitative Performance in Phase 1	0.925***	0.00243
	(0.132)	(0.00361)
Sympathy	0.873	0.571
	(10.49)	(0.26045)
Trust	5.121	-0.12608
	(6.411)	(0.20986)
Difference in Ability	0.583*	-0.001
	(0.336)	(0.0099)
Gender composition		
(Base: Two Males)		

(*continued on next page*)

Table B6 (*continued*)

VARIABLES	Qualitative Performance Phase 2	Prob. Participation in Phase 2
Mixed	-6.088	0.411
	(9.776)	(0.300)
Two Females	-3.938	0.243
	(13.10)	(0.4139)
Difference in Age		-0.0659**
		(0.0324)
Lambda	37.7660	
	(40.5390)	
Constant	-29.62	0.625
	(28.52)	(0.444)
Observations	91	116

Trust and Sympathy are centered around the mean
Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B7
Multivariate OLS regression analysis of several variables and interaction effects on the qualitative creative performance of the second phase of the exogenous treatments

VARIABLES	Model 1	Model 2	Model 3
Treatment (Base: HOHO)			
PRPR	38.97***	40.65***	65.06***
	(14.22)	(14.10)	(17.37)
PRHO	35.99***	36.59***	86.49***
	(11.67)	(11.93)	(17.75)
HOPR	43.88***	45.54***	74.05***
	(11.42)	(11.04)	(14.29)
Average Ability	0.963	0.978	1.630***
	(0.590)	(0.604)	(0.556)
Qualitative Performance in Phase 1	0.979***	0.939***	0.799***
	(0.127)	(0.134)	(0.140)
Sympathy	-28.25		
	(17.60)		
PRPR x Sympathy	24.69		
	(22.30)		
PRHO x Sympathy	62.92***		
	(22.76)		
HOPR x Sympathy	52.19**		
	(25.83)		
Trust		5.181	
		(13.33)	
PRPR x Trust		3.888	
		(19.91)	
PRHO x Trust		3.089	
		(18.37)	
HOPR x Trust		-1.505	
		(14.59)	
Gender composition (Base: Two Males)			
Mixed			23.03*
			(12.08)
Two Females			47.95*
			(24.29)
PRPR x Mixed			-17.03
			(23.42)
PRPR x Two Females			-62.13
			(50.67)
PRHO x Mixed			-67.21***
			(21.03)
PRHO x Two Females			-76.15*
			(44.39)
HOPR x Mixed			-16.43
			(26.00)
HOPR x Two Females			-61.29**
			(26.37)

(*continued on next page*)

Table B7 (*continued*)

VARIABLES	Model 1	Model 2	Model 3
Constant	-12.13	-7.639	-30.05*
	(14.40)	(15.24)	(17.20)
Observations	91	91	91
Adj. R-squared	0.618	0.597	0.612

Trust and Sympathy centered around the mean
Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B8
The different measures of creativity and treatments effects of the exogeneous treatments

VARIABLES	Quantity (OLS)	Quality (OLS)	Rare (Poisson)	Very Rare (Poisson)	Flexibility (Poisson)
Treatment *(Base: HOHO)*					
PRPR	4.489	43.18***	0.175	0.393***	0.0104
	(6.138)	(13.78)	(0.166)	(0.129)	(0.0459)
PRHO	2.991	41.15***	0.0710	0.361***	0.000285
	(5.315)	(11.89)	(0.153)	(0.118)	(0.0529)
HOPR	4.489	45.24***	0.0270	0.406***	0.0374
	(6.138)	(11.59)	(0.159)	(0.109)	(0.0434)
Average Ability	1.094**	0.916	0.0189***	0.00492	0.00164
	(0.517)	(0.632)	(0.00716)	(0.00533)	(0.00251)
Qualitative Performance in Phase 1	0.816***	0.887***	0.00381***	0.00710***	0.00283***
	(0.106)	(0.139)	(0.00126)	(0.000922)	(0.000441)
Sympathy	-0.482	-0.679	-0.157	-0.0488	0.0101
	(5.208)	(10.16)	(0.169)	(0.0941)	(0.0385)
Trust	3.515	5.041	0.0712	0.0709	0.00952
	(3.134)	(5.488)	(0.142)	(0.0579)	(0.0252)
Difference in Ability	0.105	0.593*	0.00243	0.00398	0.000675
	(0.176)	(0.340)	(0.00413)	(0.00279)	(0.00119)
Gender composition (Base: Two Males)					
Mixed	-2.728	-6.950	-0.00934	-0.0867	0.0300
	(4.980)	(10.25)	(0.129)	(0.0851)	(0.0406)
Two Females	2.437	-4.731	0.182	-0.0271	0.0216
	(8.037)	(16.78)	(0.162)	(0.153)	(0.0633)
Constant	4.065	-8.410	0.693***	1.807***	3.486***
	(8.492)	(18.84)	(0.213)	(0.148)	(0.0668)
Observations	91	91	91	91	91

Notes: Trust and Sympathy are centered around the mean. Robust standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
The second column shows for reasons of comparison again the model of Table 7 regarding qualitative performance, which consists of rare and very rare answers and the measure of flexibility.
Quantity and Quality show results of OLS regression with robust standard errors whereas Rare, Very Rare and Flexibility show Poisson-regression.

Appendix – C

Questionnaire – Phase 1
Which gender do you feel you belong to?
M/W/D/N.D.
How old are you?
What is your highest educational qualification?
Technical university entrance qualification/general higher education entrance qualification/ apprenticeship/Bachelor/Master
What is your nationality?
EU /Non-EU
Which field of study are you studying/ In which professional field are you working?
Please indicate the extent to which you agree with the statements below regarding teamwork:
Scale:

5 (Strongly agree)
4 (Agree a little)
3 (neutral)

2 (Disagree a little)
1 (Strongly disagree)

My other team member is sympathetic.
I knew the other team member before the experiment.
I would lend my other team member personal items of mine.
I would lend money to my other team member.
I would trust my other team member with my apartment keys.
I trust my team member.
Questionnaire – Phase 2
Please indicate the extent to which you agree with the statements below regarding teamwork:
Scale:

5 (Strongly agree)
4 (Agree a little)
3 (neutral)
2 (Disagree a little)
1 (Strongly disagree)

My other team member is sympathetic.
I would lend my other team member personal items of mine.
I would lend money to my other team member.
I would trust my other team member with my apartment keys.
I trust my team member.
Below you will find a number of characteristics that might apply to you. For example, would you say about yourself that you enjoy spending time with other people? For each of the following statements, please indicate the extent to which you agree.

Scale: 5 (Strongly agree)
4 (Agree a little)
3 (neutral)
2 (Disagree a little)
1 (Strongly disagree)

I am someone who tends to be quiet.
I am someone who is compassionate, has a soft heart.
I am someone who tends to be disorganized.
I am someone who worries a lot.
I am someone who is fascinated by art, music, or literature.
I am someone who is dominant, acts as a leader.
I am someone who is sometimes rude to others.
I am someone who has difficulty getting started on tasks.
I am someone who tends to feel depressed, blue.
I am someone who has little interest in abstract ideas.
I am someone who is full of energy.
I am someone who assumes the best about people.
I am someone who is reliable, can always be counted on.
I am someone who is emotionally stable, not easily upset.
I am someone who is original, comes up with new ideas.
Do you already have experience with mobile working?
Yes/No
Are you currently in an employment relationship?
Yes/No/Self-employed
If yes or self-employed: In which form of work do you work?
I am satisfied with my place of work where I conducted the experiment.
Scale: 5 (Strongly agree)

4 (Agree a little)
3 (neutral)
2 (Disagree a little)
1 (Strongly disagree)

I prefer mobile working to working in presence.
I prefer to work in a team rather than alone.
I enjoyed the task.
I found the task to be exhausting to work on.

Data availability

Data will be made available on request.

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