

# CREATIVE AGAINST THE PANDEMIC: MEASURING CREATIVITY IN RURAL INDIA\*

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## Abstract

Defining metrics for assessing soft skills has long been an unresolved issue for social scientists. We develop a new methodology to study and measure a specific soft skill, creativity, by combining mixed-method data collections with statistical analysis. We draw close-ended questions on creativity from the management literature. We also design a novel set of open-ended questions on creativity. We administer both sets of questions to 137 Indian women in December 2020. After using qualitative coding methods to score each woman's creativity, we cross-validate the two sets of questions and find positive correlation. We then apply this methodology to study how the pandemic has affected creativity. We find that women's creativity increased during the Covid-19 pandemic, and that increases in creativity are associated with better ex-ante social connectedness. Our approach of combining quantitative questions with coded qualitative interviews can be adapted to design survey modules to measure other soft skills.

**Keywords:** *Creativity; Soft Skills, Mixed-methods; Pandemics; Social Connectedness; India*

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# 1 Introduction

Individual creativity, defined as the “production of novel, appropriate ideas in any realm of human activity, from science, to the arts, to education, to business [...]” (Amabile, 1997) is a key element of innovation (Amabile, 1988) and economic growth (Howitt and Aghion, 1998). High levels of creativity positively affect economic development by boosting entrepreneurship and firms’ creation (Lee et al., 2004). Conversely, a loss of creativity may severely hit people’s entrepreneurial and innovation skills and hence generate persistent negative effects on economic growth (Florida, 2003). In low-income countries, which are characterised by very high rates of self-employment (Gindling and Newhouse, 2014; Jayachandran, 2020), low levels of creativity may have even more dramatic effects on people’s livelihoods and on the overall economy. Thus, shocks that impact individual creativity might have paramount long-lasting effects on economic growth.

Understanding the effects of changes in creativity on economic growth requires to measure such skill in the first place. However, creativity, as other “soft” skills, is a very complex individual trait, and hence it is difficult to identify only through standard close-ended survey questions (Heckman and Kautz, 2012; Kautz et al., 2014). Moreover, in contrast with other psychological constructs (e.g., women’s agency, Jayachandran et al., 2021), there is no “gold standard” measure of creativity. In the economics literature, scholars have often used measures like patents and copyrights to identify the level of creativity of a firm or a country as a whole (Moser, 2013; Giorcelli and Moser, 2020). The psychology and organizational literature have instead focused on creative tasks (e.g., artistic work) or measures of performance in the workplace to assess individuals’ levels of creativity (Amabile, 1985; Amabile, 1997). All these measures have the advantage of relying on observable products of creativity. However, in low-income contexts, lack of data on firm innovation and on work practices makes it harder for social scientists to collect tangible measures of creativity.

To overcome this challenging task, we develop a new measurement protocol based on a mixed-method approach. Specifically, we employ qualitative, open-ended questions in conjunction with quantitative, close-ended questions on creativity. We administered both sets of questions through phone surveys to a sample of 137 women in rural Chhattisgarh, India, in December 2020. After developing qualitative coding methods to construct a series of binary measures of creativity based on the qualitative questions, we conduct a number of tests to assess the validity of the creativity measures derived through both the quantitative and qualitative method (DeVon et al., 2007; Bonilla et al., 2017; Jayachandran et al., 2021).

We find that creativity measured through open-ended and close-ended questions are highly correlated along the creative problem-solving dimension. This result indicates that there is

correspondence between the two methods. We then apply this methodology to study how the creativity of our study sample has been affected by the Covid-19 pandemic. We find that, during the pandemic, creativity has increased by any metric. We also find that the quality of women’s social connectedness at the onset of the pandemic is one of the most predictive factors of this increase in creativity measured through close-ended questions. At the same time, negative shocks to the spouse’s job are highly predictive of women’s creativity measured through open-ended questions.

Our *quantitative approach* to assess individual creativity heavily draws on the management and innovation literature (Carmeli and Schaubroeck, 2007). We employ a creative self-efficacy protocol consisting of six questions that focus on different dimensions of creativity: goal orientation; creative endeavour; overcoming challenges; creative multitasking; creative self-perception; and creative resilience. We administer these close-ended questions to a sample of 137 women living in the Mahasamund district in the Indian state of Chhattisgarh. Answers to these questions are available for 110 women in our sample. Validity checks, performed through correlations, indicate that these quantitative measures of creativity are internally robust.

Our *qualitative approach* consists of a newly-designed set of open-ended questions inspired by qualitative-methods studies developed by Parnes (1967) and Osborn (1953). Building on their methodology, we develop four situational questions to measure women’s creativity in different contexts: when meeting with other people, when engaging in productive activities with other people, when accessing technologies, when engaging in individual production. Answers to these questions are available for 77 women in our sample. After transcribing the records of the situational questions, we asked a research analyst specialized in qualitative psychology research to define creativity in our sample. The analyst referred to Parnes (1967) and Osborn (1953)’s themes and codes to assess creativity. Then, they used qualitative coding methods to construct binary measures of creativity (“scores”) based on women’s answers to these situational questions. These scores allow us to “quantify” our qualitative measures, to ensure they are internally consistent, and to compare them with quantitative measures of creativity. Finally, we cross-validate our qualitative and quantitative measures, and find that the qualitative measures of creativity are highly correlated with the “goal orientation” (quantitative) dimension of creative self-efficacy. This result is driven by the qualitative codes identifying respondents’ ability to produce alternative ideas, attitude to problem solving, and persistence.

Apart from the robustness of our methodological approach, one may wonder how these two methods should be applied “in practice”. As resources and time to implement field data collection are limited, should researchers just administer one of the two protocols, and

which one – the qualitative or the quantitative? Or, on the contrary, should both modules be administered to gather a comprehensive understanding of one’s creativity? To answer these questions, we apply our method to study how women’s creativity changed during the pandemic. The analysis reveals two important results. First, by comparing measures of women’s creativity before and during the pandemic, we observe that women’s creativity has increased, and this increase is consistent across different dimensions of creativity we elicited (i.e., goal orientation; resilience; creative endeavor, among others). Creativity increased despite evidence that women’s income, mental health and the quality of their social relationships, which we use as a proxy for social connectedness, decreased during the pandemic (a result in line with [Bertrand et al., 2020](#); [Egger et al., 2021](#); [Bau et al., 2021](#), among others).

To cast additional light on the seemingly contradictory result that creativity increased during the pandemic despite the overall worsening of socio-economic conditions, we explore whether underlying heterogeneities exist in terms of women’s creative response to the pandemic. We focus in particular on the extent of social isolation and economic hardship they underwent during the lockdown. Women who, at the start of the pandemic, reported higher quality of communication within their social networks (i.e., within the Self-Help Group (SHG) they belong to) experienced during the pandemic a significant increase in their level of creativity measured through close-ended questions. This result speaks to the importance of social networks and peer support for creative behavior. We also find that economic hardship (i.e., the negative impact of the pandemic on the husband’s job) is positively correlated with qualitative creativity.

Taken together, our findings indicate that the qualitative and the quantitative method provide complementary insights and, as such, they should be both used by social scientists interested in collecting information on creativity and, more broadly, soft skills. A simple back-of-the-envelope calculation reveals that implementing both methods is also time- and cost-effective: the average time employed to administer both sets of questions was approximately 15 minutes – as a comparison, it took our surveyors about 20 minutes to complete the income and occupation survey section. In terms of costs, we spent approximately 10% of our survey budget for the creativity section (quantitative plus qualitative) – this share raises to just above 60% when we include qualitative researchers’ salary.<sup>1</sup> Potentially, these costs can further decrease in the future by leveraging machine learning algorithms to rate the qualitative questions.

***Related Literature*** The primary contribution of this paper is methodological: we introduce a mixed-methods approach to measure creativity, a soft skill that while being a

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<sup>1</sup>We were advised to hire more than one qualitative analyst to cross-validate the qualitative framework. We provide more details in the Appendix. If we were to further replicate this study, costs would only include salary for one research analyst as we would not need to further validate our framework.

very important factor for economic growth is also hard to measure (Heckman and Kautz, 2012; Giorcelli and Moser, 2020; Amabile, 1985; Amabile, 1997). By introducing and testing this method, our paper adds to the literature that studies the role of soft, non-cognitive skills in predicting a number of outcomes like education achievement (Kautz et al., 2014; Carneiro et al., 2007); job market (Bassi and Nansamba, 2021; Adhvaryu et al., 2018) and firm performance (Sharma and Tarp, 2018). Given the additional insights gathered from the qualitative methods, our approach allows researchers to achieve a deeper understanding of what drives creativity, and to formulate policy recommendations on how to enhance creativity. One caveat here is that our questions were tailored for Indian women belonging to SHGs. One direction for future research is to expand the study elsewhere and to make the questions appropriate for other contexts – e.g., for women who are not part of economic collectives.

Our study also contributes to the literature that studies creativity and its role in economic growth and development. Specifically, our paper contributes to the burgeoning literature on the consequences of the pandemic on workplace performance (e.g., Bloom et al., 2020; Cirera et al., 2021). Our measure of creativity combines qualitative assessment of one’s creativity with quantitative questions that can be adopted in a number of contexts (high and low-income countries) and adapted to different types of data collection (in-person or phone surveys). Our results point to a positive effect of the pandemic on individual creativity, mediated by the role of social connectedness. Our results can be extended to other broad economic shocks that may affect social interactions (e.g., natural disasters), and speak to the importance of strong social ties to help individuals maintain their creativity.

The remainder of the paper is organized as follows. Section 2 describes the data and the measurement of creativity. Section 3 applies the methodology to analyse how the pandemic affected creativity and its drivers. Section 4 concludes and discusses future research.

## 2 Methods and Data

### 2.1 A novel set of questions to measure creativity

Our intent to measure women’s creativity through *quantitative* and *qualitative* questions is both motivated by the complexity of comprehensively assessing one’s creative effort (see Batey, 2012 for a review), and by the unavailability of standard measures of creativity such as patents (Moser, 2013) or work of art (Amabile, 1985) in rural India.

The quantitative questions are drawn from the Carmeli and Schaubroeck (2007)’s protocol of creative self-efficacy: the protocol consists of six Likert-scale questions that measure several aspects of one’s creativity, ranging from goal orientation to creative multitasking to creative

resilience (more details on the close-ended questions are in Appendix A). Our qualitative approach is inspired by Osborn (1953) and Parnes (1967)'s creative problem-solving process. Specifically, women were presented with hypothetical, problematic scenarios and were asked to discuss a solution to different situations (see Appendix B for details on the qualitative, open-ended questions).

Both the quantitative and qualitative questions were designed and administered via phone in partnership with Inclusion Economics India (IEIN) Centre. They were included in a broader survey we used to identify changes in women's behavior during the first wave of the Covid-19 pandemic in India in April 2020. The survey also contained questions on women's socio-economic background, economic activities, psychological well-being, and social connectedness, among others. We administered three waves of this survey via phone. Wave 1 and Wave 2 were administered in May and September 2020, respectively. Wave 3 was administered in December 2020 and included the quantitative and qualitative survey components on creativity.

## 2.2 Study Sample

Our sample consists of 137 women across 84 villages in the Mahasamund district of the Indian State of Chhattisgarh. We gathered respondents' phone numbers from administrative records held by the Chhattisgarhi State Rural Livelihood Mission (CGSRLM). CGSRLM is part of the Indian National Rural Livelihood Mission (NRLM), a poverty alleviation project implemented by the Ministry of Rural Development, Government of India. The programme promotes the creation of SHGs among poor women, and facilitates women's access to loans and savings (Hoffmann et al., 2021). Hence, all women in our sample are members of SHGs.

According to CGSRLM records, there were about 5,350 SHGs in the district of Mahasamund as of 2020. However, for the majority of the members of these groups, phone numbers are not up to date, making it impossible to reach them.<sup>2</sup> From the list of SHGs in the Mahasamund district that was provided by CGSRLM, we were able to connect with 212 women only. Of these, we succeeded in completing 137 surveys in Wave 1. We were able to reach 125 respondents of these 137 in Wave 2. Finally, we reached 116 respondents in Wave 3. Records of the open-ended questions on creativity, which we collected in Wave 3, were available for 77 out of 116 women.<sup>3</sup>

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<sup>2</sup>Due to travel restrictions during the pandemic, we could not validate these phone numbers in person.

<sup>3</sup>The main reason for attrition across survey waves was the impossibility to successfully reach out to women (either because they were repeatedly unavailable after several attempts to call them, or because their phone never connected after a similar number of attempts). The lower number of records of the open-ended questions on creativity (77 vs. 116 women reached out) relates to bad audio quality of the phone calls, resulting in the impossibility for the qualitative analyst to analyse the scripts. Protocol details on how phone calls were administered, on the number of attempts before a respondent was classified as unavailable can be shared upon request.

## 2.3 Quantitative Measures of Creativity

Our quantitative measures of creativity build on Carmeli and Schaubroeck (2007)’s protocol for assessing creative self-efficacy. In line with other work on creative behavior (Tierney and Farmer, 2002; Reiter-Palmon et al., 2012), Carmeli and Schaubroeck (2007)’s approach focuses on the role of self-expectations for creativity. We follow their creative self-efficacy protocol and include Likert-scale questions to assess women’s goal orientation; creative endeavor; ability to overcome challenges; creative multitasking; creative self-perception; and creative resilience. Answers were ranked from 1 (strongly disagree) to 5 (strongly agree). These questions were administered in Wave 3 of the survey (we refer to these questions as “*during the pandemic*”). To assess respondents’ creativity before the start of the pandemic, we asked the same questions retrospectively (“*before the pandemic*”, henceforth).<sup>4</sup>

## 2.4 Qualitative Measures of Creativity

One caveat to Carmeli and Schaubroeck (2007)’s approach, as they themselves point out, is that self-assessed measures of creativity from close-ended questions might be biased by the characteristics of the respondent’s reference group or by the social norms individuals are exposed to.<sup>5</sup> To alleviate concerns about the robustness of creative self-efficacy, we develop a new protocol to measure creativity using qualitative methods. In particular, we asked women four open-ended, situational questions (i.e., hypothetical questions where respondents were asked to put themselves in a hypothetical situation and explain what action they would take) to assess women’s creative problem-solving ability. We asked them their views about four different challenging situations : i) setting up a Self-Help Group meeting (“**SHG meeting**” question); ii) setting up a Self-Help group related production activity (“**SHG production**”); iii) having a smartphone (“**Technology**”); iv) engaging in an individual production activity (“**Individual Production**”). As with the close-ended questions, we administered these situational questions in Wave 3 of the survey.

After transcribing the phone records from the local language (Chhattisghari) to Hindi, we hired a Hindi-speaking qualitative data analyst who developed and assigned themes and codes to responses as it is standard practice in qualitative research.<sup>6</sup>

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<sup>4</sup>To further complement our survey data on women’s creativity, we also administered a module on self-initiative following Frese and Fay (2001)’s protocol. Self reported initiative consists of questions on problem solving attitude, solution finding, active involvement, taking initiative, being resourceful, realising ideas and doing more than asked.

<sup>5</sup>This is referred to as reference bias; also mentioned in Kautz et al. (2014).

<sup>6</sup>Following the advice of several qualitative researchers, we initially hired two data analysts who looked at the scripts independently and formulated their recommendations on which qualitative framework was most suited to our data. Since they both recommended the same framework, we felt comfortable to continue with only one research analyst to complete the work.

Qualitative coding involves a process of systematically categorizing excerpts of qualitative data, such as transcripts, in order to find themes and patterns for analysis. Three types of qualitative coding processes are typically used for analysis (e.g., [Bryman, 2016](#); [Creswell and Poth, 2016](#)): deductive coding (or top-down coding); inductive coding (or bottom-up coding); or a combination of the two.<sup>7</sup> Our qualitative analyst used a combination of deductive and inductive coding: the qualitative analysis begins with a deductive coding by developing a codebook adapting the [Osborn \(1953\)](#) and [Parnes \(1967\)](#) creative problem-solving process.<sup>8</sup> On the one hand, the deductive coding facilitates future replication and reliability testing of this method ([Roberts et al., 2019](#)). On the other hand, the inductive coding allows for any “unexpected” themes – especially related to respondents’ social contexts and questions formulation – to develop during the coding process.

For deductive coding, the qualitative analyst established a coding framework that breaks creative problem-solving attitude into six themes: objective finding, fact finding, problem finding, idea finding, solution finding and acceptance finding. Within each of these six themes, 16 codes were identified. The correspondence between themes and codes is illustrated in [Figure 1](#). Codes were created under each theme separately (see [Appendix C](#) for a detailed explanation of themes and codes). This helped to measure women’s creativity in a variety of social contexts, including at home and at work. Codes include knowledge; ability to understand the problem; promptness in ideas; alternative and innovative ideas etc. Additional codes like leadership, reliance on social networks like SHG or family and friends etc. were created following the inductive coding process.

## 2.5 “Quantifying” respondents’ answers to qualitative questions of creativity

A key challenge we face in our study is to ensure the quantitative and qualitative measures of creativity are comparable to each other. Doing so requires “quantifying” qualitative questions, in order to perform internal validity checks and statistical analysis. Building on the qualitative framework discussed earlier (and graphically represented in [Figure 1](#)), our research analyst created and assigned a binary variable (“qualitative score”) to each of the codes that they identified. This variable takes the value of one if the respondent’s answer to each qualitative question allows for a specific code to be detected, and zero otherwise. For example, if a woman’s answer to one of the qualitative questions shows evidence of *understanding the*

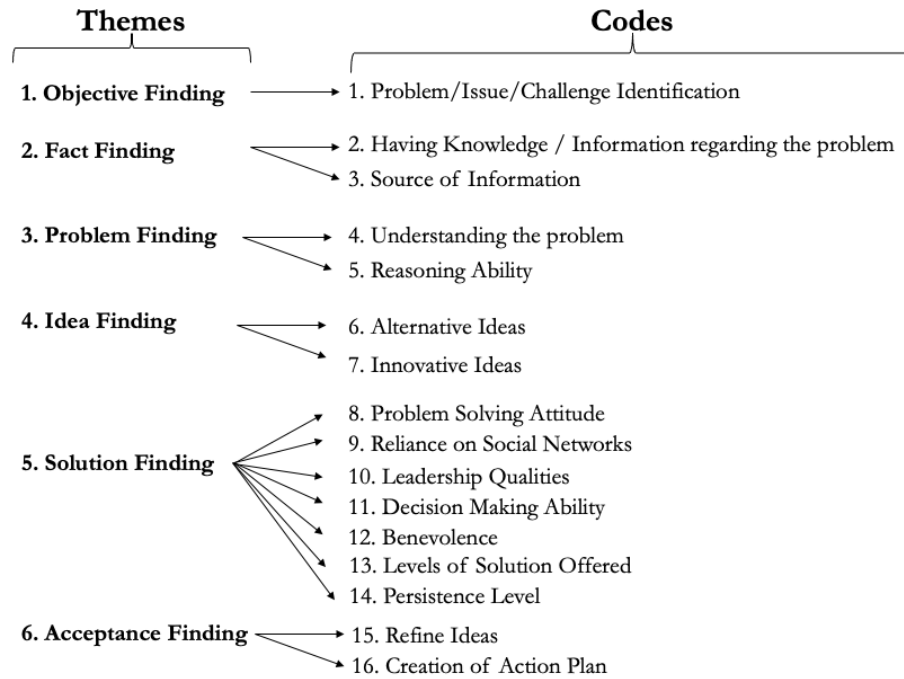
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<sup>7</sup>Please refer to [Appendix C](#) for a discussion on deductive and inductive coding.

<sup>8</sup>Both qualitative analysts after reviewing the [Guilford \(1967\)](#), [Osborn \(1953\)](#) and [Parnes \(1967\)](#), and [Amabile and Hennessey \(1999\)](#), found the [Osborn \(1953\)](#) and [Parnes \(1967\)](#) model to be the most appropriate for the present study.



Figure 1: Framework to Analyse Qualitative Questions



Note: This figure illustrates the six themes and the sixteen codes that were identified by the analyst in the qualitative data obtained from the transcripts.

*problem* (code n. 4, as shown in Figure 1), the quantitative score for that specific code takes the value of 1. This process was applied to all the 16 codes of each of the four qualitative questions.

To better understand how scores were assigned, we provide two examples of transcripts that the research analyst classified as high and low in terms of creativity, respectively. In one of the situational questions (“**SHG meeting**”), we asked women the following:

*“You have a Self-Help Group meeting today evening and you have recently given birth to a small child. Usually, when these SHG meetings happen, your mother in law takes care of the baby but today your mother-in-law is sick. And your husband is at work/not at home. What would you do?”*

1. **High creativity answer:** *“I will call the [SHG] Secretary and Chairman and say, this is the situation [...] We may be connected by mobile too, if meeting will be held [...] Otherwise I’ll call them at my home requesting them... I can’t come to you people, but you can come down to my place, can’t you...”*

2. **Low creativity answer:** *“Okay, so how can I go then? I will not go.”*

In the first case, the respondent’s answer shows willingness to find a solution to the hypothetical problem they were presented with. Accordingly, the overall score of the respondent from the qualitative question was one, indicating that the woman showed creativity across all the codes described in Figure 1. In the second case, the overall score of the respondent for the same question was 0.363, indicating a significantly lower creativity level.

To perform the statistical analysis, we first removed all the codes that had little to no variation across respondents. Then, we aggregated the codes into a unique score. Finally, we normalized each score. We finally constructed the total score of creativity by taking the unweighted average of the four scores for each respondent.

## 2.6 Summary Statistics and Validation of Creativity Measures

We first present summary statistics for our respondents’ characteristics. We then present internal validity checks for the quantitative and qualitative measures of creativity. We then discuss the statistical correspondence of the two approaches by describing the extent to which quantitative and qualitative measures correlate with each other.

Table 1 reports summary statistics for the main socio-demographic characteristics of our sample. This information (Panel A of table 1), together with the characteristics of the SHG respondents belong to (Panel B), were collected in Wave 1 of the survey. Panel C presents summary statistics of creative self-efficacy measures that were elicited in Wave 3 with respect to the pre-pandemic period.

As shown in Panel A of table 1, women in our sample are 32 years old on average and are reasonably educated. Average monthly household income is 11,546 INR (approx. 150 USD) which, with an average household size of 6 members, puts our respondents slightly below the income poverty line. 44% of the respondents owned a smartphone at the onset of the pandemic.<sup>9</sup>

Our survey also included questions to measure women’s wellbeing which, together with socio-economic status, may be predictive of one’s creativity. For this, the K6 protocol (Kessler et al., 2002) was administered to gather self-reported measures of depressive symptoms experienced over the 30 days preceding the interview. These included feelings of nervousness, restlessness, depressed mood, hopelessness, worthlessness, and decreased initiation. The six-items standard protocol asks about how often (in days) these feelings have been experienced, rated on a five-point Likert scale from (0) “none” to (4) “all”. This, summed up, gives the final score of (non-specific) psychological distress ranging from 0 (lowest psychological distress) to

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<sup>9</sup>We first asked women which phone they picked up our calls with to measure type of phone use. Approximately 70% of women reported using a smartphone. We then asked women whether they were the sole owner of that phone or this was a shared phone or whether it was their husband’s.

Table 1: Summary statistics - before the pandemic

Variable	Mean	sd	p50	Min	Max	N
<i>A: Socio-economic Status and Wellbeing</i>						
Age	31.81	7.31	31	20	55	137
Grade completed	9.54	2.75	10	0	16	137
Family size	6.09	3.09	5	1	17	137
Income	11546	12788	8000	0	75000	130
Smartphone Ownership	.44	.49	0	0	1	137
K6 Depression	1.50	2.33	0	0	9	137
<i>B: SHG characteristics</i>						
Pool resources	.27	.44	0	0	1	137
No. SHG members	11.80	1.405	12	10	15	137
Smartphone ownership (%)	17.26	18.70	13.33	0	100	136
SHG produces	0.19	0.39	0	0	1	137
Young SHG	0.56	0.493	1	0	1	137
Social connectedness	2.88	0.35	3	1	3	136
<i>C: Creative self-efficacy</i>						
Goal Orientation	4.37	1.16	5	1	5	109
Creative Endeavour	4.3	1.21	5	1	5	110
Overcome challenges	4.42	1.05	5	1	5	109
Multitask creatively	4.27	1.32	5	1	5	110
Creative self perception	4.25	1.25	5	1	5	110
Creativity resilience	4.33	1.20	5	1	5	110

Note: This table presents summary statistics of the main variables collected during the study. Panel A presents summary statistics for main socio-economic and wellbeing indicators. Panel B presents summary statistics for the characteristics of the Self-Help Groups respondents belong to. Panel C presents summary statistics for creative self-efficacy components. All the variable refer to the pre-pandemic period.

24 (highest psychological distress). The inclusion of measures of mental health is motivated by the widespread qualitative and quantitative evidence (Das et al., 2009; Maitra et al., 2015) that women in low-income countries often face emotional difficulties. This, in turn, may have depressing effects on their creativity and ability to innovate. On average, women entered the pandemic with very low levels of depression: they reported an average score of depressive symptoms of 1.5 on a scale from 0 to 16.

Panel B of table 1 presents summary statistics for the SHG women belong to. These SHGs consist, on average, of 12 members and are relatively young groups: almost 60% of our

respondents report their SHG to have been formed within 18 months from the interview. On average, a bit less than one third of women in our sample pooled resources together before the start of the pandemic. On average, 17% of group members in each SHG own a smartphone, indicating a relatively low penetration of smartphones. Despite being part of young groups, women in our sample report a fairly high degree of social connectedness, measured in terms of the quality of communications among SHG members – on a scale from 1 to 3, where 3 is the highest score for quality of communication within the SHG, the average score women reported was 2.9.<sup>10</sup>

Panel C provides summary statistics for respondents’ creative self-efficacy before the the pandemic, which we measure through the Carmeli and Schaubroeck (2007)’s protocol and which varies from 1 (very low creativity) to 5 (very high creativity). The smaller sample size relates to the fact that these questions were asked in Wave 3, in which we managed to reach out to only 116 respondents. On average, women in our sample reported a score above 4 for all dimensions of creative self-efficacy, highlighting very high levels of creative self-efficacy at the onset of the pandemic; half of the sample reported a score of 5.<sup>11</sup>

## 2.7 Internal Validity of Quantitative Measures of Creativity

As a first step in our analysis to validate our measures of creativity, we carry out internal validity checks for the quantitative measures of creative self-efficacy we derived using the Carmeli and Schaubroeck, 2007’s protocol. Table 2 presents simple correlations across all the components of creative self-efficacy, before the pandemic (Panel A); during the pandemic (Panel B); in terms of percentage changes in creativity across the two periods (Panel C).<sup>12</sup>

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<sup>10</sup>Women were asked the following question: *On a scale from 1 to 3, where 1 means low understanding and 3 very high understanding, how well do you think your SHG stands in terms of clear communication and understanding amongst all its members pre-lockdown?*

<sup>11</sup>We only report statistics from creative self-efficacy in the pre-pandemic period as the binary measures of creativity based on qualitative interviews only refer to the pandemic period.

<sup>12</sup>Each component ranges from 1 to 5.

Table 2: Correlation between components of creative self-efficacy

Variable	Goal Orientation	Creative Endeavour	Overcoming Challenges	Creative Multitasking	Creative Self-perception	Creative Resilience
<i>A: Before the pandemic</i>						
Goal Orientation	1					
Creative Endeavour	0.152	1				
Overcoming Challenges	0.329***	0.451***	1			
Creative Multitasking	0.0511	0.273**	0.359***	1		
Creative Self perception	0.119	0.147	0.280**	0.337***	1	
Creative Resilience	0.149	0.475***	0.455***	0.220*	0.201*	1
<i>B: During the pandemic</i>						
Goal Orientation	1					
Creative Endeavour	0.684***	1				
Overcoming Challenges	0.629***	0.743***	1			
Creative Multitasking	0.577***	0.653***	0.636***	1		
Creative Self perception	0.392***	0.447***	0.453***	0.651***	1	
Creative Resilience	0.587***	0.742***	0.680***	0.581***	0.464***	1
<i>C: Changes</i>						
Goal Orientation	1					
Creative Endeavour	0.578***	1				
Overcoming Challenges	0.584***	0.747***	1			
Creative Multitasking	0.555***	0.779***	0.812***	1		
Creative Self perception	0.578***	0.670***	0.600***	0.759***	1	
Creative Resilience	0.485***	0.745***	0.650***	0.688***	0.571***	1

Note: The table provides correlations between the components of creative self-efficacy before the pandemic (Panel A); during the pandemic (Panel B) and in terms of changes across the two periods (Panel C). \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level respectively.

Almost all the components of the quantitative measure of creativity are positively correlated with each other, in both periods, and even more significantly in terms of changes, as shown in panel C. This indicates that our quantitative measures of individual creativity are internally very robust.

## 2.8 Internal Validity of Qualitative Measures of Creativity

Table 3 shows summary statistics of each measure of creativity. Both the mean and the median values indicate that women’s creativity measured through qualitative questions was quite high, a result that is in line with the quantitative measures of creativity shown in table 2.

Table 3: Summary statistics of qualitative scores

Variable	Mean	sd	p50	Min	Max	N
<i>Qualitative Measures of Creativity (quantified)</i>						
Total Score of Creativity	0.620	0.136	0.644	0.341	0.977	76
SHG meeting	0.533	0.254	0.545	0	1	75
SHG production	0.634	0.216	0.667	0.111	1	76
Technology	0.732	0.224	0.778	0	1	75
Individual Production	0.623	0.206	0	1	0.625	75

Note: This table presents the summary statistics of the normalised scores of the qualitative creativity measures component, as well as for the total score.

Table 4 shows the correlations we performed to assess the internal validity of the scores we assigned to the qualitative measures of creativity. All scores are positively correlated with each other (some also significantly). This provides us with a first assurance of the strength of the scores we created. In table 11 of Appendix D we report the correlations between the codes for each of the qualitative questions separately. This allows us to understand which codes are most explanatory of the variation we find in the data and, thus, it provides additional insights about creativity in our sample.

Table 4: Correlation between qualitative scores

	Qual. Total	SHG meeting	SHG production	Technology	Ind. Production
Qual. Total	1				
SHG meeting	0.591***	1			
SHG production	0.644***	0.161	1		
Technology	0.623***	0.0861	0.261**	1	
Ind. Production	0.537***	0.0501	0.152	0.169	1

Note: This table reports the correlations between each of the four qualitative measures as well as their average. \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level respectively.

## 2.9 Cross-Validation of Quantitative and Qualitative Measures of Creativity

After having assessed the internal validity of our quantitative and qualitative measures separately, we turn to the study of how our quantitative measures of creativity (self-efficacy,

Carmeli and Schaubroeck, 2007) correlate with the qualitative measures through the scores we attached to the codes (Osborn, 1952).

We focus on the 77 respondents for whom we have data on both creative self-efficacy and creativity from qualitative questions. Results are presented in table 5. The “goal orientation” component of creative self-efficacy is always positively correlated with the qualitative scores except for the “SHG meeting” component; in particular, it is positively and significantly correlated with the qualitative measure of creativity related to finding a solution to technology-related problems. This result indicates the quantitative self-assessed “goal orientation” measure has the largest explanatory power among the self-reported quantitative creativity measures. At the same time, our qualitative measures are negatively correlated with creative endeavour and overcoming challenges components. However, none of these correlation coefficients is statistically or economically significant.

Table 12 in Appendix D provides additional insights to these findings by showing the correlations between the quantitative measures and each individual code identified from the qualitative questions. For instance, panel C of table 12 shows that the strong positive correlation between goal orientation and creativity in technology is driven by women showing ability in “alternative ideas”, high “problem solving attitude”, and high “persistence levels”.

Table 5: Correlation between qualitative measures of creativity and quantitative measures of creative self efficacy

	(1)	(2)	(3)	(4)	(5)
	Qual. Total	SHG meeting	SHG production	Technology	Ind. Production
Goal Orientation	0.171	-0.0462	0.106	0.313***	0.0503
Creative Endavour	-0.0224	0.0973	-0.0772	-0.0339	0.00295
Overcome Challenges	0.0347	0.0563	-0.103	0.0659	0.0541
Multitask Creatively	-0.0289	-0.0632	0.0187	0.0143	-0.0365
Creative Resilience	-0.0731	-0.153	0.0460	-0.00802	-0.0467
Creative Self Perception	-0.0622	0.00784	-0.209*	0.0462	0.0228

Note: This table reports the correlations between the quantitative measures of creativity (rows) and the qualitative measures of creativity (columns). \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level respectively.

## 2.10 Discussion

Our analysis has so far focused on identifying and validating measures of individual creativity among women living in rural India. Using a mixed-methods approach, we combined quantitative measures of creativity (inspired by the survey protocol of Carmeli and

[Schaubroeck, 2007](#)) with qualitative measures. The latter were measured using open-ended, situational questions that were coded by a qualitative research analyst, and then “quantified” through scores.

Our results show that respondents’ goal orientation (one of the components of creative self-efficacy) is highly correlated with creativity in accessing mobile technology. By further disentangling the technology-related qualitative measure of creativity, we observe that codes of “alternative ideas”, “problem solving attitude”, and “persistence levels” drive this correlation. These findings indicate that there is statistical correspondence between the two methods, and point to the robustness of our newly-developed approach to measure creativity, which may be particularly helpful in contexts like low-income countries where standard measures of creativity previously identified in the literature ([Amabile, 1997](#); [Moser, 2013](#)) may not be easily available.

However, one may wonder how these two methods should be applied “in practice”. As resources and time to implement field data collection are limited, should researchers just administer one of the two protocols, and which one – the qualitative or the quantitative? Or, on the contrary, should both modules be administered to gather a comprehensive understanding of one’s creativity? In the next section, we discuss the application of our method to measure respondents’ creativity during the pandemic, and we draw lessons on the validity as well as the cost-effectiveness of our mixed-method approach.

### **3 Application: Creativity and the Pandemic**

We put our measures of creativity “in action” to study i) how the creativity of women in rural India changed during the pandemic; ii) what the main predictors of changes in creativity are. We are especially interested in understanding whether the qualitative and the quantitative method provide similar results and can therefore be considered as substitutes for data collection or, on the contrary, they provide different insights and, as such, they should be both used by researchers interested in collecting information on creativity and, more broadly, soft skills.

This application also helps us corroborate the consistency of our approach for low-income country settings where measures of creativity are hardly available and yet creativity may play a central role for economic development and growth. Insights from this analysis have the potential to cast further light on the impact the pandemic has had on people’s lives, particularly among the poorest.

We proceed by first describing how our quantitative and qualitative measures of creativity, respectively, correlate with respondents’ socio-economic indicators. We then report how



women’s creativity changed during the pandemic.<sup>13</sup> Finally, we analyze the main determinants of creativity (both in changes and levels, measured through quantitative and qualitative methods, respectively).

### 3.1 Correlations between Creativity Measures and Respondents’ Socio-Economic Indicators

To study how women’s creativity measured in Wave 3 correlate with their main socio-economic variables, we consider the following indicators: age; years of schooling; family size; household income; whether the respondent’s husband job was affected by the pandemic; the K6 depression index (Kessler et al., 2002); smartphone ownership, and whether the woman stepped out of the house during the lockdown. We also analyse how measures of creativity correlate with a set of characteristics of the SHG the respondent belongs to: whether SHG members pool money together; the share of women in the respondent’s SHG owning a smartphone; whether the SHG carried out production activities; the number of members in the respondent’s SHG; whether the SHG was recently formed; and social connectedness within the SHG.

#### 3.1.1 Quantitative Measures of Creativity

Table 6 presents univariate correlations for our quantitative measures of creativity (Carmeli and Schaubroeck, 2007). Depressive symptoms are negatively correlated with multi-tasking creativity; so are women’s likelihood of stepping out from the house during the pandemic, and that their husband’s job was affected by the pandemic. SHGs characteristics do not appear correlated with any dimension of creativity elicited through quantitative methods.

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<sup>13</sup>Changes in creativity can only be assessed through our quantitative questions on creativity.

Table 6: Correlations with quantitative creativity measures and women’s characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Goal	Creative	Overcome	Multitask	Creative	Creative
	Orientation	Endavour	Challenges	Creatively	Resilience	Self- Perception
<i>Panel A: Respondent Characteristics</i>						
Age	-0.128	0.197*	0.147	0.161	0.00129	0.199*
Years of Schooling	0.0975	0.0109	-0.0622	-0.0881	0.0472	0.133
Households Size	0.0154	0.0412	0.0290	0.0861	0.143	0.0911
Household Income	0.0612	0.162	0.0958	0.0751	0.116	0.0971
K6 Depression	0.0363	-0.0627	0.0260	-0.315***	-0.141	-0.181
Owens smartphone	-0.150	-0.160	-0.0912	-0.205*	-0.286**	-0.0947
Stepped out of the house	-0.0967	-0.229*	-0.00924	-0.246**	-0.00136	-0.215*
Husband’s job affected	0.0413	-0.182	-0.107	-0.256**	-0.218*	-0.149
<i>Panel B: SHG Characteristics</i>						
SHG pools resources	0.107	0.0236	0.173	0.139	0.0540	0.0518
Share of women with smartphones	-0.0789	-0.149	-0.0679	-0.192	-0.166	-0.0613
SHGs produces	0.100	-0.0231	0.0977	0.0907	0.159	0.00205
Connectedness	-0.149	0.0407	-0.186	0.0437	-0.0998	-0.0896
Number of SHG members	0.0253	0.0827	0.0566	0.165	-0.0108	0.0271
SHG is new	-0.0759	-0.0998	-0.112	0.0232	-0.0901	0.0986

Note: This table provides correlations between quantitative measures of creativity and the respondent socio-demographic characteristics (Panel A); and between quantitative measures of creativity and the characteristics of the SHGs respondents belong to (Panel B). \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level, respectively.

### 3.1.2 Qualitative Measures of Creativity

We then turn to the univariate correlations for the scores we constructed from our qualitative questions about creativity. Results are shown in table 7 below. In line with results shown in table 6, we observe a negative correlation between the probability of stepping out of the house and creativity, particularly for creativity in individual production. We also observe a negative relationship between age and creativity, which is significant for creativity related to technology. In contrast with results from table 6, we observe a positive correlation between depressive symptoms and creativity, as well as between the likelihood that the respondent’s husband’s job was affected by the pandemic and the respondent’s creativity.

Finally, we do observe some significant correlations between women’s creativity and their SHGs’ characteristics. Women who belong to large collectives have significantly higher creativity in terms of SHG production, and women who are in an SHG for longer also have higher creativity in SHG production. All these findings speak to the relevance of peer support and steady social networks in promoting individual creativity.

Table 7: Correlations with qualitative creativity measures and women’s characteristics

	(1)	(2)	(3)	(4)	(5)
	Qual. Total	SHG meeting	SHG production	Technology	Individual Production
<i>Panel A: Respondent Characteristics</i>					
Age	-0.135	-0.0710	-0.0198	-0.331***	0.103
Years of Schooling	0.0590	0.130	-0.0503	0.154	-0.0835
Household Size	-0.112	-0.165	0.0340	0.0740	-0.200*
Household Income	-0.0524	-0.0361	0.0325	-0.0959	-0.0357
K6 Depression	0.242**	0.307***	0.0835	0.152	0.0765
Owens smartphone	0.0211	0.177	-0.171	-0.0239	0.0729
Stepped out of the house	-0.188	-0.0980	0.0601	-0.164	-0.324***
Husband’s job affected	0.322***	0.212*	0.0961	0.349***	0.146
<i>Panel B: SHG Characteristics</i>					
SHG pools resources	0.0667	0.175	-0.0607	-0.0792	0.160
Share of women with smartphones	-0.0184	0.0903	-0.171	-0.127	0.137
SHG produces	0.0510	0.130	-0.0340	-0.0226	0.0838
Connectedness	0.105	0.134	0.0786	0.0270	0.000897
Number of SHG members	0.145	-0.0451	0.285**	0.0243	0.146
SHG is new	-0.0655	-0.0115	-0.236*	0.0518	0.0567

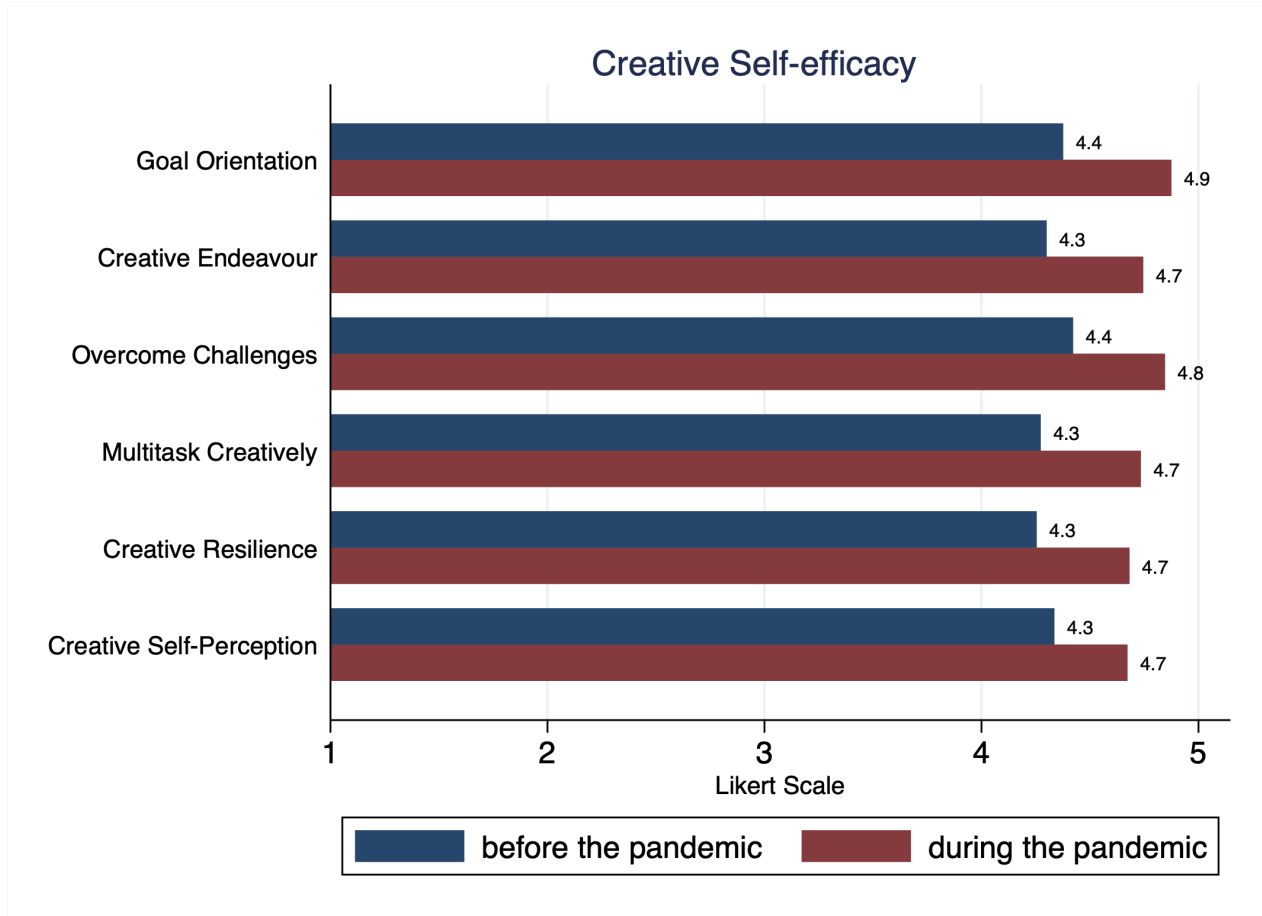
Note: This table provides correlations between qualitative measures of creativity and the respondent socio-demographic characteristics (Panel A); and between qualitative measures of creativity and the characteristics of the SHGs respondents belong to (Panel B). \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level, respectively.

### 3.2 Main Fact: Creativity Increased during the Pandemic

We collected quantitative measures of creativity that refer to both the pre-pandemic and the pandemic period. This allows us to study *changes* in women’s creativity during the pandemic.

Figure 4 reports the comparison for the six dimensions of creativity measured through the Carmeli and Schaubroeck (2007)’s protocol before the pandemic and during the pandemic, respectively. The red lines represent the period in December 2020: they indicate higher levels of creativity compared with the pre-pandemic levels in blue. This increase in creativity is consistent across all the dimensions of creative self-efficacy and ranges between 9 and 11%.

Figure 2: Change in Creative Self-efficacy Measures



Note: This figure reports averages of the creativity measures with respect to the before-pandemic period (blue bars) and during the pandemic period (red bar). Each measure is reported on a Likert scale ranging from 1 to 5.

We test for the statistical significance of these differences more formally in table 8. We report the mean differences between levels of creativity pre- and post-pandemic, and the corresponding p-value. All the differences are statistically different at 99.9% level of confidence, confirming that our study sample during the pandemic showed a significantly higher creative self-efficacy than before the pandemic.

Table 8: t-tests for differences between pre and post lockdown mean of creative self efficacy

Variable	Difference	Pre-lockdown	Post-lockdown	N	p-value
Goal Orientation	0.51	4.37	4.89	109	0.0000***
Creative Endeavour	0.45	4.38	4.74	110	0.0001***
Overcome challenges	0.42	4.42	4.84	109	0.0001***
Multitask creatively	0.46	4.26	4.73	109	0.0001***
Creative self perception	0.42	4.25	4.68	110	0.0001***
Creativity resilience	0.33	4.33	4.67	110	0.0023***

Note: The table reports results from mean tests in differences of components of creative self efficacy before the pandemic and during the pandemic. \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level respectively.

### 3.2.1 Additional Facts during the Pandemic

The impact of the pandemic and the resulting lockdown on individual creativity is a priori ambiguous: on the one hand, the psychology literature suggests that social isolation can be considered as a prerogative for creativity and generation of new ideas (Banerjee and Rai, 2020), on the other hand, economic theory has shown that individuals strongly benefit from interactions with peers to exchange ideas and increase knowledge (Lucas, 1988). While our findings strongly indicate that the pandemic has encouraged a creative attitude among our study sample, it is not clear what the cause could be, especially in light of three additional pieces of evidence we gather by further analysing our data: first, compared to the pre-pandemic period, women’s depression increased; second, household income decreased during the pandemic (see figure 3a and 3b in the Appendix); third, women’s degree of social connectedness deteriorated during the pandemic (see figure 4 in the Appendix).<sup>14</sup>

To reconcile these seemingly contradictory results we explore whether underlying heterogeneities exist in terms of women’s creative response to the pandemic. We focus in particular on the extent of social isolation and economic hardship they experienced during the lockdown: the social interaction with peers may have helped women tame the pandemic through exchanges of information and ideas (Lucas, 1988) that led to increased creativity despite reductions in wellbeing, income and social connectedness. At the same time, creativity could have also being triggered by necessity: women whose husband’s job was affected by the pandemic may have had to come up with creative solutions to compensate for the economic shortfall in the household. We explore these hypotheses in more detail in the next section.

<sup>14</sup>We refer the reader to Appendix D for a more extensive discussion on the effects of the pandemic on income, wellbeing and social connectedness.

### 3.3 Determinants of Creativity Increase

With this conceptual framework in mind, we run a horse-race regression and estimate the following equation at the respondent level:

$$Y_{i,t} = \beta X_{i,t-1} + \epsilon_{i,t} \quad (1)$$

where  $Y_{i,t}$  is alternatively the relative change of a woman’s creative self-efficacy between the pre-pandemic and the pandemic period measured with the quantitative questions ( $\Delta$  creativity $_{it}$ , which we estimate through Ordinary Least Squares), and the level of creativity measured through coding of qualitative questions (creativity $_{it}$ , estimated through a Linear Probability Model).  $X_{i,t-1}$  is a vector of respondent’s characteristics, which include: i) an index that measures the quality of social connectedness within the SHG the woman belongs to pre-pandemic; ii) a dummy variable that equals one if the SHG the woman belongs to has been formed recently (i.e., less than 18 months at the time of the interview), or 0 if it is more than 18 months old in April 2020;<sup>15</sup> iii) a dummy that equals one if the husband’s job was affected during the pandemic; iv) (log of) pre-pandemic household income; v) the pre-pandemic K6 depression index. The reason for choosing these variables is that these are the covariates that correlate more strongly with both the quantitative and qualitative measures of creativity in the univariate analysis shown in Table 6 and table 7. All these covariates are measured either in Wave 1 or Wave 2 of the survey, in order to avoid simultaneity bias. Also the social connectedness index and the age of the SHG are proxies for how socially connected women were with their peers at the onset of the pandemic.

Table 9 reports results from estimating equation 1. Both in Column (1) and (6) of table 9 we observe that the extent of connectedness within the respondent’s SHG positively and significantly predicts increases in creativity. These results are in line with theories of social networks that stress the importance of peers to boost creativity (Lucas, 1988): the higher the social connectedness of women, the higher their likelihood to learn from their peers could be. This in turn can spur their creativity and willingness to innovate.

We test the same hypotheses using the creativity measures from qualitative data.<sup>16</sup> Column (3) of table 10 shows evidence that belonging to a newly-formed SHG is negatively correlated with creativity. This finding could be again interpreted through the lenses of “social connectedness”, in a similar spirit as results shown in table 9: the younger the SHG, the less socially connected women may be and hence the lower their ability to innovate and produce creative solutions especially on “SHG production” during the pandemic. In

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<sup>15</sup>We picked this cut-off based on the average age of the SHGs in our sample.

<sup>16</sup>Our qualitative measures of creativity only refer to Wave 3 and hence we cannot observe *changes* in qualitative measures of creativity since we are not asking situational questions retrospectively.

Table 9: Horse-race in Quantitative Creativity Changes Drivers

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta$ Goal Orientation	$\Delta$ Creative Endavour	$\Delta$ Overcoming Challenges	$\Delta$ Creative Multitasking	$\Delta$ Creative Self Perception	$\Delta$ Creative Resilience
Husband's job affected	0.1443 (0.0882)	0.1189 (0.1130)	-0.0262 (0.1090)	-0.0034 (0.1253)	-0.0744 (0.0880)	0.1130 (0.1002)
Household income (log)	-0.0336 (0.0210)	-0.0102 (0.0247)	-0.0004 (0.0181)	0.0007 (0.0292)	0.0072 (0.0229)	-0.0256 (0.0381)
K6 Depression	-0.0142 (0.0185)	-0.0012 (0.0183)	-0.0210 (0.0132)	-0.0090 (0.0175)	0.0000 (0.0190)	-0.0187 (0.0215)
Connectedness	0.1454 (0.0685)**	0.0362 (0.0803)	0.0255 (0.0972)	-0.0009 (0.1607)	0.0151 (0.0946)	0.1389 (0.0803)*
New SHG	-0.0741 (0.0938)	-0.0340 (0.1022)	-0.0726 (0.0970)	-0.0339 (0.1017)	-0.0988 (0.0813)	0.0714 (0.0985)
Observations	109	110	109	109	110	110
$R^2$	0.1100	0.0824	0.0516	0.0613	0.0958	0.0766

Note: This table reports results from estimating equation 1 for quantitative measures of creativity. The dependent variable in each regression is the percentage change in each of the six components of creative self-efficacy described above. Each specification includes the following socio-economic controls: age of respondent, years of education, family size, SHG membership and number of members of the SHG are included. All the standard errors in these regressions are robust. Standard errors are in parentheses. \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level, respectively.

In addition to supporting the findings of the qualitative questions, the quantitative questions also suggest that women whose husband's job was affected by the pandemic tend to be more creative in terms of engagement with technology as shown in column (1) and (4) of table 10. Finally, we observe that women's depression positively predicts women's creativity along the "SHG meeting" dimension. Although in line with results shown in the univariate analysis (table 7), this result contradicts previous findings that poor mental health negatively affect socio-economic outcomes (Das et al., 2009). One explanation could be that women who are more prone to depressive symptoms may be actively seeking creative solutions to receive peer support.

Table 10: Horse-Race in Qualitative Creativity Drivers

	(1)	(2)	(3)	(4)	(5)
	Qual. Total	SHG meeting	SHG production	Technology	Ind. Production
Husband's job affected	0.0921 (0.0341)***	0.1028 (0.0685)	0.0515 (0.0602)	0.1295 (0.0619)**	0.0966 (0.0606)
Household income (log)	-0.0024 (0.0100)	0.0071 (0.0170)	-0.0032 (0.0202)	0.0034 (0.0200)	-0.0194 (0.0163)
K6 Depression	0.0130 (0.0070)*	0.0295 (0.0139)**	0.0169 (0.0117)	0.0099 (0.0108)	0.0041 (0.0123)
Connectedness	0.0003 (0.0627)	0.0029 (0.0895)	-0.0530 (0.0749)	0.0096 (0.1525)	0.0343 (0.1140)
New SHG	-0.0502 (0.0382)	-0.0659 (0.0760)	-0.1625 (0.0550)***	0.0110 (0.0590)	0.0468 (0.0562)
Observations	76	75	76	75	75
$R^2$	0.2597	0.2307	0.2820	0.2614	0.2703

Note: This table reports results from estimating equation 1 for qualitative measures of creativity. The dependent variable in each regression is the level of creativity measured through qualitative methods. Each specification includes the following socio-economic controls: age of respondent, years of education, family size, SHG membership and number of members of the SHG are included. This table reports the results of estimating equation 1 with the measures of qualitative creativity in levels estimated in December 2020 as dependent variables. Standard errors in parentheses are clustered at village level. \*\*\*, \*\*, \* indicates significance at the 1%, 5%, and 10% level, respectively.

## 4 Conclusions

Defining metrics for assessing soft skills has long been an unresolved issue for social scientists. We propose a new approach by using mixed-methods to study and quantify creativity, a soft skill that is essential for economic growth and sustained well-being. To do so, we leverage both the organizational and the psychology literature and establish a protocol that allows us to give a quantitative assessment of creativity to situational questions.

We apply this methodology to ask how the pandemic has affected creativity. We find that women's creativity increased during the Covid-19 pandemic, and that increases in creativity are associated with better social connectedness at the onset of the pandemic.

Apart from the robustness of our methodological approach, one may wonder how these two methods should be applied "in practice". Our findings indicate that the qualitative and the quantitative method provide complementary insights and, as such, they should be both used by social scientists interested in collecting information on creativity and, more broadly, soft skills. A simple back-of-the-envelope calculation reveals that implementing both methods is also time- and cost-effective, indicating that our approach of combining quantitative questions with coded qualitative interviews can be used to design survey modules to measure several others soft skills.

One caveat is that our questions were tailored for women belonging to SHGs in rural



India. One direction for future research is to expand our approach by making our questions appropriate for other contexts – e.g., for women who are not part of economic collectives, and in different low-income countries. Another complementary direction is to automate our qualitative protocol by using a machine learning algorithm that identifies the presence of the codes in the answers. In a contemporaneous and large scale project that involves a full scale randomized control trial in Indian SHGs, we are currently working on enhancing this methodology taking lessons from this study.

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## A Quantitative Measures of Creativity

This section reports the text of self-assessed creativity questions used in Wave 3 of the phone survey.

- **Goal orientation** - "I will be able to achieve most of the goals that I have set for myself in a creative way – when facing difficult tasks, I am certain that I will accomplish them creatively";
- **Creative endeavor** - "In general, I think that I can obtain outcomes that are important to me in a creative way. I believe I can succeed at most any creative endeavor to which I set my mind";
- **Overcoming challenges** - "I will be able to overcome many challenges creatively";
- **Creative multitasking** - "I am confident that I can perform creatively on many different tasks";
- **Creative self-perception** - "Compared to other people, I can do most tasks very creatively";
- **Creative resilience** - "Even when things are tough, I can perform quite creatively".

Respondents were allowed to give answers on a Likert Scale where the options were strongly disagree, disagree, neither agree nor disagree, agree and strongly agree.

## B Qualitative Measures of Creativity

We report in this section the English-translated version of the four situational questions we used to gather a qualitative assessment of our respondents' creativity.

- **SHG meeting:** *You have an SHG meeting today evening and you have recently given birth to a small child. Usually, when these SHG meetings happen, your mother in law takes care of the baby but today your mother-in-law is sick. And your husband is at work/not at home. What would you do?*
- **SHG production:** *You and your SHG members have produced 300 masks over the past 1 month thinking that everyone will buy them or at least the medical store/hospital will buy them due to the corona virus pandemic. However, the medical stores/hospital was able to get a big private company contract and refused to buy your masks at the last minute. You were able to sell 100 masks in your village or from your/friend's grocery/essentials shop. What do you do?*
- **Technology:** *Your child used to study at a residential school in a nearby town but has come back home due to corona virus. Their expenses used to be covered by the school but now the school is not sending any reimbursements since they have come back home. On top of that, the school has begun taking online classes. Only your husband has a smart phone and he takes it to work with him. You don't have enough savings/current income to invest in a smart phone. What do you do?*
- **Individual production:** *You had been making papads at home as a side business. Sales used to happen from your husband's grocery shop. Lately you noticed that people have stopped buying your papads and have shifted to a widely known brand of papads. Along with that, people have also started buying/demanding mixed pickle and masks. You have quite a bit of inventory left of papads. What do you do?*

## C Themes and Codes

*This section summarises the analysis carried out by the qualitative researcher and provides explanations to the chosen themes and codes.*

Deductive coding is a top-down approach where a codebook is developed with an initial set of codes. This set could be based on the research questions or an existing research framework or theory. Inductive coding is a ground-up approach where one derives the codes from the reading and re-reading of data.

The qualitative researcher does not start with preconceived notions of what the codes should be, but allows the narrative or theory to emerge from the raw data itself. In practice, research studies often combine both deductive and inductive approaches to coding. For example, one could deductively start with a set of codes, but then inductively come up with new codes and iterate on the codes as they sift through the data.

Here we further detail what each of the theme and code used for qualitative analysis represents.

### 1. Theme 1: Objective Finding

- **Code 1: Problem Identification:** We assess the point at which creative problem solving begins. Without the perception of a problem, there can be no solution. Hence, it is necessary to see whether the research participants are able to identify the challenge/problem or the issue in an existing situation.

### 2. Theme 2: Fact Finding

- **Code 2: Gathering information or knowledge on the issue:** This includes gathering information concerning the problem situation by asking –who, what, when, where and how questions pertaining to the problem situation. This is an important part of creative problem solving endeavor as ‘information is the key’ in dealing with many problem situations, especially in a pandemic situation where changes and transformations (social, economic and cultural) are happening at a very rapid pace.
- **Code 3: Sources of gathering the information and knowledge on the issue:** It is important to find out from whom the information/knowledge is obtained regarding the problem situation at hand. As this is a telephonic survey,

it is not always possible for the interviewer to find this out. However, it should be noted by the interviewer whether the research participant is asking anyone around (eg. children, husband, in-laws, other family members, neighbours, any fellow SHG member around). This would help us to know the about source/sources of access to information for the research participant and hence we would be in a better situation to form an idea about her family and social networks. Also, in some cases the interviewer can be the provider of information to the research participant if the participant asks him/her, the “who”, “what”, “when”, “where” and “how” questions pertaining to the problem situation.

### 3. Theme 3: Problem Finding

- **Code 4: Understanding of the Problem:** This is basically making an attempt to clarify the challenge or problem at hand based on the information gathered during the fact finding stage to comprehend or understand it in a better way.
- **Code 5: Reasoning Ability:** This involves how the research participant is trying to understand the problem at hand- whether she is using her own reasoning ability in the process of clarifying or understanding the problem or challenge at hand.

### 4. Theme 4: Idea Finding

- **Code 6: Alternative Ideas:** In dealing with a problem situation at hand, whether the research participant is able to offer alternative ideas to solve it are significant. Hence, the qualitative analyst has considered it necessary to find out whether alternative ideas are provided by the research participants in their problem solving endeavor.
- **Code 7: Innovative Ideas:** The qualitative analyst tries to find out whether the research participants have the ability of ‘out of box’ thinking in order to solve the problem at hand. Whether any of the alternatives ideas offered by the research participant would be considered as an ‘innovative’ idea or not would depend on how frequently that idea is being found in the transcripts. If such ideas are not repetitive, then it is termed as an ‘innovative idea’. It is important to mention here that coding is an iterative process and in case an idea which has been termed as an ‘innovative idea’ in the beginning of the coding process is found to be repeated in other transcripts, as the qualitative analyst proceeds with her coding process, it can becomes an ‘alternative idea’ and loses its place under the ‘innovative ideas’ code.



## 5. Theme 5: Solution Finding

- **Code 8: Problem Solving Attitude:** This code helps to identify whether the research participants have the requisite ‘attitude’ or ‘mind set’ for solving the problem at hand and are willing to take up the challenge posed by the problem.
- **Code 9: Reliance on Social Networks:** It is important to find out whether the respondents are relying on social networks (especially on their own SHG or to some extent on their neighbours/ relatives) in finding solutions for any problem at hand. The existing literature on the impact of SHGs on rural Indian women have documented that SHGs represents one of the very few, or in some cases the only opportunity to develop social networks. Hence, it would be interesting to see in a pandemic situation whether these social networks, especially the SHGs are playing a role in the process of creative problem solving of their members.
- **Code 10: Leadership Qualities:** This code helps to identify whether any ‘extra initiative’ or ‘effort’ has been showcased by research participants in order to deal with a problem or to solve it.
- **Code 11: Decision Making Ability:** Having ideas (both alternative and innovative), and also an attitude for problem finding are not enough, what is also required is the ability to decide as which ideas to follow amongst a host of ideas.
- **Code 12: Benevolence:** It is not always that when faced with a problem a research participant would offer a viable solution, which can be measured in terms of its economic consequences or considerations. There can be alternative, purely altruistic solutions offered by them. It becomes important to consider them especially when they are conscious of the consequences of their decisions and also are able to justify their solutions.
- **Code 13: Levels of Solution Offered:** This code shows how the research participants are able to offer different sets of solutions for different problems at hand.
- **Code 14: Persistence Level:** This code is to designate whether the research participants have the ability to persist not only when faced with a problem at hand but also have the ability to persist with any solution that they are providing.

## 6. Theme 6: Acceptance Finding

- **Code 15: Refine Ideas:** In the course executing any solution, if required, the research participants are able to modify their existing ideas. This shows their

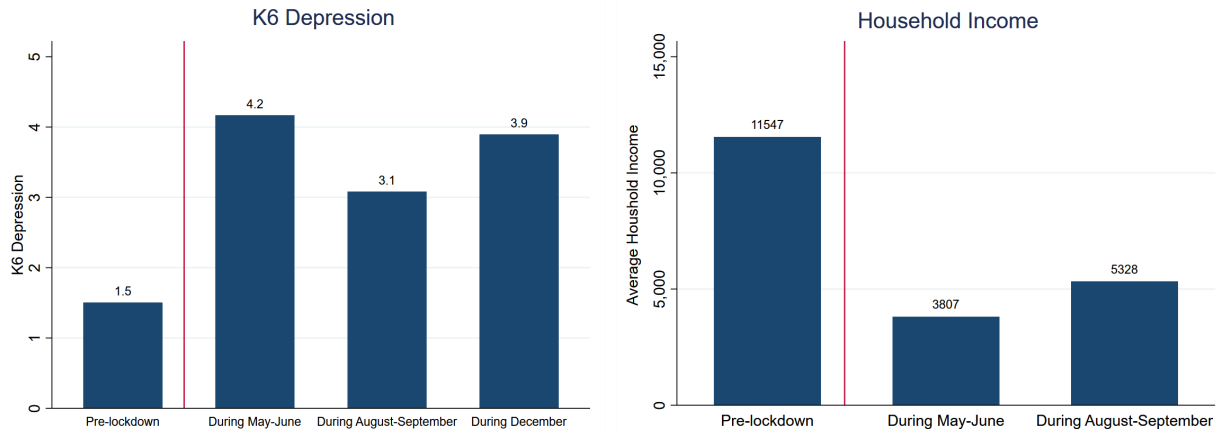
openness to accept something new, sense of practicality to achieve the desired goals and also their ability to improvise.

- **Code 16: Creation of Action Plan:** This code helps to explain the entire action plan that the research participants chalks out to execute their ideas in solving a problem at hand.

## D Additional Empirical Findings on Mental Health, Income and Social Connectedness

*Fact 1: Depression Increased and Income Fell during the Pandemic* We find that mental depression increased and household income fell during the pandemic as reported in figure 3. The left panel of figure 3 shows the K6 index for depression in four different points in time ranging from pre-lockdown to December 2020. We find that respondents reported that their depression almost triples from the pre-pandemic period to May/June 2020. The months of August/September show lower level of depression compared to May/June. However, in December 2020, the levels of depressions increased again. The right panel of figure 3 reports the values for household income, expressed in Indian Rupees (INR) in three different points in time. Differences in the levels of pre-lockdown household income between women belonging to young versus old groups appear negligible (11,700 INR versus 11,600 INR, approximately 150USD). Household income experienced a sharp decline during the May/June lockdown. Household income slightly increased again during August/September but it was less than half of the pre-lockdown income.

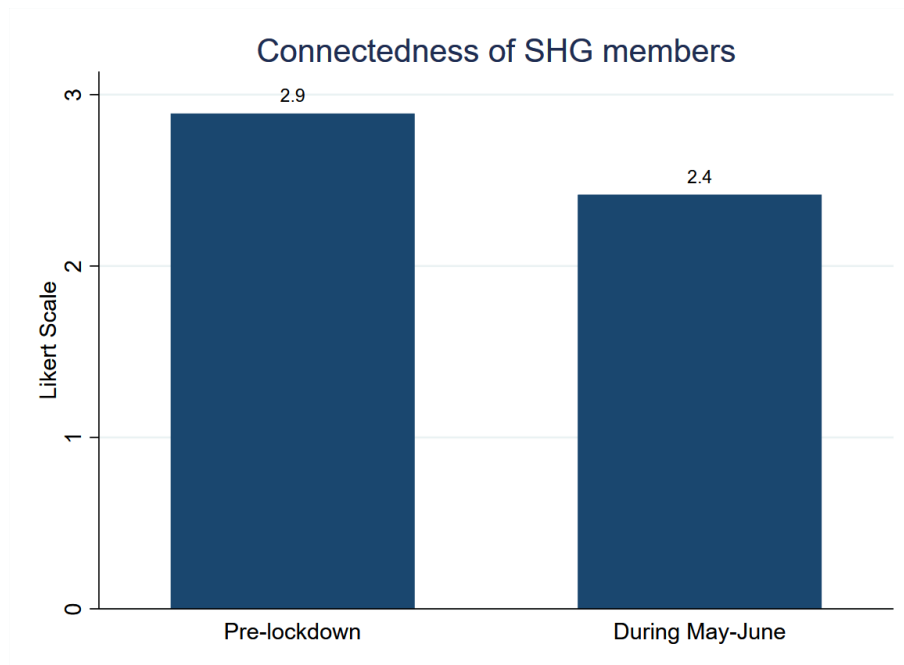
Figure 3: Differences in mental health and income before / during the lockdown



Note: This left figure (Figure 3a) reports the average K6 depression index on a scale from 1 to 5 evaluated in the pre-lockdown period; in May 2020; in September 2020; in December 2020. The right figure (Figure 3b) reports the average weekly household income level evaluated in the pre-lockdown period; in May 2020; in September 2020

***Fact 2: Social Connectedness Decreased during the Pandemic*** Using the measure of social connectedness described above (quality of communication within the respondent's SHG), we report changes in it before and during the first three months of the pandemic when stringent lockdown measures were in place in the state of Chhattisgarh. As figure 4 shows, social connectedness decreased by almost 20% among SHG women averaging from 2.9 to 2.4 points on the Likert scale. This result suggests that the quality of communication among SHG members decreased during the first months of the pandemic. While we kept conducting two more waves of surveys we did not consistently ask the questions again in the interest of brevity and not overloading women with redundant questions. However, the change shown in figure 4 is very sharp and statistically significant at 99%.

Figure 4: Change in reported social connectedness quality



Note: This figure reports the social connectedness index in Likert scale with respect to the pre-pandemic period (left bar) and May-June 2020 (right bar). The index ranges from 1 to 5.

## E Additional Results

Table 11: Correlation between codes in qualitative creativity measures

Panel A: SHG meeting

(1)

Challenge Identifier	Understanding of the Problem	Reasoning Ability	Alternative Ideas	Innovative Ideas	Problem Solving Attitude	Reliance on Social Networks	Levels of Solution	Persistence Level	Refine Ideas	Creation of Action Plan	
Challenge Identifier	1										
Understanding of the Problem	0.167	1									
Reasoning Ability	-0.0492	-0.0492	1								
Alternative Ideas	-0.0118	-0.0118	0.178	1							
Innovative Ideas	-0.0818	-0.0818	0.0474	0.606***	1						
Problem Solving Attitude	0.0801	0.0801	0.0744	0.852***	0.653***	1					
Reliance on Social Networks	0.132	0.132	0.253**	0.357***	0.164	0.105	1				
Levels of Solution	0.0278	0.0278	0.415***	0.469***	0.270**	0.337***	0.436***	1			
Persistence Level	-0.0179	-0.0179	0.0278	0.744***	0.696***	0.818***	0.0801	0.311***	1		
Refine Ideas	0.0680	0.0680	0.415***	0.469***	0.334***	0.454***	0.350***	0.871***	0.311***	1	
Creation of Action Plan			0.0439	0.415***	0.260**	0.401***	0.196*	0.249**	0.340***	0.322***	1

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Panel B: SHG production

(1)

Source of Information	Reasoning Ability	Innovative Ideas	Problem Solving Attitude	Reliance on Social Networks	Benevolence	Levels of Solution	Persistence Level	Refine Ideas	
Source of Information	1								
Reasoning Ability	0.219*	1							
Innovative Ideas	-0.0196	0.0524	1						
Problem Solving Attitude	-0.109	0.240**	0.273**	1					
Reliance on Social Networks	0.219*	0.0743	0.357***	0.138	1				
Benevolence	0.164	-0.00286	0.0187	-0.535***	-0.0640	1			
Levels of Solution	0.0676	0.0531	0.290**	0.410***	0.185	0	1		
Persistence Level	-0.121	0.203*	0.316***	0.898***	0.167	-0.495***	0.418***	1	
Refine Ideas	0.101	0.204*	0.192*	0.438***	0.174	-0.0201	0.586***	0.459***	1

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Panel C: Technology

(1)

Reasoning Ability	Alternative Ideas	Innovative Ideas	Problem Solving Attitude	Reliance on Social Networks	Levels of Solution	Persistence Level	Refine Ideas	Creation of Action Plan	
Reasoning Ability	1								
Alternative Ideas	0.357***	1							
Innovative Ideas	0.198*	0.198*	1						
Problem Solving Attitude	0.357***	1	0.198*	1					
Reliance on Social Networks	0.0988	0.317***	-0.00620	0.317***	1				
Levels of Solution	0.242**	0.242**	0.422***	0.242**	0.156	1			
Persistence Level	0.315***	0.906***	0.219*	0.906***	0.350***	0.266**	1		
Refine Ideas	0.269**	0.269**	0.283**	0.269**	0.247**	0.680***	0.198*	1	
Creation of Action Plan	0.764***	0.491***	0.151	0.491***	0.103	0.184	0.441***	0.206*	1

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Panel D: Individual production

(1)

Alternative Ideas	Innovative Ideas	Problem Solving Attitude	Reliance on Social Networks	Benevolence	Levels of Solution	Persistence Level	Refine Ideas	
Alternative Ideas	1							
Innovative Ideas	0.195*	1						
Problem Solving Attitude	0.467***	0.165	1					
Reliance on Social Networks	0.00724	0.185	0.0709	1				
Benevolence	0.0987	-0.0966	-0.398***	0.107	1			
Levels of Solution	0.336***	0.231**	0.331***	0.240**	0.0264	1		
Persistence Level	0.494***	0.0644	0.744***	0.0418	-0.195*	0.278**	1	
Refine Ideas	0.201*	0.122	0.230**	0.0163	-0.0557	0.481***	0.261**	1

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Table 12: Correlation Between Quantitative Measures and Codes in Qualitative measures

Panel A: SHG meeting					
	(1)	(2)	(3)	(4)	(5)
	Goal Orientation	Creative Endaviour	Overcome Challenges	Multitask Creatively	Creative Self Perception
Challenge Identifier	-0.0588	0.278**	-0.0885	-0.0799	-0.0831
Understanding of the Problem	-0.0588	0.278**	-0.0885	-0.0799	-0.0831
Reasoning Ability	0.0126	0.0252	0.111	-0.0543	0.0820
Alternative Ideas	-0.119	-0.0104	-0.0311	-0.00141	0.0173
Innovative Ideas	0.0986	0.0806	-0.0685	-0.125	-0.0431
Problem Solving Attitude	-0.121	-0.0667	0.0103	-0.0657	0.0163
Reliance on Social Networks	0.0496	0.135	0.0899	-0.0361	-0.0294
Levels of Solution	0.0913	0.185	0.161	0.112	0.0512
Persistence Level	-0.207*	-0.0798	-0.107	-0.121	-0.0736
Refine Ideas	0.0913	0.185	0.222*	0.112	0.0868
Creation of Action Plan	-0.0904	-0.0769	0.0736	-0.147	0.0111

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Panel B: SHG production					
	(1)	(2)	(3)	(4)	(5)
	Goal Orientation	Creative Endaviour	Overcome Challenges	Multitask Creatively	Creative Self Perception
Source of Information	0.0520	-0.0593	-0.0707	-0.0638	0.221*
Reasoning Ability	0.0105	-0.0959	0.105	0.0260	0.138
Innovative Ideas	0.0885	-0.198*	-0.0857	-0.106	-0.279**
Problem Solving Attitude	-0.0954	-0.151	-0.0894	0.0351	-0.222*
Reliance on Social Networks	0.132	-0.0682	-0.0935	-0.106	-0.0499
Benevolence	0.0931	0.164	0.0592	-0.0915	0.0479
Levels of Solution	0.108	0.117	-0.128	0.0597	-0.212*
Persistence Level	-0.109	-0.167	-0.113	0.161	-0.239**
Refine Ideas	0.148	0.0129	-0.0141	0.147	-0.0917

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Panel C: Technology					
	(1)	(2)	(3)	(4)	(5)
	Goal Orientation	Creative Endaviour	Overcome Challenges	Multitask Creatively	Creative Self Perception
Reasoning Ability	-0.0759	-0.0959	-0.00457	0.219*	0.0749
Alternative Ideas	0.443***	-0.0185	0.142	-0.0199	0.178
Innovative Ideas	0.169	-0.117	0.0822	-0.0578	-0.186
Problem Solving Attitude	0.442***	-0.0197	0.141	-0.0212	0.177
Reliance on Social Networks	0.165	0.147	0.111	0.0246	0.147
Levels of Solution	0.173	0.0472	0.0490	0.0178	0.0293
Persistence Level	0.393***	-0.0358	0.105	-0.0385	0.138
Refine Ideas	0.160	-0.0971	-0.128	0.0269	-0.148
Creation of Action Plan	-0.0580	-0.0732	-0.0872	-0.0786	0.153

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Panel D: Individual production					
	(1)	(2)	(3)	(4)	(5)
	Goal Orientation	Creative Endaviour	Overcome Challenges	Multitask Creatively	Creative Self Perception
Alternative Ideas	-0.0759	0.144	-0.00457	-0.103	0.138
Innovative Ideas	-0.0279	-0.0325	0.129	-0.000478	0.101
Problem Solving Attitude	-0.0652	-0.0341	0.0374	0.00733	0.0285
Reliance on Social Networks	0.152	0.120	0.195	0.0299	0.103
Benevolence	0.0386	0.0404	-0.0105	0.0930	-0.0362
Levels of Solution	0.0825	-0.0264	-0.113	-0.0663	0.0552
Persistence Level	-0.118	-0.107	-0.0226	-0.0234	-0.132
Refine Ideas	0.132	-0.0617	-0.0483	-0.104	-0.166

\*  $p < .1$ , \*\*  $p < .05$ , \*\*\*  $p < .01$

Note: This table reports the correlations between each of the quantitative creativity measures in column (1)-(5) and the codes from the qualitative creativity measures in each row. The \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels respectively.