Through thick and thin: changes in creativity during the first lockdown of the Covid-19 pandemic.

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Acronyme: ConfiCrea

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Abstract

COVID-19 took us by surprise. We all had to face a new situation never encountered before and find new solutions to the problems it generated, either related to the disease or the lockdown's consequences. The lockdown and pandemic crisis caused new issues and placed us in an entirely new context, changing our way of life, work time and conditions, and habits. Coping with such an unprecedented situation may have stimulated creativity. However, the situation also restricted our liberties and wellbeing and triggered health or psychological difficulties. Worrying, concerns, challenging conditions of confinement may have hampered creativity or its expression. Hence, wellbeing factors related to affective experience, living conditions, social interactions, as well as workload or available free time, may have impacted creativity during the lockdown. We carried out an online survey based on a self-administered questionnaire to examine whether the first lockdown period related to the COVID-19 pandemic (spring 2020) was associated with creativity changes and explore the role of several factors in these changes. We measured self-reported creativity changes using two approaches: changes in creative self-efficacy and creative activities and achievements. We related them to several variables estimating time availability, conditions of confinement, social interactions, and affective experience of the situation. Despite a global negative subjective experience of the situation, individuals who participated in our survey (n=380) reported that they were on average more creative during the lockdown than before and engaged in more creative activities. The converging results from self-perceived and activity-based measures showed that this positive change could be linked with more time availability, feeling more motivated or inspired, or the need to solve a problem. However, when negative changes in creativity were experienced, they were instead related to negative affective experiences, including stress and anxiety, a low mood, a feeling of pressure, or a lack of resources or opportunities. This study helps to document what happened during the first lockdown period in France regarding aspects of creativity, showing some positive outcomes of the situation despite its negative consequences, and providing cues about the key factors that stimulated or, on the contrary, blocked creativity.

Introduction

The context of the COVID-19 pandemic has led to the implementation of unprecedented restrictive measures in society. From March 16 to May 11, 2020, 67 million French people entered the first strict lockdown with stay-at-home orders, which dramatically changed our daily lives and wellbeing. Many countries applied (and still apply) similar measures to limit the spread of the virus. These constraints imply a restriction of movement, the need to adapt working methods (remote working, partial unemployment), a modification of daily life within households (e.g., management of children, protection of vulnerable people, living conditions), and a decreased wellbeing (linked to health issues, restrictions of activities and social interactions, or economic consequences) with elements of distress, loneliness, and anxiety¹⁻⁵. Paradoxically, during this period, general and social media have reported that individuals and businesses seemed to show great adaptability to face the situation by finding innovative solutions as well as creative behaviors.

Creativity is defined in science as the ability to produce something that is both original and appropriate⁶. Creative abilities are involved in many human activities, from solving everyday problems (little-c) to the great discoveries of our civilization (Big-C). Creativity is a key mental capacity to cope with change, invent and innovate, and face the challenges of our society. The situation related to the COVID-19 and its consequences on our daily life and working conditions are at the forefront of the current challenges we had and still have to cope with. Understanding the conditions that foster (or hinder) our creativity is essential, and the COVID-19 situation provides a unique opportunity to study some of these factors. Hence, the current study aimed to 1) explore how this unprecedented context has changed the creative behavior of individuals and 2) try to understand the factors influencing this change. It also helps to document this unprecedented period from a new perspective and tell another aspect of collective history: individuals' creativity.

According to the multidimensional approach to creativity⁷, creativity relies on cognitive factors (our mental capacities), individual personality, and motivation. It is influenced by emotions (e.g., mood) and factors related to our environment (living conditions, social, cultural, and professional context). Cognitive factors underlying creativity depend on complex cognitive operations that include control and spontaneous processes. Control processes allow us to respond to the environment's constraints and direct behaviors towards a specific goal. They include, for instance, inhibiting common ideas or manipulating concepts⁸⁻¹¹. Spontaneous processes are based in part on semantic associative mechanisms¹²⁻¹⁴, and allow idea generation. They usually benefit from a release of constraints from the environment. These two categories of cognitive processes interact, and their relative involvement depends on the context and the task in which individuals are engaged¹⁵⁻²⁰.

Emotional, contextual, and environmental factors have a critical impact on creative mental operations or their implementation as a creative behavior⁶. A series of studies have highlighted the strong relationships between affective states and creativity and showed that

creative thinking tasks are mood-sensitive. Positive mood (such as joy) is often reported as facilitating creativity, and negative mood (such as stress, anxiety) as hindering creativity. However, whether positive or negative moods facilitate or inhibit creativity is still debated in the literature and may depend on contextual factors²¹⁻²³. Individual motivation, especially intrinsic motivation, is an essential component of creative behavior²⁴⁻²⁹ and drives involvement, intensity, and perseverance in activities. Finally, creative activities and achievements are influenced by our environment, at home or in the workspace, and by the standards, needs, and values of the society⁷.

The situation related to COVID-19 likely has a major impact on many if not all the creativity dimensions or factors described above, by affecting our emotions, motivations, and wellbeing, modifying our environment, our lifestyle, and availability, but also by modifying the standards and incentives of our society during this period, opening a new framework of thought^{30,31}. Several studies reported how the pandemic and lockdown had increased psychological distress, mood disorders, loneliness, and anxiety¹⁻⁵, with a potential negative impact on creativity. Nevertheless, the few existing scientific studies that explored creativity during the COVID-19 pandemic have indeed suggested that the lockdown period facilitated everyday creativity^{32,33} or that creative abilities could help people dealing with the situation and improve their wellbeing^{3,34,35}. However, those studies did not assess how creativity changes related to environmental, contextual, or emotional changes.

The current study aimed at exploring how the lockdown and context related to COVID-19 had positively or negatively impacted creativity and identifying the potential factors linked to these changes. Our working hypotheses were that the lockdown could have stimulated creativity for at least two reasons. First, the confinement increased the availability of time and mind by reducing our usual daily outdoor activities and, in some cases, workload. More free time provides an opportunity to engage in new activities, produce more thoughts and ideas. Second, the new situation created a need or drive, pushing the individuals to adapt to continue their usual activities. Facing and solving the new problems may have led individuals to propose original solutions. However, other factors triggered by the situation could have blocked creativity. For instance, unfavorable living conditions, including a shrinking of personal space, or intense workload, can limit creativity or its expression. Also, the situation may have caused negative subjective experience and distress, with stress and anxiety, a feeling of pressure, a lower mood, which can alter creativity. Last, because the restrictive measures related to the COVID-19 targeted social interactions tremendously and unexpectedly and creativity is also influenced by the social context^{25,28}, we hypothesized that social distancing could also have harmed creativity.

Thus, the specific objectives of this study were to assess whether the first lockdown in France stimulated or altered everyday creativity, and to explore the role of the hypothesized factors on these changes, i.e., free time, subjective experience of the situation, social interactions, living conditions. We carried out an online survey based on a self-administered questionnaire to estimate the impact of the first lockdown on two aspects of creativity: self-perceived creativity changes and changes in creative activities and achievements. We

collected information related to our main tested factors by a series of independent questions targeting the individuals' everyday conditions during the lockdown and the reasons why they engaged or not in creative activities.

Results

Demographics and lockdown situation

Participants completed the survey between May 27th and August 1st of the year 2020, just after the end of the French first lockdown period. All questions were referred to the lockdown period, that was, in mainland France, from March 16th to May 11th. Data from 380 participants were included in the analyses (281 females; mean age 43.16 years, age ranging from 18 to 84 years).

The first part of the survey was designed to collect information about the confinement circumstances of the participants. Overall, the majority of participants were confined in France (77%), at home (85%), in urban areas (50%). 63% had access to private or large public outdoor spaces, 60% were confined with one or more individuals, and 87% declared not having encountered a severe problem during the lockdown. They were working remotely for 54% of them. 83% of the respondents had a professional activity not related to the fight against the pandemic. All demographic details are provided in Table 1 and Supplementary Table S1.

Living conditions and subjective experience of the lockdown situation

In the survey, participants were asked subjective and objective questions to gather information about their lockdown experience. These items aimed at estimating their environmental conditions (available space per cohabitant, i.e., number of rooms per inhabitant; feeling of a change in physical constraints), social relationships (change in the number of social interactions; feeling of a change in loneliness), available time (number of working hours per week; feeling of a change in time availability), and subjective affective changes (feeling of a change in mood, motivation, anxiety or stress, and pressure) (see methods for more details). Those ten measures were used to assess the living conditions and subjective experience of the lockdown situation.

As expected, on average and in terms of subjective experience, our sample felt more physically constrained (mean=0.33+/-0.08, $t(379)=4.16$, $p=4.10^{-5}$), more lonely (mean=0.32+/-0.07, $t(379)=4.69$, $p=4.10^{-6}$), and with more free time (mean=0.6+/-0.07, $t(379)=8.82$, $p=4.10^{-17}$). In terms of affective changes, they felt more anxious or stressed (mean=0.32+/-0.08, $t(379)=3.96$, $p=9.10^{-5}$), and had a poorer mood (mean=-0.18+/-0.07, $t(379)=-2.39$, $p=0.02$). On

average, they did not feel significantly more or less motivated (mean=0.12+/-0.09, $t(379)=1.39$, $p=0.17$), nor experienced more (or less) psychological pressure (mean=0.09+/-0.09, $t(379)=1$, $p=0.32$).

Within-factor measures were consistent. Indeed, the subjective report of change in physical constraints was correlated with the number of rooms per inhabitant (mean=1.19+/-0.03, $r=0.10$, $p=0.049$), the subjective report of change in loneliness was correlated with the quantitative change in social interactions (mean=-0.22+/-0.07, $t(379)=-3.31$, $p=1.10^{-3}$ $r=0.18$, $p=5.10^{-3}$). The subjective report of change in free time was correlated with the number of working hour per week (20% worked more than 42 hours/week, 19% between 36 and 42 hours/week, 15% between 29 and 35 hours/week, 13% between 22 and 28 hours/week, 14% between 15 and 21 hours/week, 9% between 8 and 14 hours/week, 10% less than 7 hours/week, $r=0.53$, $p=6.10^{-24}$). Additionally, affective changes in mood, motivation, anxiety or stress, and pressure were all correlated to each other (all $p<8.10^{-11}$).

Subjective creativity change during the lockdown

Measures of creativity

When prompted to subjectively report how much they think their creativity changed during the lockdown (subjective creativity change - SCC, rating scale from -50 to 50), the participants declared on average to have been more creative during the lockdown period (mean=8.08+/-0.98, $t(379)=8.26$, $p=2.10^{-15}$) (Figure 1A).

Additionally, at the end of the survey, participants were asked to freely report the five most creative productions they carried out during the lockdown. Those productions' creativity was evaluated by four different raters, all experts in creativity research, on a Likert scale (0-5). The inter-class correlation was 0.95, and the ratings from the four raters were averaged for each production. We then computed a global score of creativity during the lockdown by summing the average ratings of all productions for each subject, yielding a rating score (RS) ranging from 0 to 25. RS mean was 7.74+/-0.21 across the 286 participants who responded to that question.

Creative personality traits were also assessed using the BFI-openness (BFI-O) questionnaire validated in French³⁶. The average score of our sample was 3.68+/-0.03.

The BFI-O scores, RS and SCC were all significantly pairwise correlated ($r(\text{BFI-O-RS})=0.46$, $p=2.10^{-16}$, $r(\text{BFI-O-SCC})=0.21$, $p=3.10^{-2}$, $r(\text{SCC-RS})=0.15$, $p=9.10^{-3}$). Hence, as the RS might reflect both the creative personality traits and creativity changes during the lockdown, we tested whether BFI-O scores mediated the correlation between SCC and RS. The mediation analysis revealed that the correlation between SCC and RS was mediated by the BFI-O scores, as we observed a loss of significance of the direct path when including the mediator effect (linear regression of SCC against RS (without the mediator): $\beta_{\text{SCC-RS}}=0.68$, $p=9.10^{-3}$; linear regression of SCC against RS and BFI-O (the mediator): $\beta^*_{\text{SCC-RS}}=0.37$, $p=0.2$). The difference between $\beta_{\text{SCC-RS}}$ and $\beta^*_{\text{SCC-RS}}$ was confirmed using bootstrapping (confidence interval=[0.01

0.62]). Since our main aim was to assess the creativity change related to the lockdown, we decided to use the SCC score as our main variable of interest, as RS seems to reflect more the creative personality traits than the change in creativity during the lockdown period, and because we did not have a baseline measurement of creativity.

Relations between SCC and subjective experience during the lockdown

Figure 1. Subjective creativity change (SCC) and subjective experience of the lockdown. A. Histogram of SCC scores. **B.** Correlation matrix between measures assessing the living conditions and subjective experience of the lockdown situation. Stars indicate $p < 0.05$. Cold to hot colors represent the Pearson correlation coefficient (r). R indicates that the measure's sign was reversed to get positive values as positive changes (improvement) for all variables. Colored squares group measures clustering on the three principal components (red: Component 1, blue: Component 2, magenta: Component 3). **C.** SCC as a function of participant's component loadings. One dot represents one participant, and bold lines indicate that the correlation between the principal component and SCC was significant (Pearson correlation, $p < 0.05$).

We explored the link between SCC and the variables reflecting the living conditions and subjective experience of the lockdown situation. To reduce our set of variables into a smaller set of dimensions, we conducted a principal component analysis on the ten variables of interest using the available complete data from 287 participants. The Kaiser–Meyer–Olkin measure was 0.755, above the acceptable limit of 0.5. Three factors had eigenvalues over one and, in combination, explained 53.1% of the variance. Figure 1B shows the correlation matrix

between variables, and Table 2 shows the components loadings after rotation. The variables that cluster on the same component suggest that component 1 represents affective changes during the lockdown, component 2 represents changes in the available time, and component 3 interactions with other people.

We searched for correlations between the participant's components loadings and SCC. SCC correlated significantly with component 1 representing affective changes during lockdown ($r=0.28$, $p=1.10^{-6}$) and with component 2 representing changes in time available ($r=0.12$, $p=0.045$), but not with component 3 representing interactions with other people ($r=0.04$, $p=0.52$) (Figure 1C). Individual correlations of each variable and SCC are provided in Supplementary Table S2. These results indicate that two main factors were associated with subjective creativity changes during the lockdown period: affective changes and change in the available time. Restrictions in social interactions were not significantly associated with creativity changes.

As creativity could help emotionally cope with difficult situations, we explored whether creative personality traits could have impacted the subjective and affective experience of the lockdown, which influenced creativity changes. We tested for a mediation effect of component 1 (representing affective changes during lockdown) on the relationship between BFI-O and SCC. The results showed a significant partial mediation with a decrease in the direct path when including the mediator effect (linear regression of SCC against BFI-O (without the mediator): $\beta_{\text{SCC-BFI-O}}=0.62$, $p=3.10^{-5}$; linear regression of SCC against PC1 and BFI-O: $\beta^*_{\text{SCC-BFI-O}}=0.38$, $p=0.02$). The difference between $\beta_{\text{SCC-BFI-O}}$ and $\beta^*_{\text{SCC-BFI-O}}$ was confirmed using bootstrapping (confidence interval=[0.08 0.44]). Hence, individuals with higher openness may have felt more creative because they managed to have a more positive affective experience during the lockdown. The same mediation analysis conducted with the second component loadings (time available) did not reveal a significant mediation effect (confidence interval=[0 0.33]).

Regarding demographic and other categorical factors, there was no significant effect of gender ($F(1, 378)=0.01$, $p=0.93$), age ($r=-0.02$, $p=0.69$), education ($\rho=0.04$, $p=0.44$), socio-professional category ($F(8, 350)=1.45$, $p=0.17$), socio-professional domain ($F(19,339)=0.64$, $p=0.88$), or residential area ($F(2, 377)=0.43$, $p=0.65$) on SCC (see Table 1). Being at home ($F(1, 378)=0$, $p=0.99$), having a job related to COVID-19 ($F(1, 378)=0$, $p=0.99$), or working remotely ($F(1, 378)=0.56$, $p=0.46$) had also no significant association with SCC.

Change in creative activities

In the survey, we qualitatively and quantitatively assessed the creativity change experienced during the lockdown. In total, 343 participants were presented with 28 activities (among them, 37 participants completed an older version of the questionnaire that included additional questions not considered here). All activities are reported in Supplementary Table S3. For each of them, participants were first asked to indicate whether they had performed

the activity during the last five years (lockdown included). If so, they were asked whether they did it during the lockdown and how often (more or less than before), for which reasons (various reasons were proposed for negative and positive frequency changes), and how they valorized it (showed it to co-confinee, on social media, sold it, or reached other achievements). For each activity that was less performed during the confinement than before, the participants were asked whether they thought more or less about it during the lockdown.

Activities

We identified activities that were relevant at the participant level to further estimate a lockdown-related change. On average, participants engaged in 8.38 ± 0.25 activities (out of the 28 proposed) during the previous five years (including the lockdown period). Three participants did not engage in any activity, and four participants engaged in more than 20 activities. All the activities were performed at least by 9.9% of the participants during the lockdown (Figure 2). The activities of our list were consistent with the top-productions that the participants freely reported (see 'Top-production' section below).

Figure 2. Frequencies and changes in activities. Proportions of changes across subjects regarding each of the 28 activities on the list for positive changes (in green), negative changes (in red), or no changes (in grey). Changes refer to a difference reported by each subject between the five last years preceding the lockdown and the lockdown period. Each activity is named by its English-translated quick name (see Table S4) and is associated with the number of subjects who answered this question (i.e., subjects who did the activity during the last five years, including the lockdown period). Activities are sorted in descending order based on the number of subjects involved in this activity.

We also quantified the changes that occurred during the lockdown for each activity performed in the last five years (Figure 2). Among the activities performed during the last

five years, the five activities with the highest increase in frequency during the lockdown across participants were 'Cooking and drink recipes' (67.1% of the participants, n=233), 'Sports program' (65.7%, n=140), 'Dance and choreography' (61.3%, n=31), 'Mutual aid initiatives' (59.3%, n=27) and 'Garden or floral arrangement' (58.1%, n=211). Activities with the deepest decrease in frequency during the lockdown were 'Jewelry design' (86.7%, n=45), 'Original sculpture or alike' (82.4%, n=34), 'Furniture making' (64.5%, n=75), 'Decoration creation' (52.5%, n=176), and 'Object making, craft' (52.1%, n=96).

Quantitative changes in activities during the lockdown period

To quantify the overall changes in performing creative activities during the lockdown (based on our list of 28 activities), we computed the average frequency of change across activities for each subject (Figure 3A). On average, $40.3 \pm 1.5\%$ of the activities performed by the participants during the last five years were carried out more frequently during the lockdown, and additionally, $5.2 \pm 0.7\%$ of the activities were new ones. Conversely, $20.2 \pm 1.3\%$ were carried out at the same frequency, $2.7 \pm 0.4\%$ less frequently, and $20 \pm 1.2\%$ were not performed at all during the lockdown. Another $11.8 \pm 0.2\%$ of the activities were not performed, but the participants thought about it during the lockdown period. The proportions of activities that were more (positive changes), less (negative changes), and equally (no change) performed during the lockdown differed significantly ($F(2,678)=49$, $p=2.10^{-19}$ with Greenhouse–Geisser correction; Figure 3B). Post-hoc Tukey tests revealed significant differences between all pairwise comparisons ($p_{\text{corr}} < 10^{-7}$). Importantly, the mean frequency of change across activities was significantly correlated with SCC (n=331, $\rho=0.23$, $p=3.10^{-5}$; Figure 3C).

Figure 3. Quantitative changes in performing creative activities during the lockdown period. A. Averaged proportions of changes across participants in performing activities. We show the activities with negative changes, positive changes, and no changes separately. The activities with negative changes were not done during the lockdown (dark red), were not done, but participants had ideas to do it (light red) or were done less frequently than before the lockdown (pink). The activities with positive changes were done more frequently (light green) or were new (dark green) during the lockdown. The activities with no changes were done as frequently (gray) as before the lockdown. **B.** Averaged proportion of changes across participants for negative changes (red), no changes (gray), and positive changes (green) during the lockdown period compared to the five last years. Each dot represents a participant, color boxes represent the upper and lower quartiles, and squares indicate the mean. Stars indicate post hoc tests with a $p_{\text{corr}} < 0.05$. **C.** Participant's SCC as a function of the averaged frequency score of change (a dot per participant). The red line indicates a significant correlation between SCC and the mean frequency score of change (Pearson correlation, $p < 0.05$).

Reasons and motives

To examine why each activity was more or less frequently performed during the lockdown than before, we analyzed the reasons provided by the participants for positive and negative changes separately (Figures 4A and 4C, respectively). Note that they could select several reasons for each activity during the survey.

Across all activities, the frequency of the selected reasons for positive changes significantly differed ($F(6,1722)=152$, $p=2.10^{-98}$ with Greenhouse–Geisser correction; Figure 4B). The most frequently selected reasons for positive changes were: 1) having more free time ('More time,' 60+/-2.3% of the activities carried out by each subject); free time significantly differed from each of the other reasons ($p_{\text{corr}} < 0.05$ for all posthoc tests); 2) being inspired by the lockdown

situation ('Inspired,' 21.3+/-1.7%); and 3) having to solve lockdown/pandemic issues ('Problem solving,' 20.8+/-1.6%). The frequency of those two last reasons did not statistically differ but was higher than the frequency of each of the remaining reasons ($p_{\text{corr}} < 0.05$ for all corresponding post hoc tests). Additionally, 12.3+/-1.3% of the activities performed more often than before were carried out for work ('Work related'), and 11.1+/-1.3% for other undetermined reasons ('Others'). The frequencies of these last two reasons did not significantly differ from each other but were significantly higher than the frequency of each of the remaining reasons that were to feel better ('Wellbeing') and that the conditions of confinement were favorable to this activity ('Favorable conditions') ($p_{\text{corr}} < 0.05$ for all posthoc tests).

Figure 4. Reported reasons for positive and negative changes in creative activities. A. Proportions of reasons for positive changes. Each row represents a participant, and reasons are sorted by decreasing average proportion across subjects. B. Boxplots of the average proportion of reasons for positive changes across subjects. Each dot represents a participant, color boxes represent the upper and lower quartiles, and squares indicate the mean. Stars indicate significant differences between proportions of selected reasons (post hoc tests with $p_{\text{corr}} < 0.05$). C and D are the equivalent of A and B, respectively, for negative changes.

Among the reasons for negative changes, the frequency of the reported reasons significantly differed ($F(7, 1925) = 14$, $p = 5.10 \cdot 10^{-15}$ with Greenhouse–Geisser correction; Figure 4D). The most selected reasons for carrying out an activity less frequently than before were: 1) having other concerns or worries ('Concerns and worries,' 18.8+/-1.7%), 2) not having favorable conditions ('Unfavorable conditions,' 15.3+/-1.6%), 3) not willing or not feeling like doing it ('Did not feel like it,' 14.1+/-1.6%), 4) lacking the necessary material to do it ('Lack of resources,' 13.1+/-

1.5%), 5) not having enough time to do it ('No time,' 13.3+/-1.6%). The frequency of those five main reasons did not statistically differ from each other ($p_{\text{corr}} > 0.05$ for all posthoc tests). However, the frequency of each of these reasons differed significantly from the remaining reasons that were: not having ideas for this activity ('Lack of ideas,' 3+/-0.8%), that this activity was performed only occasionally before and was not common for the participant ('Occasionally,' 6.3+/-1.1%), or other undetermined reasons ('Others,' 7.9+/-1.2%) ($p_{\text{corr}} > 0.05$ for all posthoc tests).

To check the consistency of the participant's responses to the first part of the survey (global experience of the lockdown) and the second part (activity-based questions), we explored whether the activity-based reported reasons correlated with the global subjective experience of the lockdown measured in the first part of the survey. The difference between selecting 'Inspired' for positive reasons and 'Concerned and worries' or 'Did not feel like it' for negative reasons was correlated with Component 1 (reflecting affective experience) across individuals ($r=0.13$, $p=0.03$). Additionally, we found that the difference between selecting 'More time' for positive reasons and 'No time' for negative reasons was correlated with Component 2 (reflecting more free time) across individuals ($r=0.51$, $p=2.10^{-19}$) (See Methods and Supplementary Figure S1).

Obstacles

For each activity carried out more frequently or as often as before the lockdown, participants were asked how many obstacles they had to overcome to conduct this activity (an obstacle score was computed based on the average of ratings provided across performed activities for each subject, using a rating scale from 0 to 100). On average, they reported a low amount of obstacles to overcome (mean: 15.44+/-0.79). The mean obstacle score was not significantly correlated to SCC ($r=-0.04$, $p=0.49$, $n=331$). However, using a polynomial fit of second-order, we identified a quadratic relationship between those two measures ($\beta_{\text{quadr}}=4.10^{-3}$, $p=5.10^{-3}$) (Supplementary Figure S2), suggesting that the amount of encountered obstacle was high for individuals experiencing a large negative or positive SCC.

Creative achievements

In this survey, we estimated, for each participant, the level of creative achievements for the activities performed during the lockdown by adapting items of an achievement questionnaire (ICAA, part 2³⁷) (Figure 5; see Supplementary Table S4 for details). For the activities carried out more frequently or as often during the lockdown as before, we asked the participants to report how they shared their activities to other people, published something, were recognized by other groups or in the media, won prizes, or sold their work. The participants reported that for 53.98+/-1.80% of the activities they carried out, they shared the result with family, friends, or colleagues, and 16.96+/-1.47% were shared with no one. For 11.08+/-1.09% of the performed activities, the results were communicated to the participant's remote social network. Among higher achievements, the participants reported that the result

of their activity was noticed outside of their usual network for 5.89+/-0.81% of their activities, published for 4.28+/-0.66%, or mentioned in the media for 1.27+/-0.43%. Other achievements represented less than 1% of the activities each.

Importantly, based on the level of achievement reported by the participants, we computed a creative achievement score per participant (see Methods), and we found that it was significantly correlated with SCC ($n=330$, $\rho=0.16$, $p=4.10^{-3}$).

Figure 5. Creative Achievements. **A.** Proportion of the selected levels of creative achievement averaged across activities for each subject. **B.** Individual SCC as a function of individual creative achievement score. The red line indicates a significant correlation between SCC and the creative achievement score (Pearson correlation, $p<0.05$).

Top-productions

At the end of the survey, participants were asked to freely report their most creative productions (up to five) during the lockdown. To check the validity of our list of activities, we examined whether each of the 1091 reported top-productions corresponded to an activity included in our list. We found that 90% of the top-productions reported by the participants were in the list (with a mean+/-SEM RS of 2.1+/-0.03 on a rating scale from 0 to 5). Moreover, among the 10% of the top-productions that were not referring to an activity included in our list, 83.5% had an RS lower than 2.5 (with a mean+/-SEM RS of 1.3+/-0.1). The majority of those low-rated top-productions were about 'learning something new,' 'storing/classifying,' 'reading,' and 'projects/ideas.' Among the top-productions not covered by our list, the top-productions with a score higher than 2.5 (18 productions) were about ecology ($n=3$), artistic projects or ideas ($n=4$), and diverse multimedia creations ($n=3$).

To analyze the frequency of the productions among the participants, we recoded the name of the top-productions and selected the ones with a mean RS higher than 0.5. 'Cooking and recipes' were the most frequent realizations (reported by 31% and 19% of the participants), followed by 'Writing' (25%), 'Manufacturing' (19%), 'Gardening' (18%), and 'Sewing' (13%).

Discussion

Using an online survey, we aimed to estimate the impact on creativity of the lockdown in France due to the COVID-19 pandemic and to understand the potential factors leading to creativity changes. Our main a priori factors were the affective states, available time, personal conditions of confinement, and social isolation. Our survey used two main approaches to quantify creativity changes and their reasons: a global subjective report and an activity-based questionnaire. Participants reported that, on average, they felt more constrained, anxious or stressed, lonely, and with lower mood, but also had more free time. On average, they judged their own creativity (SCC) as increased during the lockdown period when compared to before.

Interestingly, this subjective increase in creative self-perception was positively significantly correlated with the increase in available time and negatively with the degradation of affective states. The activity-based approach showed, on average, a positive change in everyday creative activities that significantly correlated with SCC. However, the positive or negative direction of the changes varied across activities and individuals. Among activities that were performed more frequently during the lockdown, participants declared that they carried them out mainly thanks to an increase in their amount of free time. Less frequently reported reasons were being inspired by the situation or having to solve a problem related to it. Among activities that were performed less often during the lockdown, the most frequently reported reasons were: having worries and concerns, experiencing a lack of motivation, technical or resources issues, and lack of time. In sum, the subjective report of self-creativity and activity-based questionnaire provide converging results supporting an overall positive change in creativity during the lockdown period, which was mainly related to having more free time. However, the changes were heterogeneous across participants, and when negative changes in self-creativity or creative activities were reported, they were mainly related to affective factors.

Creativity during the lockdown

In this survey, we assessed several aspects of creativity and its changes during the lockdown period. Creativity changes were first estimated based on a self-report of a change as perceived by each participant (SCC). SCC revealed that participants experienced being more creative during the lockdown than the period before, which is consistent with previous studies that reported an increase in everyday creativity during the lockdown^{32,33}. SCC correlated with the BFI-O score, which captures a basal creative personality trait^{38,39} and which was in the range of what has been previously observed⁴⁰. The correlation between SCC and BFI-O indicates that individuals with higher openness to new experiences reported more positive self-perceived creativity changes. The link between BFI-O and SCC was linear: the increase in self-perceived creativity was proportional to the BFI-O score. This last result

seems at variance with Mercier and colleagues'³² results showing that participants with a lower creativity baseline experienced a larger improvement in everyday creativity during the lockdown than those with a higher baseline. Their baseline measure of creativity was assessed by adapting a past tense scale of everyday situations. This discrepancy might indicate that creativity traits (that BFI-O measures in our study) and other creativity dimensions (measured by a baseline self-perception scale in Mercier and colleagues' study) modulated everyday creativity changes during the lockdown period in different ways. Here, we also assessed creativity during the lockdown using an external rating approach of the top-5 creative productions freely reported by the participants (RS). SCC correlated positively with this measure, indicating that the participants who reported a higher increase in their creativity also had higher creativity ratings of their top-productions. Interestingly, BFI-O mediated the link between SCC and RS, suggesting that creativity during the lockdown (as measured by external ratings of the participants' productions) depended on both a basal creative personality trait (BFI-O) and the subjective feeling of lockdown-related changes in creativity (SCC). Lockdown-related creativity changes were also assessed using an activity-based questionnaire, which results are consistent with those from SCC, as further discussed below.

Activities carried out during the lockdown: quantitative and qualitative aspects

We presented 28 various creative activities to our participants and assessed how those everyday creative activities were affected by the lockdown in terms of frequency, motives, encountered obstacles, and achievement. We first checked whether those activities were representative of the creative productions that individuals carried out during the lockdown by comparing them to the freely reported top-productions. Overall, 90% of the reported top-productions corresponded to activities included in our list, suggesting that our list was indeed representative. 'Home rearrangement,' 'Cooking and drinks recipes,' and 'Garden or floral arrangement' were the three activities in which participants engaged the most. In addition to being internally consistent with our self-report of top-productions, the creative activities carried out by participants were also consistent with another study that assessed the frequency of creative activities in several domains before the COVID-19 pandemic²⁸ ('Cooking,' 'External and internal garden' and 'Creative social activity' were the three most frequent creative activities in this study²⁸).

In addition, when we looked at the frequency changes in carrying out creative activities during the lockdown, we found a global quantitative increase during the lockdown. This global increase is consistent with the SCC measure showing an increase in self-perceived creativity. Qualitatively, Activities with the highest increase in frequency were 'Cooking and drinks recipes,' 'Sports program', 'Dance and choreography,' 'Mutual aid initiatives,' and 'Garden and floral arrangement.' Among them, cooking and physical training activities were

also reported in a study conducted in New Zealand showing that individuals increased their cooking and baking activities during the lockdown⁴¹ and in another one in Italy for physical training⁴².

We also checked the level of creative achievement of each subject for the activities they carried out during the lockdown. We found that the score was relatively low, confirming that our questionnaire assessed 'everyday creativity' rather than extraordinary achievements. Notably, both activity-based measures, i.e., the change in creativity as measured from the activities (i.e., frequency change, Figure 1C) and the achievement score (Figure 5B), correlated with SCC, highlighting the link between subjective self-measures of creativity and real-life creative achievements.

Finally, we found a quadratic relationship between the amount of obstacles to overcome to achieve an activity and SCC: individuals who declared having a decrease in their creativity had to face too many obstacles while individuals experiencing an increase in their creativity might have been stimulated by the amount of obstacles. This result may suggest that our creative behaviors differ according to the perception of an obstacle or to the nature of the obstacle. Individual factors that influence our creative behavior in facing obstacles remain to be explored.

Potential reasons for the impact of the lockdown situation on creativity

We explored how creativity changes could be related to different factors. We found no significant effect of demographic factors on the subjective change in creativity. However, using PCA, we found that the two first principal components of the lockdown conditions and subjective experience were significantly correlated with the subjective change in creativity. The first component that we labeled 'affective change' included anxiety and stress, motivation, psychological pressure, mood, and to a lower extent, loneliness and physical constraints. This result is consistent with a series of studies showing that affective states such as positive mood and motivation are associated with higher creativity^{21,43}, and that intrinsic motives drive everyday creative activities²⁸. However, the impact of the situation on creativity was not positive for everybody, and some individuals reported negative changes. Negative changes could be related to negative affective states during the lockdown. Our survey shows that overall our participants reported more negative subjective and affective experiences during this period than before. This finding converges with other COVID-19 related studies conducted worldwide during the lockdown of Spring 2020 that showed that people experienced an increase in stress and depression symptoms in Italy⁴, Spain⁴⁴, New Zealand⁴⁵, Kuwait⁴⁶, or Croatia⁴⁷. Interestingly, we found a significant mediation effect of the principal component 1 (reflecting affective changes) on the relationships between BFI-O and SCC. This result suggests that higher openness may help to cope with difficult psychological situations during the lockdown, which in turn facilitated their self-perceived creativity

during this period⁴⁸. The second principal component of the lockdown conditions and subjective experience was related to the available time and included the number of working hours, free time, and to a lower extent, space per inhabitant. The relationship between available time and creativity has been mainly investigated in terms of time pressure hindering creativity^{49,50}. In agreement with those previous results, we found that an increase in free time was linked to higher creativity change. An increase in free time has received less attention than affective states in lockdown-related studies, but one study mentioned that both parents and children in the Netherlands experienced having more free time during the lockdown⁵¹.

It is important to mention that given the correlational nature of the link between change in creativity and affective change, we cannot conclude about any causality effect: more positive affective states could trigger higher creativity, but the reverse could be true. Also, a third unknown variable could mediate this correlation. However, the coherence of our findings based on two different sets of measures is to be highlighted. In addition to a global subjective report of their self-perceived emotions, free time, and creativity, the participants indicated the reasons they achieved or gave up specific creative activities during the lockdown. The reasons for carrying out an activity more frequently were dominated by more free time, while the reasons for carrying out an activity less frequently were mainly related to concerns and worries. These reasons for doing or not an activity (worrying and free time) correlated with the individual component loadings of the two first principal components (reflecting affective state and free time) identified among the subjective experience factors that we collected. These results indicate consistency between the different parts of our questionnaire. Overall, the correlations of SCC with the reported affective and free time changes on the one hand, and the identified reasons for engaging more or less frequently in creative activities during the lockdown than before on the other, converge to the crucial role of emotions and free time on creativity during this period. The exact nature and context of the affective factors remain to be clarified.

Limitations

One potential limitation of our study is that our sample is not fully representative of the French population. For instance, there were more women than men in our sample, they had a high education level, and most of them could work remotely. It is also possible that individuals who participated in this survey were inherently interested in creativity or had more time for online surveys. Thus, the increase of creativity observed in this sample might not be replicable in other populations, such as individuals who could not work remotely or had no time to answer online surveys because of too heavy family issues. In addition, the participants responded just after the end of the lockdown, their reports are thus retrospective and may lack accuracy or objectivity. Yet, it is worth mentioning that most surveys used questions regarding the actual lockdown period, with difficulties in measuring a valid baseline, while in our study, we focused on the change between before and during the

lockdown. We did not collect data during the second lockdown in France during Autumn 2020 because our survey was based on the direct assessment of changes by the subjects compared to the preceding period. As restrictions became a common situation for most individuals at the end of 2020, such an approach was not appropriate. It is possible that people experienced lassitude, and more negative affective states with the duration of the restrictions, impacting creativity more negatively than we observed during the initial period. Future studies will be needed to address this question. Finally, although our results focus on the COVID-19 related situation, they may provide interesting hypotheses to explore in future studies regarding the conditions and factors that could be acted on to foster creativity in real life.

Conclusion

The massive lockdown provoked by the COVID-19 pandemic gave an exceptional opportunity to investigate how various factors and exceptional situations could impact everyday creativity. Our study documents this unique situation regarding creativity, creativity enablers, and blockers based on the description of how individuals experienced this situation and how they adapted their everyday creative activities. While the lockdown had negative effects on affective components (such as a decrease in mood and an increase in stress and anxiety) that were associated with decreased creative self-efficacy and creative activities, it was not the most important effect on average. In fact, creativity appeared to be stimulated in a large group of individuals, potentially enabled by an increased amount of free time or opportunities that came with this unusual situation. A creative personality may have helped to cope with the negative emotions induced by the crisis, and to better express one's creativity. Those factors have thus to be considered when trying to enhance creativity in individuals and society. Future studies exploring more comprehensively the affective, emotional, and wellbeing dimensions are needed to understand better their bidirectional link with creativity during the COVID-19 related crisis.

Methods

Ethics and participants

The study was approved by the INSERM ethical committee. All the data were collected anonymously online and in compliance with the General Data Protection Regulation (GDPR). The participants were recruited online through social networks. Respondents were invited to complete the entire survey if they were French speakers over 18 years old, agreed to participate, and did not already participate.

In total, we collected data from 551 participants (365 females; mean age 42.31 years, age ranging from 18 to 84 years). Participants were French speakers and completed the survey

between May 27th and August 1st of the year 2020. All questions were referred to the lockdown period, that was, in mainland France, from March 16th to May 11th of the year 2020. Data from 171 participants were removed because they did not complete more than 50% of the survey (which corresponds to the end of part VI, see below). The final sample of the survey considered the data collected from 380 participants (281 females; mean age 43.16 years, age ranging from 18 to 84 years). All demographic details about included participants are provided in Table 1 and Supplementary Table S1.

Survey and scores

The survey was programmed in Qualtrics as a self-administered questionnaire. We collected several types of information using independent questions distributed into nine distinct parts in the following order: (I) demographic information, (II) conditions of lockdown, (III) affective experience, (IV) SCC, (V) BFI-O, (VI) the participant's behavior regarding a list of 28 activities, (VII) their ideational behavior regarding a list of three topics, (VIII) complementary information about demographics and lockdown situation, and (IX) the top-creative productions they carried out during the lockdown (written free report). We grouped those nine parts into five main types of data: demographic data, creativity-relevant measures, and potential factors linked to a change in creativity. The creative ideation part (VII) was not included in the current study, which focuses on activities instead of ideation. The types of data we collected are detailed below, indicating for each one to which part of the questionnaire the item belongs.

Demographic data

We collected individual information about participants. It includes basic demographic information (age (I), gender (I), education level (I), socio-professional activity (VIII), and main field of activity (VIII)) but also more specific information relative to the lockdown period (residential area type (II), own residence (II), country of residence (VIII), access to private or large public outdoor spaces (II), whether professional activity was COVID-19 related (II), professional situation (II), the occurrence of a serious problem that could have limited the initiation of activities (and in this case, how long it limited one's activities) (II).

Measures of creativity

We collected four different continuous variables related to participants' creativity. The main measure was the SCC that aims to capture the self-perceived creativity change during the lockdown period. We asked participants how much they think their creativity changed positively or negatively during the lockdown as compared to before (IV). The participants responded using a continuous visual scale ranging from -50 (less creative during the lockdown) to 50 (more creative during the lockdown).

We adapted a French-translated version of the Openness part of the Big Five Inventory (BFI-O)³⁶. This is an 11 questions questionnaire that evaluates the openness personality traits of participants (V). We chose the BFI-O because openness is the personality trait most associated with creativity^{39,52}. The participants answered each of the 11 questions using a 5-point Likert scale, converted to individual scores ranging from -2 to 2. The BFI-O score was computed as the mean of the 11 individual responses recorded in the BFI-O.

At the end of the survey (IX), we asked participants to freely report the five most creative realizations (or top-productions) they carried out during the lockdown. They entered their responses directly in a text box without any time or word limit and with the possibility to leave empty boxes. An external panel of 5 experts in creativity research rated each of the top-productions for their creativity using a 5-point Likert scale from 0 ('not creative') to 5 ('highly creative'). Good reliability was observed between judges (ICC=0.95). Then, the ratings were averaged across judges for each top-production, and we computed for each participant a Rating Score (RS) as the sum of averaged ratings of his/her productions. The RS aims to reflect the creativity of the activities achieved during the lockdown. Hence, it may both depend on the pre-existing creativity of the participants and on the effect of the lockdown situation on their creative thinking and behavior.

In an independent part of the survey (VI), we collected information about lockdown-related changes concerning participants' involvement in creative activities. We aimed to qualitatively and quantitatively assess the creativity changes induced by the lockdown on a list of 28 creative activities (see Supplementary Table S3). The 28 activities were selected based on existing items in other validated creativity questionnaires (ICAA, CBI, and RIBS-s^{37,53,54}). For each activity, participants had to answer sequential questions about their involvement in this activity. The sequence of questions was conditional to their previous responses as the survey progressed (See Supplementary Figure S3 for a summary). The sequence was repeated for each of the 28 activities as follows.

For each activity, participants were first asked whether they had performed the activity during the last five years (lockdown period included). If not, the sequence stopped, and they were asked about the next activity. If so, they were asked whether they did it during the lockdown period and at which frequency ('much less,' 'less,' 'as much,' 'more', or 'much more' than before the lockdown period). They could also indicate whether they did it only during the lockdown period, i.e., if the activity was new for them. The frequency change was converted into a ranking value from -2 ('much less') to 2 ('much more'). In case the activity was not performed during the lockdown period, we assigned the value of -3. The frequency change score was computed for each participant as the mean of these ranking values across activities. We also computed the proportion of activities for each participant for which there was a negative, a positive, or no change.

Then, for each activity reported either less or more performed during the lockdown period than before, multiple-choice questions were displayed to explore the reasons for the change

in frequency (different options were proposed for negative and positive changes, see Supplementary Table S4) with the possibility to select several responses. Participants also had the option to write down their answers if none of the options were satisfying. We manually checked these additional reasons and created two new *a posteriori* categories of motives for positive changes ('Wellbeing' and 'Favorable conditions'). For each participant, and separately for positive and negative changes, we computed the number of times each reason was selected divided by the total number of activities for which the question was asked.

To check for consistency between reasons explaining changes in engaging in specific activities and the general subjective experience of the lockdown, we ran bivariate correlations between the proportions of the main activity-based selected reasons (that were related to free time and affective states) and the components of our previous PCA that related to changes in SCC (See 'Statistical analyses'). For activity-related reasons, we computed the difference in the percentage of positive and negative reasons as follows: Free time-related reasons were the difference between the proportion of 'More Time' and of 'No time.' Affective change-related reasons were the difference in proportion between 'Inspired' and both 'Concerned and worries' / 'Did not feel like it.' The difference was computed (instead of only positive or negative) as positive and negative reasons might capture the same effect. If an individual selects 'More time' as often as 'No time' across activities (scores around zero), it might reflect a small change in experienced free time.

Finally, in case they did the activity as much or more often during the lockdown period than before, we asked:

- How they valorized it. Participants were asked to make a multiple choice among 11 options to assess the level of achievement of the performed activity. Each option represented an amount of points that reflected the level of achievement (Supplementary Table S4). Based on this question, a Creative Achievement Score was computed using a procedure similar to the ICAA scoring. The values corresponding to all the selected options for a given activity were summed. If participants shared their creative activities at least beyond the immediate surroundings (friends, family, cohabitant, or colleague), they automatically reached 8 points, and the three first proposals were not considered in the sum. Then, participant's scores were averaged across activities for each participant to compute an individual creative achievement score.

- To report their feeling of having encountered obstacles during its realization using a visual scale from 0 (no obstacles) to 100 (many obstacles). The obstacle score was computed as the mean of obstacles rating across activities for each participant.

When the series of questions related to one activity (and dependent on participant's responses) was complete, the same sequence was proposed for the next activity until the end of the list of 28 activities.

Psychological and physical conditions of confinement:

In the survey, we asked specific questions about how participants experienced the lockdown. The aim was to identify subjective and objective factors that can explain creativity changes based on our hypotheses. We collected four categories of information:

(a) Environmental conditions: we asked the participants to report the number of cohabitant and the number of available rooms in the residence place (survey part II), allowing us to compute the objective available space per cohabitant (i.e., the number of rooms per inhabitant). We also collected the subjective feeling of change in physical constraints (III).

(b) Social relationships: participants were asked whether they exchanged with as many people during the lockdown period as before (II) and the feeling of a change in loneliness (III). These variables aim to reflect changes in social relationships during the lockdown period.

(c) Available time considering the objective number of working hours per week (multiple-choice question with eight options ranging from 'not concerned' to 'more than 42 hours' with an increment of 7 hours per option) (VIII) and the feeling of a change in the amount of free time (II).

(d) Affective changes assessed by asking participants their feeling of a change in mood, motivation, anxiety, and stress, and pressure (III).

All the questions related to a change refer to a difference between the period before and during the lockdown. All subjective information in part III was collected using multiple-choice questions with eight available choices: seven ranging from 'much less' to 'much more' and one allowing a neutral response ('I do not know'). Change in free time and in social interactions had only five available choices ranging from 'much less' to 'much more.' Those variables were considered as continuous or ordinal, and the sign was reversed for the ones with a negative meaning (indicated with 'R' in figures and tables, such as loneliness) in order to obtain homogeneous valence across them (the higher, the better).

Statistical analyses

All analyses were performed using Matlab Statistical Toolbox (Matlab R2020a, The MathWorks, Inc., USA), SPSS (v22.0; IBM Corp.), and R (v3.6.2). Independent variables were defined as the reported responses by the participants (categorical variables) or as a score based on participant responses (quantitative variables; see above). Variables of interest could be binomial, ordinal, or continuous. For binomial and categorical variables (such as being a woman or a man), one-way ANOVAs were used to test their effect on continuous variables (such as SCC). Correlation analyses were performed using Pearson coefficient for continuous variables and Spearman coefficient for ordinal variables (such as Education, Frequency change in activity, and RS). When relevant, the difference from zero was tested for significance at the group level using a one-sample two-tailed t-test.

To explore whether the relationship between RS and SCC could be mediated by creative personality traits (BFI-O), we ran a mediation analysis. The mediation analysis between SCC, BFI-O, and RS was implemented in Matlab 2020. BFI-O can be considered as a mediator if the direct path from RS to SCC is no longer significant when introducing the mediator BFI-O ($\beta^*_{\text{SCC-RS}}$). Thus, the mediation analysis was estimated using the two following linear models⁵⁵:

$$\text{SCC} = \beta_{\text{SCC-RS}} \times \text{RS}$$

$$\text{SCC} = \beta^*_{\text{SCC-RS}} \times \text{RS} + \beta_{\text{SCC-BFI-O}} \times \text{BFI-O}$$

Path significance ($\beta_{\text{SCC-RS}} - \beta^*_{\text{SCC-RS}}$) was then assessed with a bootstrap test using 5,000 bootstraps.

We used the same procedure to test the mediation effects of the components loadings on the link between BFI-O and SCC.

When examining the factors that can be associated with SCC during the lockdown period, we first conducted a principal component analysis to reduce the ten variables used to assess the living conditions and subjective experience of the lockdown situation into a smaller set of dimensions while retaining as much of the original information as possible. It also helped to deal with the problem of multicollinearity among our variables. We ran the principal component analysis on our ten variables of interest with oblique rotation (direct oblimin) to rotate loadings and identify the variables contributing the most to each component, using the available complete data from 287 participants. Factors with eigenvalues over Kaiser's criterion of 1 were kept. Sampling adequacy for the analysis was assessed with the Kaiser–Meyer–Olkin measure (standard threshold=0.5).

Conflict of interest

The authors declare no conflict of interest.

Author contributions

All authors designed the online survey and collected the data. TB, MOT, EV and ALP performed the data analyses. ALP designed the open MatLab App. ALP, TB, MOT and EV wrote the manuscript. All the authors discussed the results and commented the manuscript.

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Tables

940 Table 1

941 Demographic data. Each information is displayed with statistical tests (one-factor ANOVA for
 942 categorical factors, Spearman correlation coefficients for ordinal factors, Pearson correlation coefficients
 943 for continuous factors) on SCC. SCC mean and SEM are reported in the table. N indicates the number
 944 of participants in each category.
 945

Participants	Total included		SCC Mean	SCC SE
	380		8.0	0.98
Gender (F(1, 378)=0.01, p=0.93)	N	%	SCC Mean	SCC SE
Female	281	73.95	8.12	1.17
Male	99	26.05	7.94	1.78
Education (rho=0.04, p=0.44)	N	%	SCC Mean	SCC SE
no High School Diploma	13	3.42	0.15	5.91
High School Diploma or Secondary Education Certificate (Baccalaureat in French)	32	8.42	9.56	3.64
2 or 3 years completed after High School Diploma (e.g., Bachelor’s degree)	73	19.21	7.78	2.17
4 or 5 years completed after High School Diploma (e.g., Master’s degree)	154	40.53	7.6	1.61
more than 6 years completed after High School Diploma (e.g., Doctorate’s degree)	108	28.42	9.46	1.66
Age (mean=43.16, SE=15.85) (r=−0.02, p=0.69, [continuous measure])	N	%	SCC Mean	SCC SE
18-21	8	2.11	5.75	6.08
21-30	97	25.53	9.98	1.89
31-40	79	20.79	6.94	2.22
41-50	66	17.37	4.73	2.25
51-60	76	20.00	11.42	1.98
61-70	30	7.89	7.63	4.31
71+	20	5.26	3.7	4.62
Residential area (F(2, 377)=0.43, p=0.65)	N	%	SCC Mean	SCC SE
Urban	191	50.26	8.4	1.27
Peri	128	33.68	6.92	1.85
Rural	61	16.05	9.49	2.51

Residence during confinement (F(1, 378)=0, p=0.99)	N	%	SCC Mean	SCC SE
My home	322	84.74	8.07	01.05
Other	58	15.26	8.1	2.64
Country (F(5, 317)=0.25, p=0.94)	N	%	SCC Mean	SCC SE
France	293	77.11	7.9	1.12
France-outré mer	2	0.53	8.5	8.5
Suisse	2	0.53	18	2
Canada	2	0.53	2	8
Belgique	6	1.58	8.67	4.2
Other	18	4.74	9.67	4.9
Professional Activity (F(1, 378)=0, p=0.99)	N	%	SCC Mean	SCC SE
Related to the fight against COVID-19	43	11.32	7.86	3.15
Unrelated to the fight against COVID-19	315	82.89	7.87	1.06

Table 2

Summary of exploratory principal component analysis results for the variables hypothetically related to creativity changes during the lockdown period (n=287). Loadings greater than 0.4 are in bold.

	Component 1	Component 2	Component 3
	Affective change	Available time	Interactions
R Anxiety and stress	0.783	-0.023	-0.18
Mood	0.774	0.098	0.017
Motivation	0.652	0.027	-0.032
R Pressure	0.621	0.383	-0.305
R Loneliness	0.594	-0.075	0.295
R Physical constraints	0.521	-0.256	0.245
R Working hours	-0.161	0.731	0.138
Free time	0.236	0.642	-0.254
Space per inhabitant	-0.025	-0.464	-0.312
Social interactions	0.042	0.141	0.831
Eigenvalues	2.823	1.352	1.134
% of variance	28.227	13.525	11.341

Supplementary material

Figure S1

Supplementary Figure S1. Correlations between activity-based reported reasons (the difference between positive and negative reasons) and the subjective components related to creativity changes measured in the first part of the survey. Left: Proportion of ‘Inspired’ minus proportion of ‘Concerned and worries’ and ‘Did not feel like it’ selected respectively as positive and negative reasons for carrying out an activity per individual as a function of component loading of affective change. Right: Proportion of ‘More Time’ minus the proportion of ‘No time’ selected respectively as positive and negative reasons for carrying out an activity per individual as a function of component loading of available time.

Figure S2

Supplementary Figure S2. Individual mean obstacle score across activities as a function of individual SCC. The solid line represents a second-order polynomial fit, illustrating a significant quadratic link ($p < 0.05$).

966 Figure S3

967
968 **Supplementary Figure S3.** Schematic representation of the conditional sequence of questions
969 proposed for each activity

970 Table S1

971 Additional demographic information, with statistical tests (one-factor ANOVA) on SCC. SCC mean
972 and SEM are reported in the table. N indicates the number of participants in each category. No
973 statistical test was performed when one group represented less than 5% of the data (in italic).
974

Participants	Total included		SCC Mean	SCC SE
	380		8.0	0.98
Professional Activity (F(1, 378)=0, p=0.99)	N	%	SCC Mean	SCC SE
Related to the fight against COVID-19	43	11.32	7.86	3.15
Unrelated to the fight against COVID-19	315	82.89	7.87	1.06
Socio-professional category (F(8, 350)=1.45, p=0.17)	N	%	SCC Mean	SCC SE
Agriculture/Operator	2	0.53	17	17
Artisan/ Merchant/Entrepreneur	4	01.05	12	15.95
Professionals and intellectual professions	162	42.63	8.44	1.37
Intermediate professions	28	7.37	09.07	3.66
Employee	49	12.89	11.88	2.6
Student	43	11.32	6.93	2.7

Salaried worker		1	0.26	33	0
Retired		33	8.68	5.62	2.95
Other		37	9.74	-0.3	4.64
Main field of activity (F(19,339)=0.64, p=0.88)		N	%	SCC Mean	SCC SE
Agriculture / Agronomy		3	0.79	15	10.02
Arts/ Design/ Architecture		29	7.63	5.97	5.09
Audiovisual / Cinema / Spectacle/ Musician		11	2.89	5.45	5.4
Audit / Accounting		8	2.11	7.75	7.09
Building / public worker		2	0.53	6.5	6.5
Food trade / Distribution		1	0.26	20	0
Non - food retail / Distribution		6	1.58	0.17	11.4
Culture / Artisan		13	3.42	2.54	7.11
Law/ Justice/ Economy / Management		9	2.37	18.11	6.2
Education		25	6.58	10.04	3.51
Finance/ Bank/ Insurance		12	3.16	5.58	7.03
Industry		6	1.58	9.83	9.67
Computer science / Engineering		28	7.37	3.29	2.65
Medias/ Communication / Marketing / Advertising		17	4.47	14.53	3.79
Research / Higher Education		69	18.16	8.46	1.97
Health		70	18.42	8.46	2.27
Security		0	0	-	-
Social		21	5.53	7.48	3.76
Sports / Leisure		6	1.58	4.17	11.93
Tourism / Hotel / Restoration		3	0.79	9.67	6.33
Transportation		0	0	-	-
Other		20	5.26	9.1	3.16
Professional situation during confinement		N	%	SCC Mean	SCC SE
I kept moving to my workplace (F(1, 356)=0.77, p=0.38)	Yes	54	14.21	5.76	2.56
	No	304	80.00	8.24	1.1
Remote working (F(1, 356)=0.56, p=0.46)	Yes	204	53.68	8.52	1.25
	No	154	40.53	7	1.66
Partial unemployment (F(1, 356)=1.32, p=0.25)	Yes	49	12.89	10.78	2.92
	No	309	81.32	7.4	1.07
Searching for a job (F(1, 356)=0.8, p=0.37)	Yes	31	8.16	4.94	4.02
	No	327	86.05	8.14	1.04
	Yes	41	10.79	5.83	3.15

Student (F(1, 356)=0.53, p=0.47)	No	317	83.42	8.13	1.06
	Yes	12	3.16	11.58	7.5
<i>House-husband / housewife</i>	No	346	91.05	7.74	1.01
	Yes	41	10.79	5.39	3.03
Retired (F(1, 356)=0.78, p=0.38)	No	317	83.42	8.19	1.07
	Yes	10	2.63	24.4	7.21
<i>On sick leave</i>	No	348	91.58	7.39	1.01
	Yes	2	0.53	26.5	10.5
<i>Maternity / paternity leave</i>	No	356	93.68	7.76	1.01
	Yes				

975

976 Table S2

977 Pearson correlation coefficients and p-values between SCC and living conditions / subjective
 978 experience of the lockdown situation. N indicate the number of participants included (available data).
 979

	Pearson correlation coefficients with SCC	p-value (2-tailed)	N
R Anxiety and stress	0.175	0.001	380
Mood	0.226	<0.001	380
Motivation	0.462	<0.001	380
R Pressure	0.185	<0.001	380
R Loneliness	0.088	0.086	380
R Physical constraints	0.092	0.075	380
R Working hours	-0.013	0.796	287
Free time	0.147	0.004	380
Space per inhabitant	-0.069	0.242	380
Social interactions	0.079	0.125	380

980

981 **Table S3**

982 List of the 28 activities for which participants had to respond a series of question. Original French
 983 sentence, English translation and short name are reported for each of the activity.
 984

Activity	French	English translation	Short name
1	J'ai fabriqué un meuble	I made a piece of furniture	Furniture making
2	J'ai créé une décoration pour mon habitation	I created a decoration for my home	Decoration creation
3	J'ai organisé ou réorganisé une pièce de mon habitation	I have organized or reorganized a room in my home	Home rearrangement
4	J'ai entrepris du jardinage ou réalisé une composition florale	I started gardening or made a flower arrangement	Garden or floral arrangement
5	J'ai réparé seul un objet cassé	I repaired a broken object alone	Object repair
6	J'ai conçu un bijou	I designed some jewelry	Jewelry design
7	J'ai conçu ou revisité un vêtement ou un accessoire (couture, tricot, ...)	I have designed or revisited an item of clothing or an accessory (sewing, knitting, ...)	Clothing or accessories
8	J'ai recyclé ou détourné un objet (non mentionné plus tôt) pour lui donner une deuxième vie	I recycled or diverted the use of an object (not mentioned previously) to give it a second life	Recycling and alternative use of objects
9	J'ai conçu ou revisité une recette de cuisine, une boisson ou un cocktail	I designed or revisited a cooking recipe, a drink or a cocktail	Cooking and drink recipes
10	J'ai mis en place des jeux ludiques et/ou pédagogiques pour des enfants (loisirs ou école à la maison)	I have set up fun and / or educational games for children (leisure or home school)	Games and education for children
11	J'ai inventé ou organisé un jeu, un quizz ou un concours (pour des amis, famille, collègues...)	I invented or organized a game, a quiz or a contest (for friends, family, colleagues ...)	Games or contests for adults
12	J'ai élaboré un programme ou un exercice d'entraînement sportif	I have developed a sports training program or exercise	Sports program
13	J'ai réalisé un tableau, un dessin ou un collage original	I made an original painting, drawing or collage	Original painting, drawing or collage
14	J'ai réalisé une sculpture, une mosaïque, une poterie ou de la céramique	I made a sculpture, a mosaic, a pottery or a ceramic	Original sculpture or alike
15	J'ai créé un slogan ou un logo	I created a slogan or logo	Logo creation
16	J'ai réalisé ou j'ai joué dans une vidéo, un montage, un court ou long-métrage, ou un film d'animation	I made or acted in a video, a montage, a short or full-length film, or an animation film	Films and videos
17	J'ai réalisé des images photographiques avec des techniques originales	I made photographic images with original techniques	Photography
18	J'ai écrit une histoire, un poème, une nouvelle, un roman, une bande dessinée, ou une pièce de théâtre	I wrote a story, a poem, a short story, a novel, a comic book, or a play	Short or long literary writing

19	J'ai écrit un article	I wrote an article	Article writing
20	J'ai inventé ou revisité une musique, une mélodie, un rythme ou les paroles d'une chanson	I invented or revisited a music, a melody, a rhythm or the lyrics of a song	Music and lyrics
21	J'ai conçu un instrument de musique ou une manière de faire de la musique	I designed a musical instrument or invented a way to make music	Musical instrument
22	J'ai inventé ou ré-interprété une chorégraphie ou une danse	I invented or re-interpreted a choreography or a dance	Dance and choreography
23	J'ai conçu un programme informatique, un site internet ou une enquête	I designed a computer program, a website or a survey	Website, survey or computer program
24	J'ai créé un tutoriel ou un cours (hors sport et éducation des enfants)	I created a tutorial or a course (excluding sports and children's education)	Courses and tutorials
25	J'ai créé ou organisé un système ou réseau d'entraide (par exemple de distribution de nourriture ou de soutien aux personnes isolées)	I have created or organized a support system or network (for example for the distribution of food or support for isolated people)	Mutual aid initiatives
26	J'ai organisé de manière originale un événement (anniversaire, apéritif, ...) ou inventé des solutions alternatives pour échanger avec les autres (club, lettres, ...)	I organized an event in an original way (birthday, aperitif, ...) or invented alternative solutions to communicate with others (club, letters, ...)	Event organization and communication
27	J'ai fabriqué un objet ou un accessoire	I made an object or an accessory	Object making, craft
28	J'ai écrit un projet innovant ou diversifié mon activité dans le cadre de mon travail	I wrote an innovative project or diversified my activity as part of my work	Professional project

986 Table S4

987 Details of the presented options for reasons for change in the frequency of an activity, and details of
 988 the presented options of achievement reached for each activity. Original French sentence, English
 989 translation and short name are detailed. Ranking values were used to compute the achievement score.
 990

	French	English translation	Short name	Ranking value
Reasons for positive change	J'avais plus de temps	I had more time	More time	-
	Le confinement et/ou l'épidémie m'ont inspiré.e	The situation inspired me	Inspired	-
	Je devais résoudre un problème lié au confinement ou à l'épidémie de COVID-19	I had to solve a problem related to the situation	Problem solving	-
	Je devais le faire pour mon travail	I had to do it for work	Work related	-
	Autres	Others	Others	-
	Je l'ai fait pour me sentir mieux	I did it to feel better	Wellbeing	-
	J'étais dans des conditions favorable pour le faire	I was in favorable conditions to do it	Favorable conditions	-
Reasons for negative change	Je n'ai pas eu le temps	I had no time to do it	No time	-
	J'avais d'autre soucis ou préoccupations	I had other concerns	Concerns and worries	-
	Mes conditions de confinement ne m'ont pas permis de le faire	I was not in favorable conditions to do it	Unfavorable conditions	-
	Je n'avais pas les ressources matérielles nécessaires	I did not have the material opportunities to do it	Lack of resources	-
	Je n'ai pas eu envie	I did not feel like it	Did not feel like it	-
	Les idées ne me venaient plus	I hadn't any ideas	Lack of ideas	-
	Je ne l'avais fait que ponctuellement auparavant	I did it only a few times before	Occasionally	-
	Autres	Others	Others	-
Creative achievements	Je ne l'ai montré à personne	I did not share it	Not shared	2
	Je l'ai montré à mes co-confinés	I shared it with my co-confinées	Shared with co-confinées	3
	Je l'ai montré à mes amis, mes proches ou mes collègues	I shared it with my close ones	Shared with close ones	3
	Je l'ai montré à des inconnus au-delà de mon cercle habituel ou sur les réseaux sociaux	I shared it with my remote ones	Shared with remote ones	4
	Cela a été remarqué par des personnes au-delà de mon cercle habituel ou sur les réseaux sociaux	It was noticed on social networks	Noticed on social networks	4
	Les médias en ont parlé	The media talked about it	Noticed on the media	9
	Je l'ai publié	It was published	Published	6

	Cela m'a permis de participer à un concours	I participated in a competition	Participated in a competition	7
	Cela m'a permis de gagner une récompense ou un prix	I won a competition or a price	Won a competition or a price	8
	J'ai réussi à le vendre	It was sold	Sold	10
	Autre proposition	Other	Other	-

991