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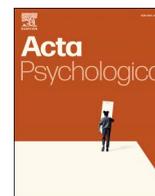
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How regulation strategies protected or worsened emotional experience during France's three lockdowns: Prepandemic versus pandemic comparisons and longitudinal approach

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ABSTRACT

The COVID-19 pandemic remains hugely challenging, but its impact on emotional experience, especially over time, has often been neglected. The French Government imposed three COVID lockdowns with varying degrees of strictness that induced different types of emotional discomfort and emotion regulation. The present longitudinal study explored affect and emotion regulation strategies in each of these lockdowns, comparing samples assessed before and during the pandemic. The objective was to understand how government measures influenced subjective experience and how people adjusted their emotion regulation accordingly.

The longitudinal lockdown sample comprised 164 participants ($M_{age} = 37.60$ years, $SD = 12.50$). Affect and emotion regulation were assessed in the first week of each of the three lockdowns (20–27 March 2020, 23–30 November 2020, and 19–26 April 2021). The 120 participants in the prepandemic (control) sample were drawn from previous studies focusing on affect and regulation strategies in natural everyday situations.

Results indicated that affect deteriorated considerably, compared with prepandemic levels. Whereas activated negative affect (*nervous* and *worried*) tended to decrease, deactivated negative affect (*sad* and *bored*) increased. Regarding emotion regulation strategies, negative emotion expression was associated with more negative affect and less positive affect, while positive emotion expression and proactive behaviour were associated with a better emotional experience. A multivariate growth curve showed that in the absence of psychological support, stressful situations and repeated lockdowns do not induce people to make better emotion regulation strategy choices.

As government restrictions had a negative impact on individuals' emotional experience, support programs should be implemented in future pandemics to promote emotion regulation.

1. Introduction

The COVID-19 pandemic led the French Government to impose three lockdowns and ask the population to stay at home to limit the spread of the virus. These repeated lockdowns, which were more or less draconian, warrant longitudinal research, as they induced different types of emotional discomfort, along with different emotion regulation strategies (Hossain et al., 2020; Zhang et al., 2020). There has been little research on affective changes since the start of the pandemic, with a particular dearth in France. The present study focused on two different outcomes: changes in the French population's emotional experience across the

three lockdowns, compared with prepandemic levels (Congard et al., 2019; Congard, Boudoukha, et al., 2022; Congard, Le Vigouroux, et al., 2022; Pavani et al., 2017; Pavani et al., 2020); and the impact of emotion regulation strategy use across the three lockdowns, looking at the protective role of certain strategies and people's potential ability to adapt to the situation over time.

1.1. Context of three French lockdowns

A brief reminder of how the French Government managed the crisis is required to understand the context of the three lockdowns, which each

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involved a different set of meeting and travel regulations.

The first lockdown lasted from 17 March to 11 May 2020. Drastic restrictions were imposed (Decree no. 2020–260 of 16 March 2020): people could only leave their homes for specific reasons listed on a certificate (working when remote working was impossible, essential shopping, health problem of self or relative, compelling family reasons), and all schools were closed. Short trips (max. 1 h) were allowed (individual sport and pets' needs within a 1-km radius of home). A fine of €135 could be imposed for breaching these lockdown rules.

The second lockdown lasted from 29 October to 15 December 2020. Unlike the first lockdown, primary schools remained open, and secondary schools provided hybrid learning. During this period, people could only leave their home to go to work, shop for office supplies or basic necessities, attend a medical appointment if it could not take place remotely, or travel for compelling family reasons. Short outings were tolerated for individual physical activity, walking, or meeting pets' needs, but a certificate had to be carried at all times.

The third lockdown lasted from 3 April to 2 May 2021, again with different rules. Primary schools remained open, and secondary schools operated with reduced class sizes. Outings up to 10 km from home were authorized, and travel was unrestricted for compelling or professional reasons (on presentation of the employer's certificate). In addition, a curfew was imposed: going out without an exemption certificate was prohibited from 7 p.m. to 6 a.m., with a €135 fine (up to €3750 for repeat offenders). No inter-regional travel was authorized after 5 April, except for compelling reasons.

1.2. Relevance of a longitudinal approach to affect in the COVID-19 pandemic

Although affect and emotion regulation abilities seem to have been important determinants of emotional trajectories and adaptiveness during lockdown (e.g., Gullo et al., 2020; Lábadi et al., 2021.; Park et al., 2021; Smith et al., 2020; Wang et al., 2020; Zsido et al., 2022), there has been little research on affective dynamics and longitudinal changes across successive lockdowns (Charbonnier et al., 2022). The psychological consequences of lockdown are many and complex, owing to the numerous dynamic interactions between the public health situation, affect, and emotion regulation strategies (Martín-Brufau et al., 2020). Unlike cross-sectional studies, longitudinal studies enable us to understand trajectories over time and to pinpoint differences within the population.

Research on the emotional consequences of COVID-19 over time has mainly involved comparing affect during lockdown with prepandemic levels (Brooks et al., 2020; Rubin & Wessely, 2020). Studies conducted in the United Kingdom, Italy and India revealed an increase in psychological disorders, compared with a reference population studied before the pandemic (Smith et al., 2020), as well as increases in anxiety and depressive symptoms (Gullo et al., 2020). Lábadi et al. (2021) found a change in negative affect in older people during the COVID-19 pandemic in Hungary. Park et al. (2021) found an increase in general distress in China and the United States after the start of the pandemic, with a more negative experience in the United States, and linked these findings to the prevention and distancing measures taken in each country. Hamidein et al. (2020)'s study in Iran showed that anxiety was the most salient affect during the first stage of the pandemic. Activated negative affect (ANA; e.g., anxiety, anger, worry, nervousness) was more present at the beginning of the first lockdown, with deactivated negative affect (DNA; boredom, loneliness, sadness) coming later.

Although research on affective dynamics has shown that identifying a specific pattern of affect variation over a period of time is essential for predicting future affective experience (Congard et al., 2011; Pavani et al., 2017), few studies have so far explored affective trajectories across lockdowns, and most of the longitudinal studies that are currently available exclusively concern first national lockdowns. The majority of published studies investigating mental health during the pandemic used

cross-sectional methodology and were conducted among either students or health professionals.

One longitudinal study (Wang et al., 2020) analysed changes that occurred in China over a 4-week period following the peak of the COVID-19 pandemic. Results failed to reveal any changes in stress, anxiety, or depressive symptoms over time. Fernández-Abascal and Martín-Díaz (2021) conducted a longitudinal study in Spain before and during lockdown, in order to analyse affect during an ordinary week versus lockdown weeks. Scores on the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) showed a significant reduction in positive affect during lockdown, but stable negative affect. When Canet-Juric et al. (2020) investigated affect over time, they found a slight increase in depressive symptoms, but a fall in levels of anxiety and negative affect. Gopal et al. (2021) observed a slight increase in depressive symptoms during lockdown, especially among women. For their part, Charbonnier et al. (2022) found that depressive symptoms were more severe in the second year of the pandemic than in the first year. In these longitudinal studies, the affective variables were anxiety and depressive symptoms, but it is also useful to analyse positive affect, in order to gain a fuller picture.

In another interesting research domain (i.e., Twitter), Mukherjee et al. (2020) studied affective reactions during the pandemic in India. Early posts showed peaks of annoyance corresponding to lockdown, but over time, people regulated their emotions and seemed to adjust to the situation, expressing lower levels of affect in their posts. Using network analyses, Yu and Mahendran (2021) studied changes in these dynamics before and during lockdown. Depressive symptoms increased dramatically, whereas anxiety stagnated or even declined. A study by Ahrens et al. (2021), also using network models, showed that positive appraisal of the pandemic, social support, and adaptive emotion regulation strategies were positively linked to positive affect, whereas perceived stress, daily worries, and loneliness were associated with negative affect, highlighting the importance of regulation strategies.

1.3. Emotion regulation and COVID

Emotion regulation refers to all the processes involved in shaping subjective experiences when emotions are aroused, as well as the ways in which emotions are expressed (Gross, 1998), with the aim of improving these emotional experiences (Gross, 2015; Russell, 2003). It involves the use of a variety of strategies. Some emotion regulation strategies act as effective protective factors, regulating stressful situations and alleviating pandemic distress (Breux et al., 2021; Xu et al., 2020). However, not all strategies are equal in terms of affective adaptation, and although some (problem-solving, positive reappraisal, acceptance, and appreciation) may reduce negative affect, others (negative emotion expression, rumination, avoidance, distraction, and suppression) are less adaptive.

The first year of the COVID-19 pandemic aroused different affects and prompted people to use a range of strategies to control them. We therefore wanted to find out whether this situation was associated with greater overall strategy use or the use of different strategies. The feeling of powerlessness in this pandemic situation and the uncontrollable changes in political decisions may have influenced strategic repertoires and encouraged recourse to strategies that are usually used less. For this reason, we felt it was important to study changes in strategy use, especially as they have been discussed relatively little thus far. The strategic repertoire and strategic flexibility can play an important role in individuals' wellbeing (Aldao et al., 2015; Bonanno & Burton, 2013). In a pandemic, lockdown rules forcing people to stay at home can deter them from using strategies involving support from family and friends. Moreover, in a new, undefined and uncontrollable health crisis, problem-solving strategies may prove inappropriate or frustrating, as it is difficult to find individual solutions and directly tackle the issue. We can even postulate that using these strategies increases stress, given the intractable nature of the problems.

An Iranian study (Hamidein et al., 2020) showed that during the pandemic, most individuals attempted to modify their affect by using more emotion regulation strategies than they had done pre-pandemic. Research in the United States has suggested that positive emotion-focused strategies, such as humour and distraction, had beneficial effects on distress - more so than problem-solving strategies (Park et al., 2021). Moreover, positive reappraisal and acceptance were the most effective strategies for regulating anxiety in the first year of the pandemic (Xu et al., 2020). Cognitive reappraisal was associated with fewer depressive symptoms, less negative affect, and greater life satisfaction (Xu et al., 2020). Hamidein et al. (2020) also highlighted the importance of problem-solving strategies and distraction, with strategies such as rumination and suppression of emotions being used less. Zsido et al. (2022) showed that catastrophizing and rumination are factors that reduce wellbeing, while positive refocusing, social support, and positive reappraisal are protective factors. Xu et al. (2020) found that negative emotion expression and avoidance strategies were predictive of anxiety and depressive symptoms. Le Vigouroux et al. (2021) also highlighted the negative effects of behavioural disengagement and self-blame on anxiety and depressive symptoms in college students. Lábadi et al. (2021) found that positive refocusing and positive reappraisal were protective factors and resulted in a less negative emotional experience, whereas catastrophizing and rumination reinforced negative affect. Few studies have explored changes in emotion regulation strategies across lockdowns. Charbonnier et al. (2022) found that students used adaptive strategies (especially acceptance and positive reappraisal) slightly less during the second lockdown than during the first. They also used slightly less adaptive coping strategies such as behavioural disengagement and distraction associated with substance use. In the present study, our aim was to explore affect and emotion regulation strategies using a longitudinal methodology, with assessments in the first week of each of France's three lockdowns.

1.4. Objectives and hypotheses

The present research was purely observational, obviating the need for sample size calibration by a priori power analysis. It had two objectives. The first was to compare emotional experience during the three COVID-19 lockdowns with the prepandemic situation, in order to ascertain how affect and emotion regulation strategies changed with the pandemic and successive lockdowns. The prepandemic sample was matched for sex and age with our longitudinal lockdown sample.

We tested two preregistered hypotheses for the first objective (https://osf.io/qa6vx/?view_only=94d6974b25654b21b42c0e2621717eae). Our first hypothesis predicted that negative affect would be considerably higher during the lockdowns than before the pandemic, while positive affect would be considerably lower. On the issue of gender, and in line with previous studies (Congard, Boudoukha, et al., 2022; Congard, Le Vigouroux, et al., 2022; Fernández-Abascal & Martín-Díaz, 2021; Gullo et al., 2020; Park et al., 2021; Smith et al., 2020; Wang et al., 2020), we expected women to be more negatively affected by this situation than men, reporting less positive affect and more negative affect than their male counterparts.

Our second hypothesis predicted that people would use more emotion regulation strategies overall than in the prepandemic period, particularly *functional strategies* (problem-solving, positive reappraisal, acceptance, and savouring), but also avoidance, which can be regarded as an effective strategy in a situation characterized by a lack of control and uncertain information about how the situation will end. More specifically, avoidance seems an adaptive strategy in fear-imminent situations with high perceived risks (e.g., death, serious illness) (Williams & Watson, 1985), or when the outcome is uncertain and time-delayed (i.e., indefinite wait for solution to problem) (Bolvin & Lancaster, 2010; Monat, 1976).

The second objective was to describe affective change over the three French lockdowns, based on assessments conducted in the first week of

each one. For this second objective, our third hypothesis predicted that emotional experience would improve across the lockdowns, as restrictions became less drastic and people adapted to the situation. In addition, we can assume that people aspire to learn adaptive regulation strategies in repeatedly stressful situations. As the three lockdowns induced a succession of stressful situations, they may have led people to make better choices in the shape of more functional strategies (problem-solving, positive reappraisal, acceptance and savouring) and reduce their use of maladaptive strategies (Bleidorn et al., 2021). Based on adaptation theory, our fourth hypothesis was that people can adapt positively to change (Lucas et al., 2003) without necessarily receiving the support of a psychologist.

For this second objective, we conducted a dynamic analysis of links between emotion regulation strategies and affect, in order to identify the strategies that worsen or protect emotional experience over time in a pandemic. Our fifth hypothesis was that functional strategy use predicts a reduction in negative affect and an increase in positive affect, whereas the use of negative emotion expression, rumination, and suppression strategies leads to an increase in negative affect and a reduction in positive affect. We also assessed the use of distraction and avoidance (considered adaptive in this kind of situation characterized by low control), as these strategies may prove functional in a pandemic context.

2. Method

2.1. Participants

2.1.1. Prepandemic sample

The prepandemic (control) sample (Fig. 1) was drawn from previous studies (Congard et al., 2019; Pavani et al., 2017, 2020), and comprised individuals who had been questioned about their affect and emotion regulation strategies in natural everyday situations.

It should be noted that the composition of this sample varied between affect and strategy, as not all data came from visual analogue scales. For each of the prepandemic versus lockdown comparisons, we constructed a prepandemic sample that was matched with the lockdown sample for sex and age. For affect, the prepandemic sample consisted of 42 women and 25 men with a mean age of 33.1 years (range = 19–67, $SD = 12.81$). This sample was similar to the lockdown sample in terms of both gender ratio, $\chi^2(1) = 0.01$, $p = .945$, and age, $t(231) = 1.77$, $p = .080$, once two participants aged 80 and 85 had been removed from the lockdown sample.

For emotion regulation strategy, the prepandemic sample consisted of 75 women and 45 men, with a mean age of 37.2 years (range = 20–64, median = 36, $SD = 11.49$). Again, this sample was similar to the lockdown sample in terms of both gender ratio, $\chi^2(1) = 0.00$, $p = .984$, and age, $t(284) = 0.7$, $p = .100$.

2.1.2. Lockdown sample

Participants in the lockdown sample were recruited during the first week of each the three French lockdowns. For the first measurement period (20–30 March 2020), 3013 participants registered on Qualtrics (platform used for completing the questionnaire), but 646 questionnaires were excluded during data cleaning (too many missing responses, incorrect responses to two control questions, weird employment status, excessively large house). The remaining 2367 participants who responded to the first questionnaire created a specific code to allow them to be identified at subsequent measurement timepoints. During the second measurement period (23–30 November 2020), 753 participants responded (after data cleaning), including 261 from the first assessment. Finally, of the 474 respondents for the third measurement period (from 19 to 26 April 2021), 168 responded to all three questionnaires. Following statistical analyses, we excluded two individuals aged 80 and 85 years from these 168 respondents, to ensure that the prepandemic and lockdown samples were statistically similar in terms of gender and age.

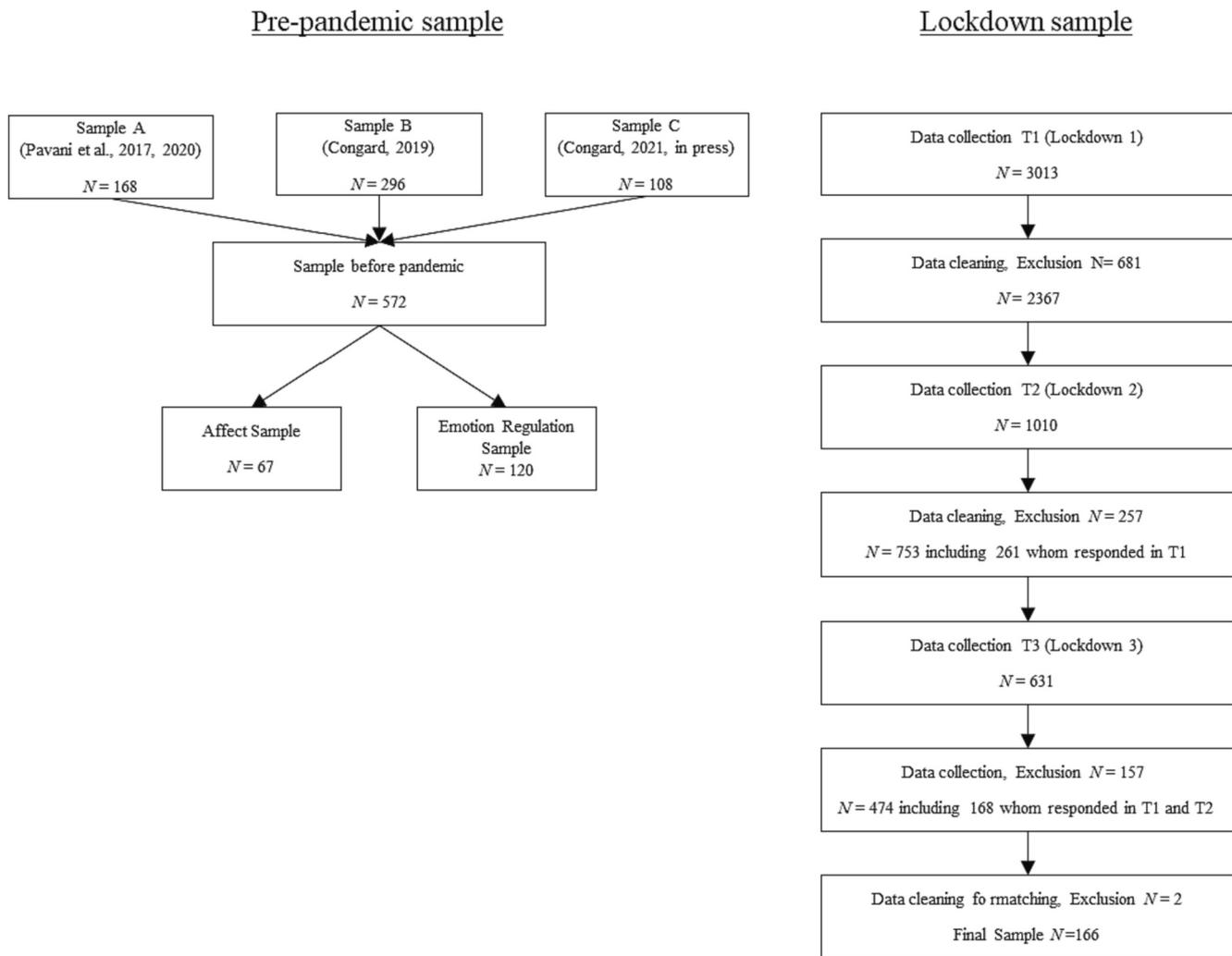


Fig. 1. Flowchart of sample formation process [dans la figure: $n =$; Prepandemic; Prepandemic sample; $N = 572$; who responded at T1; Data cleaning for matching; Final sample].

Table 1 sets out the sociodemographic characteristics of the longitudinal lockdown sample, which included 103 women and 61 men ($M_{\text{age}} = 37.60$ years, $SD = 12.50$). Regarding employment status, 117 people were in work, 15 were jobseekers, 9 were retired, and 18 were students. Four respondents declared a different status, and three declined to answer. In terms of education level, 17 participants had a high-school diploma or less, 35 were undergraduates, 84 were graduates, and 27 had a PhD (3 nonresponses). A total of 22 had studied or were studying psychology. The sample was distributed throughout France. Overall, the population seemed quite diverse in terms of age, but in terms of education level, it was mainly graduates who responded.

We compared the proportions of participants who did complete the survey at the first timepoint and at all three times according to sociodemographic data. These proportions did not differ significantly on either sex, $\chi^2(1) = 0.0, p = 1.00$, or education level, $\chi^2(7) = 10.24, p = .175$, but they did differ significantly on employment status, $\chi^2(7) = 15.89, p = .007$. More specifically, they were different for participants in employment (around 64.50 % at the first timepoint against 70.90 % at all the three timepoints), for jobseekers (7.66 % responded at the first timepoint, and 9.01 % at all three timepoints), for retirees (21.26 % vs. 6.67 %) and for students (0.80 % vs. 1.21 %).

2.2. Protocol

Participants were recruited through social media, using online

advertisements or email blasts. They did not receive any remuneration. All persons under 18 years old and/or not residing in France were excluded. The questionnaires were completed anonymously via the Qualtrics tool, available on tablet, smartphone and computer. All procedures were conducted in accordance with the ethical standards of the Ethics Committee for Non-Interventional Research (CERNI) of Nantes University (ethics committee approval no. 19052021) and with the 1964 Declaration of Helsinki and its subsequent amendments. Informed consent was obtained from each participant included in the study. We invited participants to create a code based on their personal information, so that we could identify their responses at future measurement timepoints.

2.3. Material

2.3.1. Sociodemographic questions

Standard sociodemographic data about the participants were collected. In addition to their age and sex, participants were asked questions about their occupation, education level, the type and size of their home, and whether they were single or not (see Table 1).

2.3.2. Affect

Affect was assessed using the Measurement of Affectivity: Valence/Activation scale (Congard et al., 2005), which applies a circumplex approach (Posner et al., 2005). Each item takes the form of an adjective

Table 1
Sociodemographic Characteristics of the Two Samples.

		Prepandemic sample for affect comparison (n = 67)	Prepandemic sample for regulation strategy comparison (n = 120)	Lockdown sample (n = 166)
				n (%)
Gender	Female	42 (62.27)	75 (62.50)	103 (62.05)
	Male	25 (37.73)	45 (27.50)	61 (36.75)
	Other/Nonresponses	–	–	2 (1.20)
Age in years	18–30	21 (31.34)	40 (33.33)	61 (36.75)
	31–40	18 (26.87)	25 (20.84)	49 (29.52)
	41–50	17 (25.37)	36 (30.00)	30 (18.07)
	51–60	8 (11.94)	15 (12.50)	16 (9.64)
	Over 60	2 (2.99)	4 (3.33)	10 (6.02)
	Employment status	In work	53 (79.10)	94 (78.33)
	Jobseeker	3 (4.49)	7 (5.83)	15 (9.04)
	Retired	1 (1.49)	1 (0.83)	9 (5.42)
	Student	8 (11.92)	13 (10.83)	18 (10.84)
	Other	2 (3.00)	4 (3.33)	4 (2.41)
	No response	–	1 (0.83)	3 (1.81)
Education level	High-school diploma level or less	1 (1.49)	7 (5.83)	17 (10.24)
	Undergraduate	6 (8.96)	8 (6.67)	35 (21.08)
	Graduate	60 (89.55)	101 (84.17)	84 (50.60)
	PhD	–	1 (0.83)	27 (16.27)
	No response	–	3 (2.49)	3 (1.81)

Note. The characteristics shown here are those collected at the third measurement timepoint.

describing an affective state with a positive or negative valence and a high or low activation level. Respondents rate their experience of each affective state on a visual analogue scale ranging from 1 (*Not felt*) to 100 (*Extremely felt*). Our participants were asked to read each item carefully and then to indicate the degree to which they had experienced the feeling or emotion since the last assessment. For this longitudinal study, we only selected the items that loaded the most on the relevant dimension (Congard et al., 2005): *nervous* and *worried* for ANA; *bored* and *sad* for DNA; *cheerful* and *delighted* for activated positive affect (APA); and *calm* and *still* for deactivated positive affect (DPA). Ratings for each dimension were summed to obtain a total score. Positive affect and negative affect had acceptable internal consistency both prepandemic (T0; $\alpha = 0.76$ and $\alpha = 0.82$) and during the first lockdown (T1; $\alpha = 0.81$ and 0.80). Reliability was good across the three lockdowns: $\alpha = 0.805$ (T1), 0.861 (T2), 0.805 (T3) for positive affect, and $\alpha = 0.798$ (T1), 0.829 (T2), 0.786 (T3) for negative affect.

2.3.3. Emotion regulation strategies

Participants indicated the intensity with which they used 11 emotion regulation strategies on a visual analogue scale (0 % to 100 %) We chose emotion regulation strategies that are classically studied by researchers (e.g., Augustine & Hemenover, 2009), categorizing them as *adaptive* versus *maladaptive*. Adaptive strategies included problem-solving (*J'ai agi concrètement pour changer les situations qui me déplaisaient* "I took concrete action to change a situation I did not like"; Pavani et al., 2017), action planning (*J'ai réfléchi aux actions à mettre en place dans ce type de situation* "I thought about the actions I could implement in this type of situation"; Pavani et al., 2017), positive reappraisal (*J'ai essayé de regarder les choses de manière plus positive* "I tried to view the situation more positively"; Guiller et al., 2019), acceptance (*J'ai accepté de ressentir les émotions que je ressentais sans chercher à y changer quelque chose* "I accepted emotional feelings without trying to change them"; Pavani et al., 2017), savouring (*J'ai pris le temps de savourer les moments positifs* "I took the time to savour the present moment"; Pavani et al.,

2017), and proactive behaviour (*J'ai réfléchi aux actions à mettre en place dans ce type de situation* "I anticipated and prepared for potentially problematic situations"; Pavani et al., 2017).

Strategies sometimes regarded as maladaptive included negative emotion expression (*J'ai eu tendance à exprimer mes émotions négatives* "I expressed my negative emotions"; Pavani et al., 2020), avoidance (*J'ai cherché à éviter les choses qui me confrontaient au Covid19* "I tried to avoid things linked with Covid19"; adapted from Guiller et al., 2019), distraction (*J'ai fait des choses qui m'ont distrait-e de mes ressentis* "I did things that distracted me from my feelings"; Brans et al., 2013), suppression (*J'ai évité d'exprimer mes ressentis* "I suppressed my feelings"; Brans et al., 2013), and rumination (*J'ai eu tendance à ruminer des choses déplaisantes* "I brooded over unpleasant things"; Andreotti et al., 2017).

2.4. Statistical analyses

First, we ran Student *t*-tests to compare affect and regulation strategies before the pandemic and during lockdown. Second, we used repeated-measures analyses of variance (ANOVAs) to study changes in negative affect and regulation strategies across the three lockdowns. In addition, we introduced participants' gender as a potential moderator of these changes. Finally, we used a multivariate growth curve model to predict negative and positive affect, controlling for regulation strategies as time-varying covariates, and gender as a covariate. Moreover, we investigated whether these predictions changed over time. The statistical analyses were performed with R and jamovi. Data are available here.¹

3. Results

3.1. Comparison of affect and emotion regulation strategies prepandemic and during the first lockdown

Table 2 provides the results of the Student *t*-tests for the comparison of affect and regulation strategies before the pandemic (T0) and during the first lockdown (T1).

Results showed that emotional experiences during lockdown were poorer overall. APA was significantly lower among participants assessed during the first lockdown than among participants assessed before the pandemic ($t = 3.17$, $p = .002$, $d = 0.43$), whereas no significant difference was found for DPA ($t = 0.45$, $p = .938$, $d = 0.06$). We observed significant increases in ANA and DNA, with larger effect sizes than for positive affect ($t = 5.67$, $p < .001$, $d = 0.75$ and $t = 7.90$, $p < .001$, $d = 1.08$).

In the first lockdown, participants made significantly more use of all the regulation strategies, with the exception of emotion suppression (Table 2). While *adaptive* strategies (problem-solving, positive reappraisal, acceptance, savouring) increased during lockdown, so too did *maladaptive* ones, particularly avoidance and rumination. The largest effect sizes were observed for avoidance ($t = 13.10$, $p < .001$, $d = 1.58$) and positive reappraisal ($t = 11.09$, $p < .001$, $d = 1.38$).

3.2. Affect and emotion regulation strategies during France's three lockdowns

The objective was to analyse changes in affect and emotion regulation strategy use across the three lockdowns. Results of means comparisons are set out in Table 3.

A repeated-measures ANOVA revealed that both DNA and ANA changed significantly, $F(2, 324) = 9.35$, $p < .001$, $\eta^2 = 0.019$ versus $F(2, 324) = 21.00$, $p < .001$, $\eta^2 = 0.038$. Interestingly, these two scores moved in opposite directions between the first and second lockdowns (T2 - T1), with an increase in DNA ($t = 3.05$, $p = .008$) and a decrease in

¹ https://osf.io/gjbr9/?view_only=8e082759e95944e0b2550df16b5b22c2.

Table 2
Descriptive statistics and means comparisons (Student t).

Variable	Prepandemic <i>n</i> = 67 (affect) and <i>n</i> = 120 (regulation strategy)		Lockdown 1 (<i>n</i> = 166)		Student <i>t</i> -test	
	Mean	SD	Mean	SD	Student <i>t</i>	Cohen's <i>d</i>
MAVA						
DPA	57.89	22.48	59.40	24.22	0.45*	0.06
APA	47.42	21.99	36.78	25.41	-3.17**	-0.43
PA	52.57	19.18	48.14	21.32	-1.58	-0.22
DNA	22.94	22.20	42.41	27.05	5.67***	0.75
ANA	25.57	22.30	53.52	24.76	8.36***	1.16
NA	24.29	19.81	47.89	22.79	7.90***	1.08
Emotion regulation						
Problem-solving	36.21	31.63	58.89	26.96	6.37***	0.78
Positive reappraisal	30.33	28.29	64.72	22.26	11.09***	1.38
Acceptance	43.59	30.10	63.96	24.85	6.08***	0.75
Savouring	51.55	31.01	71.90	23.65	6.01***	0.75
Avoidance	27.92	29.22	72.97	27.99	13.10***	1.58
Rumination	30.00	29.17	39.70	29.60	2.76**	0.33
Suppression	38.74	33.50	33.60	26.63	-1.38	-0.17

Note. MAVA: Measurement of Affectivity: Valence/Activation; DNA: deactivated negative affect; ANA: activated negative affect; DPA: deactivated positive affect; APA: activated positive affect.

no, "*" represents the significance of our statistics.

* *p* < .05.

** *p* < .01.

*** *p* < .001.

ANA (*t* = -5.63, *p* < .001). By contrast, they did not change significantly between the second and third lockdowns (T3 - T2; *t* = -1.08, *p* = .526 and *t* = 1.57, *p* = .263). Fig. 2 illustrates these different results and also shows that negative affect remained significantly higher during these three lockdowns, compared with prepandemic levels. For positive affect, there was no significant change across the three lockdowns, either for DPA, *F*(2,320) = 2.59, *p* = .077, or for APA, *F*(2, 324) = 1.28, *p* = .280.

We also studied changes in emotion regulation strategies in this unprecedented situation. Results showed that of the 11 strategies we considered, four changed significantly (Table 3): avoidance, action

Table 3
Descriptive statistics and means comparisons (repeated-measures ANOVA).

Variable	Lockdown 1		Lockdown 2		Lockdown 3		ANOVA	
	Mean	SD	Mean	SD	Mean	SD	Fisher's <i>F</i>	η^2
MAVA								
DPA	59.41	24.22	62.67	24.04	59.01	23.45	2.42	0.005
APA	36.83	25.41	39.45	25.12	37.82	23.88	1.02	0.002
PA	48.12	21.32	51.08	21.22	48.41	19.91	2.33	0.004
DNA	42.38	27.05	48.67	28.71	51.01	27.73	9.35***	0.019
ANA	53.54	24.76	41.46	25.93	44.33	25.62	21.01***	0.038
NA	47.89	22.79	45.09	24.89	47.72	23.71	1.27	0.002
Emotion regulation								
Problem-solving	59.31	27.01	57.78	26.39	59.70	25.41	0.22	0.001
Action planning	71.12	23.12	60.25	27.91	61.74	25.42	14.21***	0.035
Proactive behaviour	63.07	28.14	57.67	25.82	58.59	24.42	3.69*	0.011
Positive reappraisal	64.77	22.27	61.58	25.01	62.58	25.04	1.07	0.003
Acceptance	64.27	24.89	65.25	24.11	62.88	24.73	0.34	0.001
Savouring	71.89	23.67	68.88	24.52	75.20	21.33	4.23*	0.010
Negative emotion expression	50.00	27.89	50.71	28.60	53.04	28.49	0.62	0.002
Avoidance	73.21	27.91	58.02	33.44	55.63	32.18	26.7***	0.061
Rumination	39.73	29.72	42.29	31.54	43.33	31.31	1.05	0.003
Suppression	34.01	26.71	34.56	27.62	32.42	25.21	0.21	0.001
Distraction	64.04	28.41	63.69	27.51	64.01	25.91	0.07	0.000

Note. MAVA: Measurement of Affectivity: Valence/Activation; DNA: deactivated negative affect; ANA: activated negative affect; DPA: deactivated positive affect; APA: activated positive affect.

planning, proactive behaviour, and savouring. Of these four, avoidance is the only strategy that is generally regarded as maladaptive.

Fig. 3 illustrates the changes in emotion regulation strategies across the three lockdowns and in comparison with the reference population. These strategies were used more during the three lockdowns than in the prepandemic period. Avoidance, planning, and proactive behaviour were used significantly less during the second lockdown than during the first one (T2 - T1; avoidance: *t* = 5.39, *p* < .001; planning: *t* = -4.61, *p* < .001; proactive behaviour: *t* = -2.41, *p* = .045). These strategies did not change between the second and third lockdowns (T3 - T2; avoidance: *t* = -1.23, *p* = .435; planning: *t* = -.152, *p* = .987; proactive behaviour: *t* = -0.37, *p* = .927). Savouring had a relatively singular trajectory, as it remained unchanged between T1 and T2 (*t* = -1.47, *p* = .307), then increased significantly between T2 and T3 (*t* = 2.97, *p* = .010).

3.3. Multivariate growth models for affect: predictive role of regulation strategies

We wanted to examine changes in affect as well as in the use of emotion regulation strategies over time (i.e., time-varying covariates). More specifically, we investigated whether regulation strategy use was predictive of changes in affect over time, and explored the invariance of the regression parameters over time (i.e., invariance of relations between affect and emotion regulation strategies across lockdowns). We expected individuals to improve their choice of emotion regulation strategies across the lockdowns.

Longitudinal data were modelled with the lavaan package (Rosseel, 2012), with first-order autoregressive models. The aim of this analysis was to predict affect scores at time T according to regulation strategies at time T, taking account of the initial affect level (i.e. at time T-1). We conducted a preliminary analysis to control for sociodemographic variables (sex, age, employment status, education level) and the level of affect at the previous measurement timepoint. For all four types of affect, the only sociodemographic variable that predicted a significant proportion of variance was gender. As many articles on the COVID-19 pandemic had highlighted major affective differences between men and women (Congard et al., 2021; Fernández-Abascal & Martín-Díaz, 2021), we therefore included gender in the model, but not the other sociodemographic variables. Fig. 4 summarizes the model, with affective trajectories across the two lockdowns as predicted variables, and

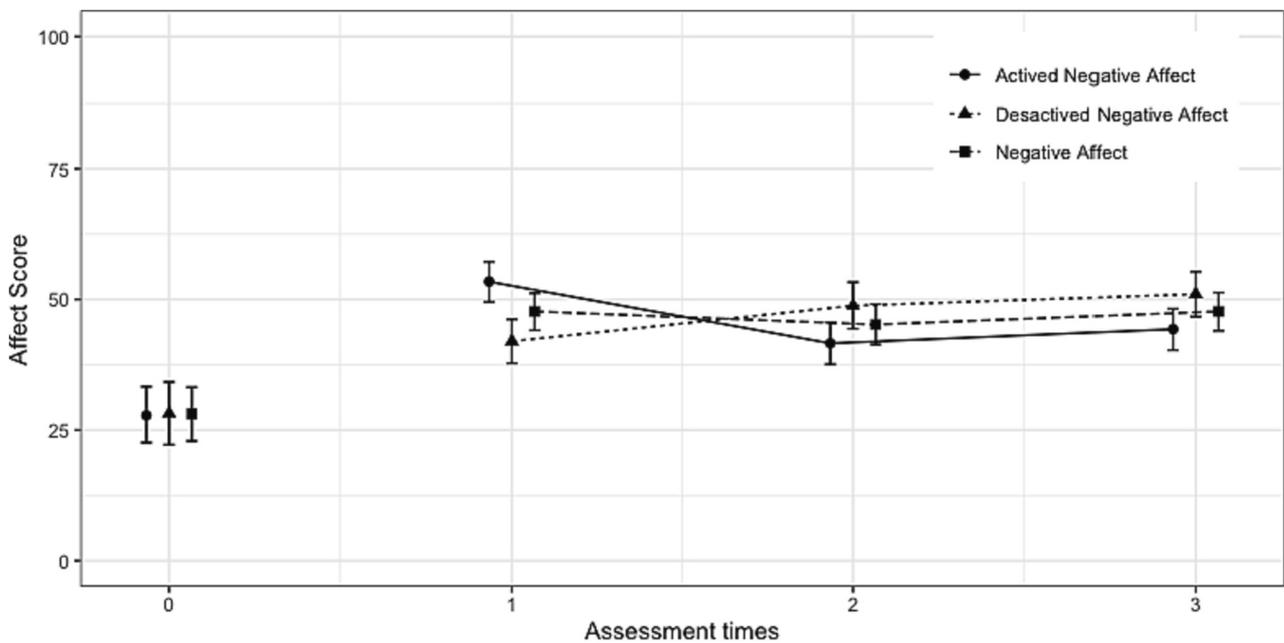


Fig. 2. Mean negative affect scores and their 95 % confidence intervals in the three French lockdowns (T1, T2 and T3) for the longitudinal sample ($n = 166$). Values for the prepanemic sample ($n = 67$) are shown at T0.[dans la figure: Activated negative affect; Deactivated negative affect; Negative affect; Measurement timepoint; T0; T1; T2; T3].

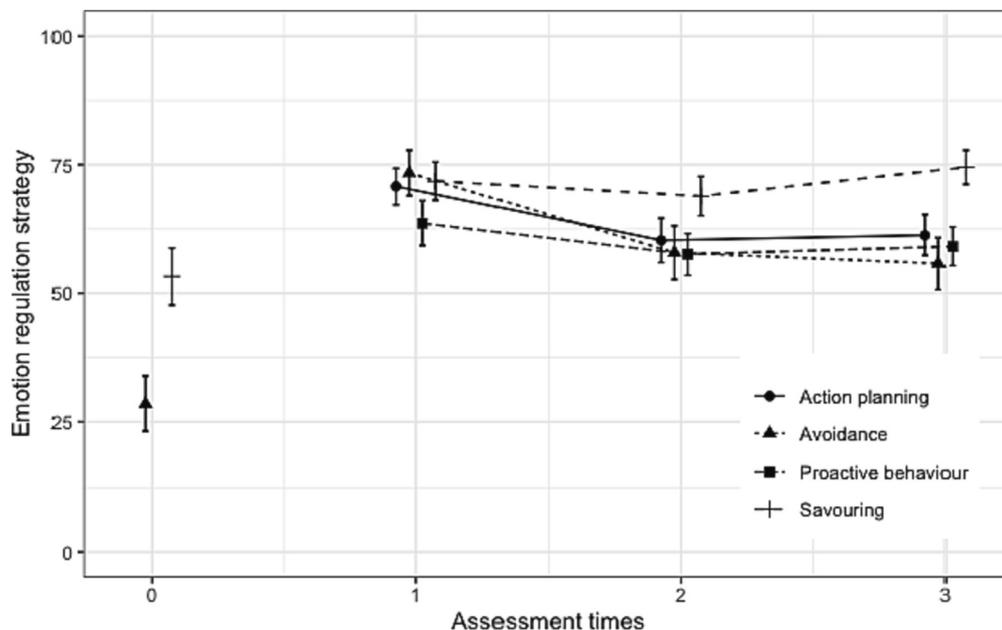


Fig. 3. Mean scores for emotion regulation strategies and their 95 % confidence intervals in the three French lockdowns (T1, T2, and T3) for the longitudinal sample ($n = 166$). Values for the prepanemic sample ($n = 120$) are shown at T0.[dans la figure: Assessment timepoint; T0; T1; T2; T3].

gender and emotion regulation strategies as predictors. More specifically, the structural equation model was defined by two regression equations. In the first one, affect in the second lockdown was predicted by emotion regulation strategies used in the second lockdown, controlling for the level of affect in the first lockdown and gender. In the second one, affect in the third lockdown was predicted by the emotion regulation strategies used in the third lockdown, controlling for the level of affect in the second lockdown and gender. To account for the longitudinal data, we constrained the emotion regulation strategies to covary for the second and third lockdowns. It should be noted that affect in the first lockdown was only introduced as an explanatory variable in the

first regression equation, as we did not have access to the prepanemic affect levels needed to define the autoregressive model. Moreover, we tested whether the link between affect and emotion regulation strategies changed between the second and third lockdowns. To test the time invariance of the autoregressive parameters, we compared two competitive models: M0, where regulation strategy coefficients were fixed for the two regression equations, and M1, where these coefficients could vary over time. Gender was the only regression parameter left free for both models (M0 and M1), as we suspected that the difference in affect between men and women might change over time.

As M0 was nested within M1, we could use the corrected likelihood

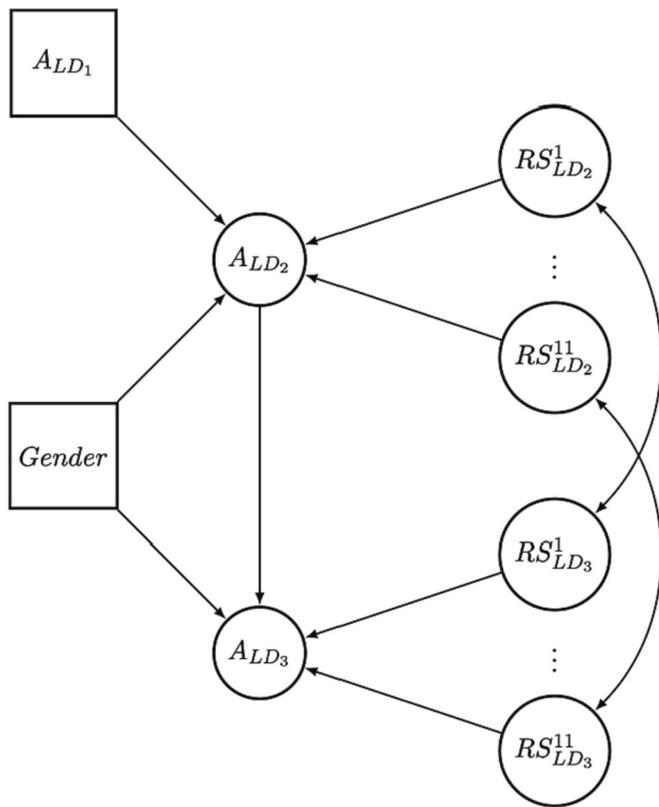


Fig. 4. Multivariate growth model for predicting affect from emotion regulation strategies (time-varying covariates) and from gender (covariate). A: affect (negative or positive); RS: emotion regulation strategy; LD: lockdown.

ratio test introduced by Satorra and Bentler (2001) to compare the two. Table 4 sets out the results of comparison tests showing that M1 did not fit the data better than M0 for any of the types of affect we studied. Consequently, results suggested that the relationship between affect and regulation strategies remained unchanged between the second and third lockdowns. In other words, the prediction of affect from emotion regulation strategies did not change across the lockdowns.

Table 5 displays the regression coefficients for the M0 autoregressive first-order model (i.e., coefficients did not vary over time).

Negative emotion expression was associated with more negative affect (DNA: $\beta = 0.30^{***}$; ANA: $\beta = 0.15^{***}$; negative affect: $\beta = 0.23^{***}$). In the same way, avoidance (DNA: $\beta = 0.08^*$; ANA: $\beta = 0.07^*$; negative affect: $\beta = 0.07^{**}$), suppression (DNA: $\beta = 0.17^{***}$; ANA: $\beta = 0.10^{**}$; negative affect: $\beta = 0.14^{***}$) and rumination (DNA: $\beta = 0.19$

*** ; ANA: $\beta = 0.15^{***}$; negative affect: $\beta = 0.17^{***}$) were significant predictors of negative affective experience. By contrast, savouring (DNA: $\beta = -0.24^{***}$; ANA: $\beta = 0.13^{**}$; negative affect: $\beta = -0.19^{***}$) and proactive behaviour (DNA: $\beta = -0.09^*$) were predictive of less negative affect.

Positive reappraisal (positive affect: $\beta = 0.08^{**}$) and savouring (positive affect: $\beta = -0.14^{***}$) were associated with more positive affect. By contrast, negative emotion expression (positive affect: $\beta = -0.13^{***}$), rumination (positive affect: $\beta = -0.08^{**}$) and suppression (positive affect: $\beta = -0.06^*$) were associated with less positive affect.

With respect to gender, men had significantly lower levels of negative affect than women ($\beta = -5.30, p = .041$), especially DNA ($\beta = -7.43, p = .014$).

4. Discussion

The present longitudinal study is one of the first to capture key information about changes in affect and emotion regulation strategies over three separate lockdowns. The first aim was to understand individual differences in perceived affect and the use of emotion regulation strategies, by comparing samples assessed before and during the pandemic matched for sex and age. The second aim was to analyse changes in these variables across the three French lockdowns.

Emotional experience significantly deteriorated compared with pre-pandemic levels, thus confirming our first hypothesis. As in many international studies (Hamidein et al., 2020; Park et al., 2021), self-reported negative affect was higher during lockdown than before the pandemic. Our novel use of the circumplex model allowed us to distinguish not only between negative and positive valence, but also between levels of arousal. Like Lábadi et al. (2021), we observed changes in negative affect, with significant increases of 19.5 points in ANA (nervous and worried) and 27.9 points in DNA (sad and bored), compared with pre-pandemic levels, and effect sizes >1. Our study complemented very extensive Spanish research focusing on valence (Fernández-Abascal & Martín-Díaz, 2021). For positive affect, we observed a significant decrease of 10.6 points in APA (cheerful and delighted), but DPA (calm and still) did not change significantly. Regarding gender, like Congard et al. (2022), Fernández-Abascal and Martín-Díaz (2021), Gullo et al. (2020), Park et al. (2021), Smith et al. (2020) and Wang et al. (2020), we found that women had a more negative experience than men. During this pandemic, women have reported significantly higher levels of negative affect (and significantly lower levels of positive affect) than men. School closures and the need to provide home schooling, sometimes whilst working from home, may have substantially increased the burden on women, who are often still on the front line for childcare, whilst the care of elderly relatives (parents or grandparents), who are more vulnerable to COVID-19, may have further increased the burden on women.

Table 4 Tests for invariance of autoregressive coefficients between second and third lockdowns.

Affect	Model	Df	AIC	BIC	χ^2	$\Delta\chi^2$	ΔDf	p value
DPA	M0	287	36,349.88	36,545.47	1014.156			
	M1	298	36,344.33	36,506.31	1030.612	16.46	11	0.125
APA	M0	287	36,316.91	36,512.51	1046.994			
	M1	298	36,312.99	36,474.97	1065.079	18.08	11	0.079
PA	M0	287	36,138.35	36,333.95	1042.57			
	M1	298	36,133.03	36,295.02	1059.259	16.69	11	0.117
DNA	M0	287	36,414.61	36,610.21	1004.484			
	M1	298	36,400.86	36,562.84	1012.741	8.26	11	0.690
ANA	M0	287	36,389.83	36,585.43	1058.702			
	M1	298	36,384.83	36,546.82	1075.709	17.01	11	0.108
NA	M0	287	36,252.41	36,448.01	1033.119			
	M1	298	36,241.85	36,403.83	1044.566	11.45	11	0.407

Note. Significant p values indicate that regression coefficients changed significantly between the second and third lockdowns. AIC: Akaike information criterion; BIC: Bayesian information criterion; DPA: deactivated positive affect; APA: activated positive affect; PA: positive affect; DNA: deactivated negative affect; ANA: activated negative affect; NA: negative affect.

Table 5

M1 regression model standardized coefficients predicting affect as a function of emotion regulation strategy, assuming invariant coefficients between lockdowns.

Predictor	DPA		APA		PA		DNA		ANA		NA	
	β	p										
Gender (male)	4.25	0.15	4.17	0.130	4.17	0.067	-7.43	0.014	-2.82	0.378	-5.30	0.041
Problem-solving	0.09	0.017	0.03	0.383	0.06	0.051	-0.03	0.455	-0.08	0.045	-0.06	0.061
Action planning	-0.07	0.071	0.01	0.875	-0.03	0.334	-0.05	0.178	0.04	0.272	0.00	0.956
Proactive behaviour	0.07	0.060	0.05	0.168	0.06	0.051	-0.09	0.039	-0.02	0.676	-0.05	0.175
Positive reappraisal	0.05	0.166	0.11	0.007	0.08	0.006	-0.01	0.766	0.02	0.662	0.01	0.793
Acceptance	0.09	0.026	-0.03	0.428	0.02	0.502	0.02	0.630	-0.06	0.184	-0.02	0.580
Savouring	0.07	0.110	0.21	>0.001	0.14	>0.001	-0.24	>0.001	-0.13	0.006	-0.19	>0.001
Negative emotion expression	-0.15	>0.001	-0.12	0.001	-0.13	>0.001	0.30	>0.001	0.15	>0.001	0.23	>0.001
Avoidance	-0.08	0.008	0.01	0.767	-0.03	0.141	0.08	0.017	0.07	0.043	0.07	0.006
Rumination	-0.14	>0.001	-0.02	0.596	-0.08	0.001	0.19	>0.001	0.15	>0.001	0.17	>0.001
Suppression	-0.05	0.143	-0.06	0.098	-0.06	0.038	0.17	>0.001	0.10	0.010	0.14	0.000
Distraction	0.06	0.102	0.02	0.534	0.04	0.160	0.01	0.802	0.03	0.442	0.02	0.499

Note. DPA: deactivated positive affect; APA: activated positive affect; PA: positive affect; DNA: deactivated negative affect; ANA: activated negative affect; NA: negative affect.

Concerning changes in emotion regulation strategies, compared with available prepandemic data, results showed that participants used more emotion regulation strategies under lockdown. With the exception of suppression, all strategies were used more during lockdown than before the pandemic. These results suggest that French respondents sought to adapt to heightened negative affect by using more strategies to cope with the situation. The crisis situation led them to make cognitive, emotional and behavioural efforts to reduce negative affect and maintain positive affect at the same level as before (Gross, 2015; Russell, 2003). These results are consistent with Hamidein et al. (2020), who demonstrated the advantage of using a combination of different strategies to cope with stress. One interesting result is that participants used both adaptive and maladaptive strategies: the use of positive reappraisal increased by 34.4 points, action planning by 22.6 points, acceptance by 20.4 points, and savouring by 20.3 points, while avoidance use also increased by 45.1 points, and rumination by 9.7 points, although suppression did not increase. Larger effect sizes were observed for avoidance and positive reappraisal. These results confirm previous findings (Bolvin & Lancastle, 2010; Monat, 1976; Williams & Watson, 1985) showing large increases in avoidance in uncontrollable situations where individuals are powerless to resolve the problem, even if this kind of strategy does not result in a better emotional experience.

The second objective of our longitudinal study was to analyse changes in emotional experience during the first days of each of the three lockdowns in France. Across these three lockdowns, DNA (*sad* and *bored*) increased and ANA (*nervous* and *worried*) decreased. As lockdown constraints became less drastic, we expected to observe an increase in positive affect and a decrease in negative affect. However, this prediction was only partially confirmed, for although ANA did indeed decrease across the three lockdowns, DNA continued to increase, and there was no significant change in positive affect. Our results therefore confirmed those of Di Blasi et al. (2021) and Yu and Mahendran (2021), who found that during the first phase of pandemic helplessness and astonishment, ANA increased, but individuals subsequently found regulation strategies that enhanced their emotional experience. By contrast, restrictions on freedoms damaged morale in the long run, and had a negative and cumulative effect on boredom and sadness, though not on nervousness and worry. These results for affective change confirmed Gopal et al. (2021)'s research showing that while anxiety tended to decrease during the pandemic, depressive symptoms continued to be experienced. Similarly, Charbonnier et al. (2022) found higher levels of depressive symptoms among students in the second year of the pandemic than in the first year. The media played an important role in both the pandemic and the affect it triggered. Information and news broadcasts were particularly stressful and alarming during the first lockdown. The tone changed slightly over time, as the French Health Ministry's messages took on a more psycho-educational tone and there was less emphasis on guilt. The wording of

speeches by Emmanuel Macron and his government also changed across the three lockdowns. When announcing the first lockdown, Emmanuel Macron used the word *war*, but he and his government subsequently made more reassuring and didactic speeches. The development of the various COVID-19 vaccines reassured part of the population and allowed them to envisage an end to the crisis, thus reducing levels of worry and nervousness. Yu and Mahendran (2021)'s studies of emotions expressed on Twitter showed the same trends, with initial expression of worries about the virus and the lack of medical progress followed by a decrease in negative emotion with the discovery of the first vaccines.

Our research revealed that participants used more emotion regulation strategies during the first lockdown than during the two others. Many strategies remained unchanged across the three lockdowns, suggesting that participants simply made less use of them as their ANA stabilised. Only four strategies changed: avoidance, action planning, proactive behaviour, and savouring. We can assume that worry and powerlessness decreased across the lockdowns, and respondents were reassured by gaining access to vaccines. Our fourth hypothesis whereby people turn to more adaptive regulation strategies when exposed to a succession of stressful situations was only confirmed for savouring. The best fitting multivariate growth curve model used to predict negative and positive affect according to regulation strategy was an invariance model. This seems to run counter to adaptive theory, in that it means that unless individuals learn new emotion regulation strategies, their strategy use remains unchanged. In the absence of psychological support, exposure to stressful crisis situations and repeated lockdowns does not lead people to implement more adaptive regulation strategies, choose more functional strategies, and reduce maladaptive strategy use. Savouring had a relatively singular trajectory. If there is one positive thing about these lockdowns, it is that people started to appreciate the little things in life, thereby promoting positive affect in everyday life (Lucas et al., 2003).

Hypothesis 5 was validated, except for distraction and avoidance. Like Lábadi et al. (2021), we found that maladaptive strategies such as rumination and suppression were associated with more negative affect and less positive affect, while adaptive strategies such as savouring, positive reappraisal, and problem-solving were associated with less negative affect and more positive affect. Again like Lábadi et al. (2021), as well as Zsido et al. (2022), we observed that reappraisal, savouring, and problem-solving contributed to an increase in positive affect. Avoidance was associated with more negative affect, while distraction was not associated with any specific emotional experience. In this repeated lockdown situation, avoiding negative discussions, information and news about the pandemic was not an effective way of reducing negative affect (Dickson et al., 2012; Woby et al., 2007; Yoon & Joormann, 2012), and did not seem to prevent aversive affect, as Suls and Fletcher had postulated (Suls & Fletcher, 1985). Temporality and

chronicity questions are important when it comes to choosing regulation strategies. Continuous use of avoidance strategies during long periods of lockdown could result in their continuance beyond the health crisis, which would be maladaptive and heighten the risk of anxiety and depressive disorders.

Regarding the effect of gender, Di Blasi et al. (2021) in Germany and Fernández-Abascal and Martín-Díaz (2021) in Spain found that women were more affected by COVID-19 than men, and our results confirmed these differences for negative affect, especially DNA, with higher levels of boredom and sadness. Female respondents' experience became increasingly negative across the pandemic. However, their affective trajectory was relatively similar to that of male respondents. A high number of divorces were recorded during the three French lockdowns, as well as cases of domestic violence, and studying conjugal relationships might shed light on the emotional experience of the women in our sample.

The present study had several limitations. First, the questionnaires were completed online, limiting participants to those with Internet access. However, the online recruitment method allowed us to collect data from respondents all over France, despite the lockdown restrictions on travel. The size of the sample remains an issue, specifically regarding education level. Second, participants' follow-up could have been better, as there was considerable loss to follow-up. In the COVID-19 pandemic chaos, participants may have missed follow-up emails. Third, we could have explored affective dynamics using repeated measurements, with network analyses to identify virtuous profiles and positive functioning, as well as negative feedback loops between affect and regulation (Pavani et al., 2017).

The cumulative effects of lockdowns on affect (sadness or boredom) and emotion regulation strategy use may well have damaged the psychological health of the French population. Our results suggest that even if lockdowns can help fight pandemics effectively, public health authorities must be aware of their impact on mental health and long-term consequences. According to Brooks et al. (2020), their psychological impact is vast, substantial, and potentially longlasting. It is therefore important to understand the mental health needs of patients and families, as well as healthcare professionals. The pandemic has highlighted the fragility of the country's healthcare system and the need for evidence-based interventions to improve psychological flexibility (Presti et al., 2020), in terms of emotion regulation strategies. Zhang et al. (2020) argue that psychological support must be available for patients and healthcare professionals in crisis situations. Like Mariani et al. (2020), our own study highlights the importance of promoting emotion regulation strategies and improving people's emotional experience. Compared with other recent infectious disease outbreaks, the use of mindfulness and acceptance and commitment therapy (ACT) to cope with the psychological consequences of COVID-19 could be interesting. Wang et al. (2021) demonstrated the viability of creating scalable, low-cost interventions, as programs targeting reappraisal during the COVID-19 pandemic consistently reduced negative affect and increased positive affect.

Statistical analysis of these data should help resolve previously unanswered questions. For example, did the number of previous traumatic events predict negative experience, quality of life, and stress during the COVID pandemic? Researchers will certainly need to analyse the impact of the media on people's experience and their trust in political and scientific institutions across the three lockdowns. Future studies should also explore how emotion regulation moderates the link between personality and emotional experience (Lucas & Diener, 2009).

5. Conclusion

Affective homeostasis is threatened by stressful situations in everyday life, and the COVID-19 pandemic and attendant government measures such as lockdown considerably modified ordinary people's emotional experience. It is important to measure affective reactions in a

pandemic, in order to anticipate the need for psychosocial support and care, and inform evidence-based health policy.

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CRediT authorship contribution statement

Anne Congard: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft. **Jean-Michel Galharret:** Data curation, Formal analysis, Resources, Software, Visualization, Writing – original draft, Writing – review & editing. **Arnaud Sapin:** Data curation, Formal analysis, Software, Visualization, Writing – original draft, Writing – review & editing. **Amélie Bret:** Conceptualization, Investigation, Methodology, Resources, Software, Writing – review & editing. **Ghozlane Fleury-Bahi:** Conceptualization, Methodology, Resources, Writing – review & editing. **Ambre Khocha:** Investigation, Resources. **Oscar Navarro:** Conceptualization, Methodology. **Abdel Boudoukha:** Conceptualization, Investigation, Methodology, Resources, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

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