



**HAL**  
open science

# Self-isolation, psychotic symptoms and cognitive problems during the COVID-19 worldwide outbreak

Mélissa Allé, Dorthe Berntsen

## ► To cite this version:

Mélissa Allé, Dorthe Berntsen. Self-isolation, psychotic symptoms and cognitive problems during the COVID-19 worldwide outbreak. *Psychiatry Research*, 2021, *Psychiatry Research*, 302, pp.114015. 10.1016/j.psychres.2021.114015 . hal-03273672

**HAL Id: hal-03273672**

**<https://hal.univ-lille.fr/hal-03273672v1>**

Submitted on 29 Jun 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

**Self-isolation, Psychotic Symptoms and Cognitive Problems  
During the COVID-19 Worldwide Outbreak**

Mélissa C Allé\*<sup>a</sup> & Dorthe Berntsen<sup>a</sup>

<sup>a</sup>Center on Autobiographical Memory Research, Department of Psychology and  
Behavioural Sciences, Aarhus University, Denmark

Total word count: 4535

\*Corresponding author:

Mélissa C. Allé  
Center on Autobiographical Memory Research  
Department of Psychology and Behavioural Sciences  
Aarhus University  
Bartholins Allé 11  
8000 Aarhus C  
+45 87 16 54 75  
Email: melissa.alle@univ-lille.fr

### Abstract

The worldwide outbreak of CoronaVirus Disease appeared in 2019 (COVID-19) has forced millions of people into social isolation. Past research has documented negative psychological effects of self-isolation during health crises, in terms of stress, anger or depressive symptoms, but overall ignored psychotic symptoms and cognitive problems. The present study (n = 211) examined the relationship between the conditions of self-isolation – that is, duration, living space, frequency of social interactions – and psychotic symptoms and cognitive problems during the COVID-19 outbreak. The frequency of both psychotic symptoms and cognitive problems was associated with time since last conversation, with time since the person last left home and with smaller living space. Participants who reported an increase of psychotic symptoms and cognitive problems during the period of the pandemic also showed higher levels of symptoms. Although social isolation is an effective method for preventing the COVID-19 from spreading, for some individuals it is associated with an increased risk of developing psychotic symptoms.

*150 words*

*Key words:* COVID-19, self-isolation, confinement, psychotic symptoms, cognitive problems

## **Self-isolation, Psychotic Symptoms and Cognitive Problems During the COVID-19 Worldwide Outbreak**

### 1. Introduction

During the spring 2020, the worldwide outbreak of COVID-19 forced millions of people into social isolation, or even confinement, in their own homes with little social and physical contact with people outside their household. Such widespread social isolation was unprecedented in modern history, and in marked conflict with the highly social nature of human beings (Tomasello, 2014). Due to its exceptional nature, we are lacking knowledge about its short- and long-term consequences.

Previous studies have shown negative psychological effects of quarantine during health crisis, including post-traumatic stress symptoms, confusion and anger (for review, see Brooks et al., 2020). Since the beginning of the COVID-19 pandemic, many studies sought to better understand the nature of this impact and have documented an increase of depressive symptoms, stress and sleep disorders during stay-at-home restrictions, in both individuals with and without psychiatric history (Fiorillo and Gorwood, 2020; Huang and Zhao, 2020; Wang et al., 2020).

Surprisingly, this research has largely ignored psychotic symptoms and cognitive problems. Psychotic symptoms are present, not only in patients with schizophrenia, but also in other clinical populations and, in an attenuated form, among some individuals in non-clinical populations (McGrath et al., 2015), reflecting a “psychosis continuum” (van Os et al., 2009). Past research has documented the development of these symptoms in contexts of solitary confinement, social isolation or sensory deprivation even in healthy individuals. Specifically,

it has been demonstrated that situations of severe solitary or group confinement (in the context of polar, submarine or insular expeditions) are associated with an increase of psychotic symptoms, paranoia and hallucination experiences in healthy populations, who were especially selected and trained to survive in extreme conditions (Cochrane and Freeman, 1989; Gunderson and Nelson, 1963; Strange and Klein, 1973). Similarly, some patients isolated in intensive care units also develop a psychotic syndrome including visual hallucinations and paranoid delusion, unrelated to their neurological condition (Granberg-Axèll et al., 2001).

A series of studies have shown similar psychological effects of social isolation in prisoners kept in supermaximum security units in the USA (Arrigo & Bullock, 2008). It has been well documented that such confinement can lead to severe changes in the sense of reality, problems with memory and concentration, problems with impulse control, self-mutilation, perceptual distortions, hallucination and derealization (Arrigo & Bullock, 2008; Grassian, 1983). It is noteworthy that these symptoms were observed in individuals with no history of psychiatric disorders and that several factors influenced their occurrence: the sensory deprivation severity, the isolation duration, the individual's personality traits, the reasons justifying the confinement, and the individual's psycho-cognitive-social functioning (Grassian and Friedman, 1986).

Overall, the relationship between social isolation (or loneliness) and psychotic symptoms appears robust, as it has been described in various conditions: borderline personality disorder (Slotema et al., 2019), Alzheimer disease (El Haj et al., 2016), psychotic continuum (Chau et al., 2019) and the general population (Narita et al., 2020).

To explain this relationship, Hoffman (2007) hypothesized that social withdrawal critically reduces sensory input and could therefore mirror the effects of sensory

deafferentation on psychotic symptoms (Menon et al., 2003). Indeed, it is well described that sensory loss or impairment (i.e. sensory deafferentation) is responsible for the emergence of hallucinations in the impaired sensory modality (for example the Charles Bonnet syndrome, the phantom limb, or auditory hallucination in case of hearing loss, Linszen et al., 2019). Another potential explanation is that reduced social contacts may reduce social reality testing, which can make the distinction between reality and imagination difficult, leading to perception distortions, derealization, and hallucination (Haney, 2005; White et al., 2000).

Although the social isolation associated with the COVID-19 crisis is considerably milder than the one enforced upon incarcerated individuals in correction facilities or extreme explorers, it shares important similarities. Like these extreme forms, it may involve loneliness, little (or markedly reduced) face-to-face contact, little (or markedly reduced) physical contact, and little (or markedly reduced) possibilities of physical activities, as well as uncertainty about the duration of the isolation. Thus, there are reasons to believe that lockdown-related social isolation may have important psychological consequences in terms of an increase of psychotic symptoms and cognitive problems.

Supporting this hypothesis, two recent articles reported case series of First Episode Psychosis (FEP) admitted to hospitals in Italy in the second month of national lockdown (D'Agostino et al., 2020; Finatti et al., 2020). All patients, with no psychiatric history, presented religious/spiritual delusions and hallucinatory contents. Some of them also presented a somatic delusion of having contracted the SARS-CoV-2 infection. The authors suggest that intense psycho-social stress associated with a novel, potentially fatal disease and national lockdown restrictions might be a trigger for FEP. Escolà-Gascón et al., (2020) showed that perceptual disturbances (mainly derealization and depersonalization), subclinical psychotic symptoms and beliefs in the pseudoscience have increased after the social

quarantine in Spain (Escolà-Gascón et al., 2020). However, this study did not assess other indicators that could explain this increase.

An additional two studies explored whether the first lockdown might have worsened pre-existing psychotic symptoms or caused the emergence of such symptoms in the general population. Using an experimental design, Lopes and collaborators (2020) showed that paranoia were more frequent in students and employed people than unemployed or self-employed people during the pandemic. The presence of hallucinations and paranoia was observed only in people with negative affect (fear of COVID-19) and low political trust. The relationship was mediated by COVID-19 news exposure. In addition, Bortolon and colleagues (2021) explored how paranoia and hallucinations were related to different stress-related factors during the lockdown in the UK. They showed that both hallucination and paranoia were predicted by repetitive thoughts and anxiety. Hallucinations were also related to sleep quality whereas paranoia was predicted by loneliness. However, none of the two studies observed a relationship between psychotic symptoms and the length of isolation during the lockdown.

The present study examined the relationship between psychotic symptoms and a wide range of potential explanatory factors, with a particular focus on living conditions and social isolation in a US-based population. We hypothesized that some characteristics of living conditions during the pandemic (such as living space per person, the duration of the self-isolation, the frequency and quality of social interactions) would be related to the frequency of psychotic symptoms and cognitive problems experienced in a general population. More precisely, based on the existing literature, we hypothesized that psychotic symptoms and cognitive problems would be higher in individuals with less social interactions, more prolonged self-isolation and smaller living space.

## 2. Methods

### 2.1. Participants

Two hundred eleven participants were recruited through Amazon's Mechanical Turk. Participants under 18 years old and non-native English speakers, were excluded. The validity of the collected data was ensured using several safeguards. Several attentional checks were included in the online survey to ensure participants answered the questions attentively and thoroughly, and did not rush through the survey. Those who failed to correctly answer one of the control questions and those who did not fully complete the survey were excluded from the analyses. The dataset was carefully checked for stereotyped responses and short completion time. Dubious participants were removed to avoid poor data quality ( $n = 16$ ).

The final sample consisted of 80 women and 131 men, all living in the USA. Participants' mean age was 38.33 years, and age ranged from 18 to 74 years. There was a roughly even number of men and women, and 85.3% of them were currently employed ( $n = 180$ ). Hence 14.7% of our sample was unemployed at the time of the questionnaire completion, which largely matches USA unemployment rate (= 13.3%) in May 2020 (data from U.S. Bureau of labor statistics). Also, the years of education showed a substantial variability (from 9 to 20). For this study, each Mechanical Turk worker received USD \$ 2.

### 2.2. Procedure and Materials

The study was conducted online using Qualtrics Survey<sup>®</sup> Software. The questions related to the coronavirus-crisis were presented by the end of a larger survey on psychotic symptoms and autobiographical memory. Data were collected during the period of April 27 and May 20, 2020 which overlapped with the time for stay-at-home restrictions in many US states. Participants were asked to answer a series of questions on the current COVID-19 pandemic (see Table 1 for details). The questions were about participants' current life situation during the coronavirus-crisis (i.e., economic situation, social isolation, changes in



life situation, time since the last conversations, time since they last had left home, the frequency of social interactions and the current worries about COVID-19).

The frequency of psychotic symptoms (i.e. reality or perception distortions, hallucinations, alienation, delusion) and cognitive problems (i.e. memory or concentration difficulties, impulse control problems, thought intrusion) were assessed on 5-point Likert scales (see Table 1), adapted from the Community Assessment of Psychic Experiences questionnaire (CAPE ; Stefanis et al., 2002). At the end of these questions, an additional question assessed whether the psychotic symptoms and the cognitive problems reported were currently more frequent, as frequent or less frequent than before the coronavirus-crisis.

By the end of the survey, the lockdown conditions were also assessed. First, participants were asked whether they were presently self-isolating. Following this yes/no question, participants who answered 'yes' were asked to report the duration of their self-isolation, the number of persons in their household, the number of square feet of the place in which they were self-isolating, and whether or not they had outdoor access.

Finally, we measured state anxiety (STAI, state subscale only; Spielberger, 1993), as this is one of the main outcome assessed in previous studies on mental health and confinement (Brooks et al., 2020).

### 2.3. Data analysis

Statistical analyses were performed using SPSS software (version 26). We first conducted Pearson correlations between the frequency of psychotic symptoms, cognitive problems and anxiety, and second between measures of individuals' current life situations and lockdown conditions.

We next transformed open-ended measures of conditions of isolation into similarly sized groups. Between-group comparisons of psychotic symptoms and cognitive controls were carried out based on these groupings and using separate one-way analyses of variance

(ANOVAs). A first series of group comparisons considered psychotic symptoms and cognitive problems as a function of different conditions of self-isolation. A second series of ANOVAs compared individuals having reported an increase versus a decrease of psychotic and cognitive symptoms.

### 3. Results

#### 3.1. Descriptive statistics

Among the 211 participants, 192 participants (91%) reported living in a state where lockdown was endorsed and 129 participants (61,1%) reported being currently self-isolating. Only 6 had lost their job because of the coronavirus outbreak (2.8%), and 180 (85,3%) reported being currently employed. See all descriptive statistics in supplemental material (Tables S1, S2 and S4).

#### 3.2. Mental health measures

##### 3.2.1. Correlation analyses

Scores of questions assessing psychotic symptoms correlated highly with each other's ( $r_s > 0.60$ ;  $p_s < .001$ ; see supplemental material Table S1) and were then analyzed aggregated together under the label "Psychotic symptoms", Cronbach Alpha = 0.95. Similarly, scores of questions on cognitive problems also correlated with each other ( $r_s > 0.23$ ;  $p_s < .01$ ; see supplemental material Table S2) and were analyzed aggregated together under the label "Cognitive problems", Cronbach Alpha = 0.82. Psychotic symptoms correlated with both cognitive problems and state anxiety ( $r_s > 0.14$ ;  $p_s < .04$ ). Cognitive problems and state anxiety, however, did not correlate with each other ( $r = 0.7$ ;  $p = .30$ ). Psychotic symptoms and cognitive problems were not correlated with age ( $r_s < -0.07$ ;  $p_s > .33$ ) or education ( $r_s < 0.11$ ;  $p_s > .11$ ). State anxiety correlated negatively with education ( $r = -0.15$ ;  $p = .03$ ) but not age ( $r = 0.06$ ;  $p = .39$ ). Some of the variables assessing the current life situation and the lockdown conditions also correlated with each other (see supplemental material Table S3).

We found a surprising negative correlation between the self-reported duration of self-isolation and frequency of psychotic symptoms ( $r = -0.25$ ;  $p = .004$ ). Because the self-reported duration of self-isolation was unrelated to the official lockdown duration endorsed by the participants' state of residence ( $r = 0.07$ ;  $p = .44$ ), and because this discrepancy may reflect attitudes concerning preventive activities, personal resources, or political inclination (CNN, n.d.; BBC news, 2020), we calculated the ratio between self-isolation duration and official lockdown duration. This ratio was thought to be a good indicator of the propensity of individuals to self-isolate themselves compared with the official rules endorsed by each state in the USA. Scores above 1.0 reflect a tendency to self-isolate more than required by the official rules, whereas scores under 1.0 reflect the opposite tendency. Negative correlations were observed between this ratio and psychotic symptoms, suggesting that people who self-isolated more than they were asked to do had less frequent psychotic symptoms ( $r = -0.27$ ;  $p = .003$ ). The same pattern of correlations was observed for cognitive problems ( $r = -0.25$ ;  $p = .004$ ), in particular for impulse control and memory problems ( $r_s < -0.21$ ;  $p_s < .005$ ).

### 3.2.2. Groups differences in psychotic symptoms and cognitive problems

#### 3.2.2.1. Groups based on measures of isolation conditions.

To examine associations between key measures of life conditions during the COVID-19 pandemic and psychotic symptoms as well as cognitive problems, we transformed the open-ended key measures of isolation conditions (i.e., days since last conversation, days since they had last left home and square feet per person) into approximately equally sized groups, based on an inspection of the frequency distributions of these variables. We did so, because for such open-ended frequency measures, raw correlations are notoriously noisy and thus less sensitive. This is in part because the differences between the raw numbers likely do not map directly onto psychological importance. For example, if a person had no face-to-face conversation the last 20 days, this may not suggest more severe social isolation than not

having had one for 25 days, whereas a difference between 0 and 5 days of having no face-to-face conversation would seem more psychologically significant, although in raw numbers, the difference is the same. Hence, this relationship is likely not linear and thus not properly described with correlation analyses (nonetheless, all group effects to be reported in the following were replicated by correlational analyses based on the raw frequency measures, see supplemental material, Tables S4).

On the basis of these transformed variables, we conducted group comparisons of the frequency of psychotic symptoms, and cognitive problems, by days since last face-to-face conversation (four groups), days since they last left home (three groups) and by square feet per person (eight groups) (see Figure 1, the first three upper plots). We observed significant group effects of these three factors : (1) days since last face-to-face conversation on psychotic symptoms,  $F(3,207) = 19.89$ ;  $p < .0001$ ;  $\eta^2_p = .22$ , and cognitive problems,  $F(3,207) = 4.14$ ;  $p = .007$ ;  $\eta^2_p = .06$ , (2) days since last left home on psychotic symptoms,  $F(2,208) = 5.45$ ;  $p = .005$ ;  $\eta^2_p = .05$ , and cognitive problems,  $F(2,208) = 3.77$ ;  $p = .02$ ;  $\eta^2_p = .03$ , and (3) square feet per person on psychotic symptoms,  $F(7,121) = 8.58$ ;  $p < .0001$ ;  $\eta^2_p = .33$ , and cognitive problems,  $F(7,121) = 2.52$ ;  $p = .02$ ;  $\eta^2_p = .13$ .

Importantly, these groups did not differ regarding economic impact of COVID-19 (except for groups based on days since they last left home,  $p = .01$ ), level of education, or frequency of having had a psychiatric diagnosis in the past (all  $ps > .053$ ). Thus, these potential confounding variables did not drive the results. Days since last conversation,  $F(2,208) = 4.00$ ;  $p = .008$ ;  $\eta^2_p = .06$ , and Days since last outing,  $F(2,208) = 8.83$ ;  $p < .0001$ ;  $\eta^2_p = .08$ , were associated with level of COVID-19 worries, but living space per person was not,  $F(7,121) = 0.90$ ;  $p = .51$ ;  $\eta^2_p = .05$ .

### 3.2.2.2. Groups based on self-reported increase or decrease of mental problems.

A substantial subclass ( $n = 31$ ) indicated that the reported symptoms and problems had become worse during the time of lockdown, while another substantial subclass ( $n = 27$ ) reported a reduction in symptoms and problems. Most participants ( $n = 153$ ) detected no change. Using one-way ANOVA, we compared the profile of these three groups of participants on psychotic symptoms, cognitive problems and anxiety related to COVID-19 (see all statistics in supplemental material Table S5).

In summary, several significant group effects were observed on the frequencies of both psychotic symptoms,  $F(2,208) = 11,41$ ;  $p < .001$ ;  $\eta^2_p = .10$ , and cognitive problems,  $F(2,208) = 20,00$ ;  $p < .001$ ;  $\eta^2_p = .16$ , on the worries on COVID-19,  $F(2,208) = 3,19$ ;  $p = .04$ ;  $\eta^2_p = .03$ . Posthoc analyses showed that the group of participants reporting an increase of the frequency of their psychological symptoms also presented a higher level of psychotic symptoms,  $p = .003$ , and cognitive problems,  $p < .001$  (see Figure 1, the lowest plots), and higher worries on COVID-19,  $p = .02$ , in comparison to the “as frequent” group.

The group of participants reporting less frequent psychological symptoms during the coronavirus crisis did not report lower frequencies of psychotic symptoms or cognitive problems,  $ps > .16$ . Instead, their scores were comparable with the “as frequent” group (see Figure 1, the lowest plots).

The group reporting more frequent symptoms did not differ from the two others groups on age, education, income, or economic impact of the COVID-19 crisis,  $F_s(2,208) < 1$ ;  $ps > .46$ . However, we observed significant differences between the “more frequent” group and the other groups on square feet per person,  $F(2,126) = 3,96$ ;  $p = .02$ ;  $\eta^2_p = .06$ , and days since last conversation,  $F(2,208) = 13,40$ ;  $p < .001$ ;  $\eta^2_p = .11$ . More precisely, post hoc analyses showed that the “more frequent” group reported fewer square feet per person compared to the “as frequent” group,  $p = .02$ , and more days since last conversation compared to the “less frequent” group,  $p < .001$ .

#### 4. Discussion

The present study examined the relationship between social isolation, psychotic symptoms and cognitive problems in the context of the worldwide COVID-19 pandemic. Overall, we observed relationships between the frequency of both psychotic symptoms and cognitive problems and life conditions (living space and days since the last outing and the last conversation) during a period of widespread stay-at-home restrictions in a general population. A substantial number of the participants reporting an increase in the frequency of their psychotic symptoms and cognitive problems during this period also displayed higher levels of these symptoms in comparison to other participants.

First, group comparisons showed that the severity of both psychotic symptoms and cognitive problems differed as a function of the time since participants' last conversation, since they last left home and as a function of the living space. We observed that the frequency of both psychotic symptoms and cognitive problems was higher when participants lived in smaller homes or had less social interactions or outings (reflected by the number of days since last conversation or last outing). This relationship was stronger during the first days of absence of interactions or outing, suggesting the importance of the lack of interactions from the very first days of isolation. Similarly, the impact of living space on psychotic symptoms and cognitive problems was higher for smaller living space.

Hence, individuals experiencing psychotic symptoms and cognitive disorders more frequently were overall more isolated during the lockdown. These results also suggest that the first days without social interactions or outings are particularly important when considering psychotic symptoms or cognitive problems. The findings are in line with the literature showing strong relationships between loneliness and psychotic symptoms (Bortolon et al., 2021; Chau et al., 2019; Narita et al., 2020). They also underscore the relevance of scientific, medical and societal attention to such symptoms in situations of forced or recommended

social isolation, in particular during the first days of isolation and for people living in small spaces.

Importantly, education, economic impact of COVID-19 and former psychiatric diagnosis were not related to the number of days since the last conversation or days since last outing, or to square feet per person. This finding rules out some of the potential confounding factors that could provide alternative explanations for the observed effects.

Along all the analyses, we found that the measures of psychotic symptoms and cognitive problems were similarly associated with the parameters of life situations or conditions of self-isolation, consistently with earlier findings showing that cognitive deficits are highly frequent in psychotic disorders and play an important role in patients' social functioning (Green et al., 2015; Jabben et al., 2007).

Second, a substantial number of participants, (15%,  $n = 31$ ) reported an increase in the frequency of their psychotic symptoms and cognitive problems during the pandemic and stay-at-home restrictions, in comparison with the period before the lockdown. These results are in agreement with the increase of perceptual disturbances (mainly derealization and depersonalization), subclinical psychotic symptoms and beliefs in the pseudoscience observed after the lockdown in Spain (Escolà-Gascón et al., 2020). In the present study, those participants also reported a higher frequency of psychotic symptoms, cognitive problems and higher worries about the COVID-19, in comparison to other participants. However, they did not differ from other participants on age, education, income or economic impact of the COVID-19 crisis, ruling out lower education or social class as potential explanations for this increase of symptoms. The only detected differences were a smaller living space and a longer time since last conversation compared with the other two groups. Although the present study was not longitudinal, we consider these findings of prime importance as the subjective experience of an increase reflects either a worsening of earlier psychotic symptoms and

cognitive problems or the emergence of new psychotic symptoms and cognitive problems during self-isolation.

Conversely, 13% of the participants ( $n = 27$ ) reported experiencing a decrease in psychotic symptoms and cognitive problems during this period in comparison to the time before the coronavirus crisis. These participants did not report lower levels of psychotic symptoms or cognitive problems. Not knowing the initial frequency of both psychotic symptoms and cognitive problems in this group prevents us from drawing any conclusion on the hypothetical beneficial effects of social isolation on these participants' mental health.

The main limitation of the present study is its cross-sectional design. This prevents us from establishing whether the results reflect specific relationships emerging during a worldwide outbreak or whether they reflect a broader reality as to how psychotic symptoms, quite common in the general population (van Os et al., 2009), relate to individuals' social functioning. To better understand the relationship between the development of psychotic symptoms and cognitive problems during a lockdown period, longitudinal studies are needed. Longitudinal studies examining depressive and anxiety symptoms showed no worsening of mental disorders during the first COVID-19 lockdown (Pan et al., 2020; Fancourt et al., 2020). However, these studies did not assess psychotic symptoms. Nonetheless, while not clarifying the direction of causality, the present findings adds to the literature by showing a clear relation between social isolation and psychotic symptoms as well as cognitive problems, and by showing that a substantial number of participants experienced these problems as having increased during the lockdown. This suggests that psychotic symptoms and cognitive problems are relatively common dysfunctional reactions that lawmakers should take into consideration when issuing societal lockdown. Speculatively, such reactions may help to fuel conspiracy theories and irrational fears in the general public during a health crisis (see also Lopes et al., 2020).



The present study did not use standardized questionnaires to measure conditions of isolation, cognitive impairments and psychotic symptoms. This is because we wanted to word the questions specifically to address the extraordinary event we were facing in terms of COVID-19 lockdowns. For this reason, we adapted some of the standard CAPE questions on psychotic symptoms to the current situation, and we selected items for cognitive problems that previously had been associated with social isolation. Both sets of items showed satisfactory internal reliability. For the sake of brevity, not all variables usually described as related to psychotic symptoms (e.g. quality of sleep) were included in the present study. Future studies should expand the range of questions to include such variables.

To conclude, the present findings identified important societal and psychological factors to take into account in periods of lockdown and stay-at-home restrictions. The findings suggest that some individuals might be more at risk for experiencing psychotic symptoms and cognitive problems than others, namely, those who have few face-to-face interactions, rarely leave home and have small living space per person. Importantly, the present study identified psychotic symptoms as an important, but so far neglected, negative effect of self-isolation and confinement during pandemics.

### **Acknowledgements**

This work was supported by a grant from the Danish National Research Foundation (DNRF89).

## References

- Bortolon, C., Capdevielle, D., Dubreucq, J., Raffard, S., 2021. Persecutory ideation and anomalous perceptual experiences in the context of the COVID-19 outbreak in France: what's left one month later? *J. Psychiatr. Res.* 134, 215–222.  
<https://doi.org/10.1016/j.jpsychires.2020.12.042>
- Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., Rubin, G.J., 2020. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet* 395, 912–920. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)
- Chau, A.K.C., Zhu, C., So, S.H.-W., 2019. Loneliness and the psychosis continuum: a meta-analysis on positive psychotic experiences and a meta-analysis on negative psychotic experiences. *Int. Rev. Psychiatry* 31, 471–490.  
<https://doi.org/10.1080/09540261.2019.1636005>
- CNN, D.A., n.d. Protests are popping up across the US over stay-at-home restrictions [WWW Document]. CNN. URL <https://www.cnn.com/2020/04/16/us/protests-coronavirus-stay-home-orders/index.html> (accessed 8.20.20).
- Cochrane, J.J., Freeman, S.J.J., 1989. Working in Arctic and Sub-Arctic Conditions: Mental Health Issues\*. *Can. J. Psychiatry*. <https://doi.org/10.1177/070674378903400908>
- D'Agostino, A., D'Angelo, S., Giordano, B., Cigognini, A.C., Chirico, M.L., Redaelli, C., Gambini, O., 2020. Brief Psychotic Disorder during the national lockdown in Italy: an emerging clinical phenomenon of the coronavirus pandemic. *Schizophr. Bull.*  
<https://doi.org/10.1093/schbul/sbaa112>
- El Haj, M., Jardri, R., Larøi, F., Antoine, P., 2016. Hallucinations, loneliness, and social isolation in Alzheimer's disease. *Cognit. Neuropsychiatry* 21, 1–13.  
<https://doi.org/10.1080/13546805.2015.1121139>
- Escolà-Gascón, Á., Marín, F.-X., Rusiñol, J., Gallifa, J., 2020. Pseudoscientific beliefs and psychopathological risks increase after COVID-19 social quarantine. *Glob. Health* 16.  
<https://doi.org/10.1186/s12992-020-00603-1>
- Finatti, F., Pigato, G., Pavan, C., Toffanin, T., Favaro, A., 2020. Psychosis in Patients in COVID-19-Related Quarantine: A Case Series. *Prim. Care Companion CNS Disord.* 22.  
<https://doi.org/10.4088/PCC.20102640>
- Fiorillo, A., Gorwood, P., 2020. The consequences of the COVID-19 pandemic on mental health and implications for clinical practice. *Eur. Psychiatry* 63.  
<https://doi.org/10.1192/j.eurpsy.2020.35>
- Granberg-Axèll, A., Bergbom, I., Lundberg, D., 2001. Clinical signs of ICU syndrome/delirium: an observational study. *Intensive Crit. Care Nurs.* 17, 72–93.  
<https://doi.org/10.1054/iccn.2000.1539>

- Grassian, S., Friedman, N., 1986. Effects of sensory deprivation in psychiatric seclusion and solitary confinement. *Int. J. Law Psychiatry* 8, 49–65. [https://doi.org/10.1016/0160-2527\(86\)90083-X](https://doi.org/10.1016/0160-2527(86)90083-X)
- Green, M.F., Horan, W.P., Lee, J., 2015. Social cognition in schizophrenia. *Nat. Rev. Neurosci.* 16, 620–631. <https://doi.org/10.1038/nrn4005>
- Gunderson, E.K.E., Nelson, P.D., 1963. Adaptation of small groups to extreme environments. *Aerosp. Med.* 34, 1111–1115.
- Haney, C., 2005. *Reforming Punishment: Psychological Limits to the Pains of Imprisonment*, 1st ed. American Psychological Association.
- Hoffman, R.E., 2007. A social deafferentation hypothesis for induction of active schizophrenia. *Schizophr. Bull.* 33, 1066–1070. <https://doi.org/10.1093/schbul/sbm079>
- Huang, Y., Zhao, N., 2020. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res.* <https://doi.org/10.1016/j.psychres.2020.112954>
- Jabben, N., van Os, J., Janssen, I., Versmissen, D., Krabbendam, L., 2007. Cognitive alterations in groups at risk for psychosis: neutral markers of genetic risk or indicators of social disability? *Acta Psychiatr. Scand.* 116, 253–262. <https://doi.org/10.1111/j.1600-0447.2006.00990.x>
- Linszen, M.M.J., van Zanten, G.A., Teunisse, R.J., Brouwer, R.M., Scheltens, P., Sommer, I.E., 2019. Auditory hallucinations in adults with hearing impairment: a large prevalence study. *Psychol. Med.* 49, 132–139. <https://doi.org/10.1017/S0033291718000594>
- Lopes, B., Bortolon, C., Jaspal, R., 2020. Paranoia, hallucinations and compulsive buying during the early phase of the COVID-19 outbreak in the United Kingdom: A preliminary experimental study. *Psychiatry Res.* 293, 113455. <https://doi.org/10.1016/j.psychres.2020.113455>
- McGrath, J.J., Saha, S., Al-Hamzawi, A., Alonso, J., Bromet, E.J., Bruffaerts, R., Caldas-de-Almeida, J.M., Chiu, W.T., de Jonge, P., Fayyad, J., Florescu, S., Gureje, O., Haro, J.M., Hu, C., Kovess-Masfety, V., Lepine, J.P., Lim, C.C.W., Mora, M.E.M., Navarro-Mateu, F., Ochoa, S., Sampson, N., Scott, K., Viana, M.C., Kessler, R.C., 2015. Psychotic Experiences in the General Population: A Cross-National Analysis Based on 31,261 Respondents From 18 Countries. *JAMA Psychiatry* 72, 697–705. <https://doi.org/10.1001/jamapsychiatry.2015.0575>
- Menon, G.J., Rahman, I., Menon, S.J., Dutton, G.N., 2003. Complex visual hallucinations in the visually impaired: the Charles Bonnet Syndrome. *Surv. Ophthalmol.* 48, 58–72.
- Narita, Z., Stickley, A., DeVlyder, J., 2020. Loneliness and psychotic experiences in a general population sample. *Schizophr. Res.* <https://doi.org/10.1016/j.schres.2020.01.018>
- Slotema, C.W., Bayrak, H., Linszen, M.M.J., Deen, M., Sommer, I.E.C., 2019. Hallucinations

in patients with borderline personality disorder: characteristics, severity, and relationship with schizotypy and loneliness. *Acta Psychiatr. Scand.* 139, 434–442.  
<https://doi.org/10.1111/acps.13012>

Spielberger, C.D., 1993. *State-trait anxiety inventory: a comprehensive bibliography.* Consulting Psychologists Press.

Stefanis, N.C., Hanssen, M., Smirnis, N.K., Avramopoulos, D.A., Evdokimidis, I.K., Stefanis, C.N., Verdoux, H., Van Os, J., 2002. Evidence that three dimensions of psychosis have a distribution in the general population. *Psychol. Med.* 32, 347–358.

Strange, R.E., Klein, W.J., 1973. Emotional and social adjustment of recent US winter-over parties in isolated Antarctic stations\*\*The opinions expressed herein are those of the authors and cannot be construed as reflecting the views of the Navy Department or of the Naval Service at large., in: Edholm, O.G., Gunderson, E.K.E. (Eds.), *Polar Human Biology.* Butterworth-Heinemann, pp. 410–416. <https://doi.org/10.1016/B978-0-433-08155-5.50043-1>

Tomasello, M., 2014. The ultra-social animal. *Eur. J. Soc. Psychol.* 44, 187–194.  
<https://doi.org/10.1002/ejsp.2015>

van Os, J., Linscott, R.J., Myin-Germeys, I., Delespaul, P., Krabbendam, L., 2009. A systematic review and meta-analysis of the psychosis continuum: evidence for a psychosis proneness-persistence-impairment model of psychotic disorder. *Psychol. Med.* 39, 179–195.  
<https://doi.org/10.1017/S0033291708003814>

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C.S., Ho, R.C., 2020. Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. *Int. J. Environ. Res. Public Health* 17. <https://doi.org/10.3390/ijerph17051729>

What's behind the anti-lockdown protests in US?, 2020. . BBC News.

White, R., Bebbington, P., Pearson, J., Johnson, S., Ellis, D., 2000. The social context of insight in schizophrenia. *Soc. Psychiatry Psychiatr. Epidemiol.* 35, 500–507.  
<https://doi.org/10.1007/s001270050271>

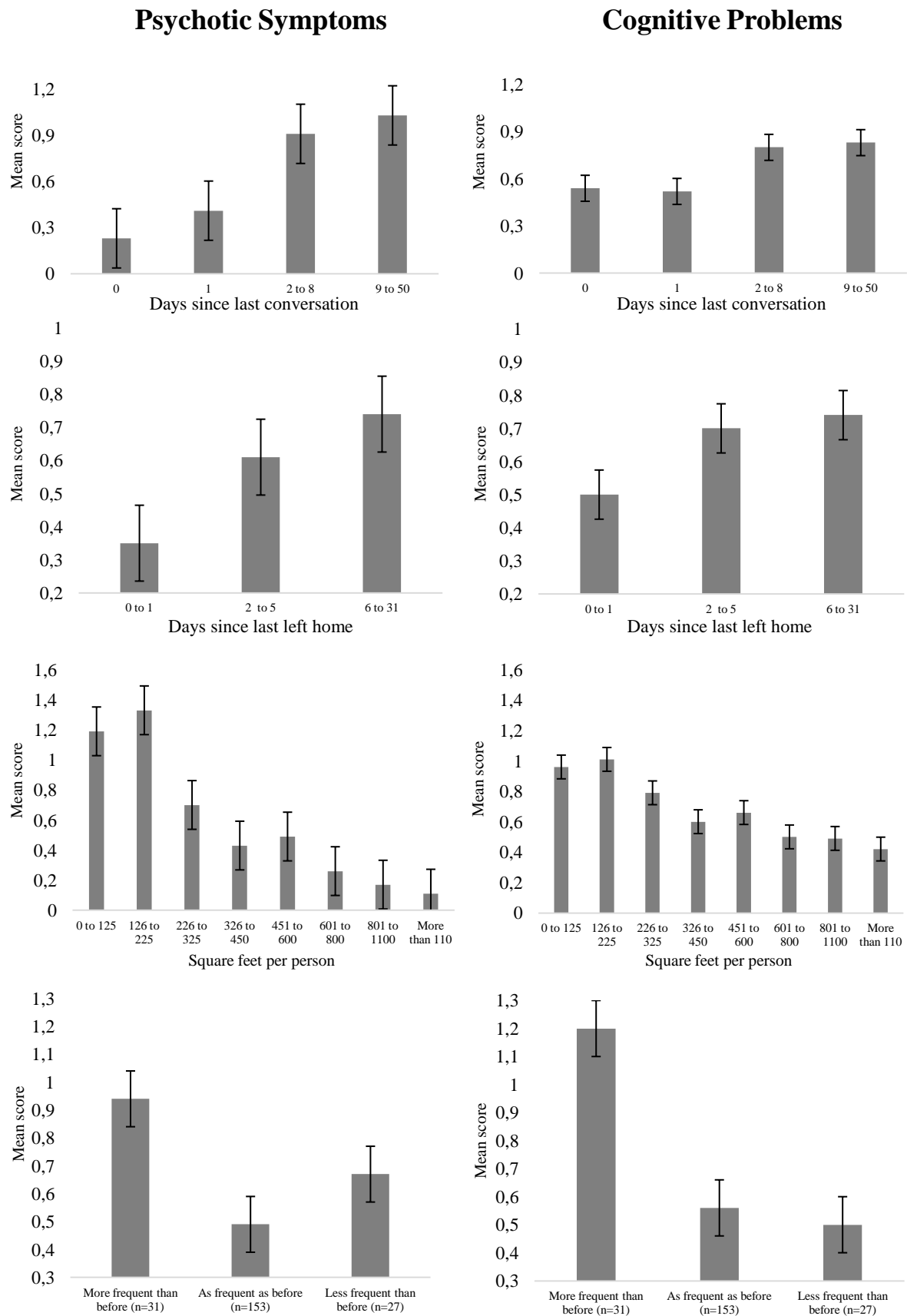


Figure 1. Mean ratings of psychotic symptoms (left plots) and cognitive problems (right plots) as a function of the number of days since the last conversation (first row), since participants last left home (second row), of living space (third row), and of the development of these symptoms during the coronavirus crisis (fourth row). Error bars represent standard errors.

Table 1

Questions Included in the Survey on Current Life Situations, Lockdown Conditions and Psychological Reactions During the Corona-crisis

Variables	Questions
<b>Current Life Situation</b>	
Economic Situation	Is your economic situation impacted by the corona-crisis? <i>From 1 = To a very small extent to 5 = To a very great extent</i>
Lockdown	Does your state/country have a lockdown? <i>Yes/No</i>
Socially isolated	Would you describe yourself as being socially isolated due to the corona-crisis? <i>From 1 = To a very small extent to 5 = To a very great extent</i>
Life difference	Does your daily life situation during the corona-crisis differ from your normal life situation? <i>From 1 = To a very small extent to 5 = To a very great extent</i>
Last conversation	When did you last have a face-to-face conversation with another person? <i>Please indicate the number of days (use 0 days ago if last time was today)</i>
Last leave home	When did you last leave home? <i>Please indicate the number of days (use 0 days ago if last time was today)</i>
Frequency interactions	How often do you have face-to-face interactions with other people during the time of the corona-crisis? <i>From 1 = Never to 5 = Once an hour or more</i>
Worries Covid-19	Are you worried about the Covid-19? <i>From 1 = To a very small extent to 5 = To a very great extent</i>
<b>Psychotic symptoms</b>	
Reality distortion	During the corona-crisis, have you experienced a distorted sense of reality? <i>From 0 = Never to 4 = Nearly Always</i>
Perception distortion	During the corona-crisis, have you experienced distortions or misinterpretation of environmental stimuli? <i>From 0 = Never to 4 = Nearly Always</i>
Alienation	During the corona-crisis, have you felt alienated, as if you were living in a dream? <i>From 0 = Never to 4 = Nearly Always</i>
Conspiracy	During the corona-crisis, have you felt as if there is a conspiracy against you? <i>From 0 = Never to 4 = Nearly Always</i>
Hearing voices	During the corona-crisis, have you ever had the experience of hearing a person's voice and then found that no-one was there? <i>From 0 = Never to 4 = Nearly Always</i>
Visual hallucination	During the corona-crisis, have you ever had the experience of seeing someone/something and then found that no-one/nothing was in fact there? <i>From 0 = Never to 4 = Nearly Always</i>
<b>Cognitive problems</b>	
Intrusive thoughts	During the corona-crisis, have you experienced intrusive thoughts about the future or past? <i>From 0 = Never to 4 = Nearly Always</i>
Impulse control	During the corona-crisis, have you experienced problems with impulse control? <i>From 0 = Never to 4 = Nearly Always</i>
Memory problems	During the corona-crisis, have you experienced problems with memory, such as forgetting where you put things? <i>From 0 = Never to 4 = Nearly Always</i>
Concentration problems	During the corona-crisis, have you experienced problems concentrating? <i>From 0 = Never to 4 = Nearly Always</i>
Intrusive future thoughts	During the corona-crisis, have you experienced intrusive, unwanted thoughts or images concerning a possible stressful experience in the future, in relation to the coronavirus crisis? <i>From 0 = Never to 4 = Nearly Always</i>
Voluntary future thoughts	During the corona-crisis, have you thought or talked about possible stressful experience in the future, in relation to the coronavirus crisis? <i>From 0 = Never to 4 = Nearly Always</i>
<b>Course</b>	In general, compared with the time before the beginning of the corona-crisis, those experiences* are: <i>More frequent than before/ As frequent as before/ Less frequent than before</i>
<b>Lockdown Conditions</b>	
Self-isolated	Are you presently self-isolated due to the coronavirus outbreak? <i>Yes/No</i>
Isolation duration	How many days have you been self-isolating in your home?
Household	How many other people are in your household self-isolating together with you?
Isolation surface	Which surface (in ft <sup>2</sup> ) is the place where you are presently self-isolated?
Outdoor	Do you have outdoor access during the self-isolation?

\*Referring to both psychotic symptoms and cognitive problems