# The impact of social isolation and changes in work patterns on ongoing thought during the first COVID-19 lockdown in the United Kingdom

Brontë Mckeown[a,1], Giulia L. Poerio[b], Will H. Strawson[c], Léa M. Martinon[d], Leigh M. Riby[e], Elizabeth Jefferies[a], Cade McCall[a,2], and Jonathan Smallwood[f,2]

[a]Department of Psychology, University of York, York, YO10 5DD, United Kingdom; [b]Department of Psychology, University of Essex, Colchester, CO4 3SQ, United Kingdom; [c]Neuroscience, Brighton and Sussex Medical School, University of Sussex, Brighton, BN1 9PX, United Kingdom; [d]Laboratoire de Psychologie Cognitive et Sociale, CNRS UMR 6024, Université Clermont Auvergne, 63000 Clermont-Ferrand, France; [e]Department of Psychology, Northumbria University, Newcastle upon Tyne, NE1 8ST, United Kingdom; and [f]Psychology Department, Queen's University, Kingston, Ontario, K7L 3N6, Canada

Edited by Susan T. Fiske, Princeton University, Princeton, NJ, and approved August 25, 2021 (received for review February 23, 2021)

**The COVID-19 pandemic led to lockdowns in countries across the world, changing the lives of billions of people. The United Kingdom's first national lockdown, for example, restricted people's ability to socialize and work. The current study examined how changes to socializing and working during this lockdown impacted ongoing thought patterns in daily life. We compared the prevalence of thought patterns between two independent real-world, experience-sampling cohorts, collected before and during lockdown. In both samples, young (18 to 35 y) and older (55+ y) participants completed experience-sampling measures five times daily for 7 d. Dimension reduction was applied to these data to identify common "patterns of thought." Linear mixed modeling compared the prevalence of each thought pattern 1) before and during lockdown, 2) in different age groups, and 3) across different social and activity contexts. During lockdown, when people were alone, social thinking was reduced, but on the rare occasions when social interactions were possible, we observed a greater increase in social thinking than prelockdown. Furthermore, lockdown was associated with a reduction in future-directed problem solving, but this thought pattern was reinstated when individuals engaged in work. Therefore, our study suggests that the lockdown led to significant changes in ongoing thought patterns in daily life and that these changes were associated with changes to our daily routine that occurred during lockdown.**

lockdown | COVID-19 | isolation | thoughts | experience sampling

On March 23, 2020, the United Kingdom entered a nationwide lockdown to curb the spread of COVID-19. This first national lockdown required people to stay at home and not meet with anyone outside their household. Social gatherings were banned, and "nonessential" industries were closed, reducing opportunities for work (1). There were also large economic changes (2), and death rates increased substantially (3). Studies show the lockdown had widespread psychological and behavioral consequences including elevated anxiety and depression levels (4), overall deterioration of mental health (5), changes to diet and physical activity (6–8), high levels of loneliness (9), and increasing suicidal ideation (10). Our study used experience sampling to measure patterns of ongoing thoughts before and during lockdown in the United Kingdom, with the aim of understanding how specific features of the stay-at-home order impacted people's thinking in daily life, and to use this data to inform contemporary theoretical views on ongoing thought.

Our investigation served three broad goals. First, the lockdown led to changes in opportunities for socializing, and contemporary theories of ongoing thought suggest that social processing is an important influence on our day-to-day thinking (11, 12). For example, previous research indicates that individuals spend a lot of time thinking about other people in daily life (13, 14) or when performing tasks dependent on social cognition in the laboratory (15). Importantly, spontaneous social thoughts decline following periods of solitude and increase following periods of social interaction in the laboratory (11). They can also facilitate socioemotional adjustment during important life transitions, such as starting university (16). Furthermore, ongoing thought patterns with social features are associated with increased neural responses to social stimuli (in this case, faces) (17). Such evidence suggests that the social environment can shape ongoing thought, leading to the possibility that changes in opportunities for socialization following the stay-at-home order could have changed the expression of social thinking in daily life.

Second, lockdowns also disrupted individuals' normal working practices, forcing people to reassess their goals. Prior work highlights that ongoing thought content is linked to an individual's current concerns and self-related goals (18–21) and that experimentally manipulating an individual's goals can prime ongoing thought to focus on these issues (21–23). In particular, a substantial proportion of ongoing thoughts are future directed (14, 18, 21, 24–26), and this "prospective bias" is thought to support the formation and refinement of personal goals for future behavior (18, 21, 27, 28). Notably, this type of thought is also important in maintaining mental health through associations with improved subsequent mood (24) and reduced suicidal ideation (29, 30).

## Significance

**Since the emergence of COVID-19, lockdowns have been imposed across the globe. These lockdowns change daily life considerably, reducing opportunities to socialize and work. The current study investigated how these changes may impact people's ongoing thought patterns by examining experience-sampling data gathered before and during the United Kingdom's first national lockdown. We found that socializing and working were significant predictors of ongoing thought in daily life and that limiting these activities during lockdown contributed to changes in ongoing thought patterns. Our findings highlight how ongoing thought patterns are shaped by the daily activities we engage in, both during lockdowns and in more normal times.**

Author contributions: B.M., G.L.P., W.H.S., L.M.R., E.J., C.M., and J.S. designed research; B.M., G.L.P., and L.M.M. performed research; B.M. analyzed data; B.M., G.L.P., W.H.S., L.M.M., L.M.R., E.J., C.M., and J.S. wrote the paper; B.M., G.L.P., W.H.S., and C.M. prepared materials; B.M. prepared visualization; L.M.R., E.J., and J.S. provided funding acquisition; and E.J., C.M., and J.S. provided supervision.

The authors declare no competing interest.

This article is a PNAS Direct Submission.



[1]To whom correspondence may be addressed. Email: bronte.mckeown@york.ac.uk.

[2]C.M. and J.S. contributed equally to this work.

This article contains supporting information online at https://www.pnas.org/lookup/suppl/doi:10.1073/pnas.2102565118/-/DCSupplemental.

Published October 1, 2021.

PSYCHOLOGICAL AND COGNITIVE SCIENCES

Changes to opportunities for working during the lockdown, therefore, provide a chance to understand whether prospective features of ongoing thought are altered when important external commitments change.

Third, previous work indicates that the contents of thought vary across the life span. For example, during periods of low cognitive demand, younger adults report significantly more future-directed thoughts, while older adults report significantly more past-related thoughts (31). At rest, older adults report more "novel" and present-oriented thoughts compared to younger adults (32). In daily life, older adults tend to report fewer "off-task" thoughts than younger adults, and their thoughts are rated as more "pleasant," "interesting," and "clear" (33). Finally, aging is associated with a decline in daydreaming, particularly a reduction in topics such as the future, fear of failure, or guilt (34). However, the degree to which these age-related changes are explained by lifestyle differences between young and older individuals is unclear. The lockdown may have altered key contextual factors that, under normal circumstances, differ systematically between younger and older adults. For example, increasing age is associated with more interactions with family members and fewer with "peripheral partners" (e.g., coworkers, acquaintances, and strangers) (35), a pattern that may be common in younger people during lockdown. With all this in mind, the lockdown provided an opportunity to examine whether changes to daily life during the lockdown differentially impacted ongoing thought patterns in younger and older individuals.

Our study used an experience-sampling methodology in which people are signaled at random times in their daily lives to obtain multiple reports describing features of their ongoing thoughts and the context in which they occur (e.g., social environment, activity, and location) (36). To examine the contents of people's thoughts, we used multidimensional experience sampling (MDES) (37). In this method, participants describe their in-the-moment thoughts by rating their thoughts on several dimensions (e.g., temporal focus or relationship to self and others) (38). Dimension reduction techniques can then be applied to use covariation in the responses to different questions to identify "patterns of thought" (37, 39). Previous studies have used MDES to identify common patterns of ongoing thought, varying in both form and content, often with distinct neural correlates (27, 37, 39–43). For example, a pattern of episodic social cognition is associated with increased activity within regions of the ventromedial prefrontal cortex associated with memory and social cognition (41), while a pattern of external task focus is associated with increased activity in the intraparietal sulcus (42). In addition, at rest, visual imagery is associated with stronger interactions between the precuneus and lateral frontotemporal network (44), while detailed task focus is high during working memory tasks (15) and other complex tasks (45) and linked to activity in the default mode network during working memory maintenance (46).

In summary, our study set out to examine whether ongoing thought patterns experienced during lockdown differed from those normally reported in daily life, focusing on the consequences of changes in opportunities for socialization and work. The prelockdown sample was an existing dataset used to provide a baseline for ongoing thought patterns in daily life before lockdown restrictions. In both samples, young (18 to 35 y) and older (55+ y) participants completed surveys five times daily over 7 d. Each sampling point obtained in the moment measured key dimensions of ongoing thought using MDES (37). Participants also provided information regarding the social environment in which the experience occurred. Dimension reduction was applied to both samples' thought data to identify common patterns of thought. We then used linear mixed modeling (LMM) to explore the prevalence of each thought pattern 1) before and during lockdown, 2) in different age groups, and 3) across social contexts. In the lockdown sample, participants provided additional information regarding their current activity (e.g., working or leisure activities) and virtual social environment, which we used to explore how specific features of daily life during lockdown corresponded with patterns of thought.

## Results

**Changes to Daily Life during Lockdown.** In both samples, after first assessing the contents of their thoughts, participants were asked about their social environment immediately before being signaled. We expected that the percentage of responses for which participants reported being alone would be higher in the lockdown sample than the prelockdown sample. To test this, we calculated the percentage of each participant's responses in which they said they were 1) alone, 2) around people but not interacting, and 3) around people and interacting. Sample means for each of the three percentages, for young and older participants, are shown in Fig. 1*A*. A two-way ANOVA confirmed that during lockdown, the "alone" percentage was significantly higher compared to prelockdown [$F(1) = 12.03$, $P < 0.001$, $\eta_p^2 = 0.06$] and significantly higher for younger compared to older participants across both samples (pre- and during lockdown) [$F(1) = 13.25$, $P < 0.001$, $\eta_p^2 = 0.06$]. Participants in the lockdown sample also reported their location immediately before completing the survey. Overall percentages for each option are shown in Fig. 1*B*, revealing that 85% of responses were "inside at home." These analyses establish that people spent more time alone during lockdown and most of their time inside at home.

**Patterns of Thought.** To identify common patterns of thought across both samples, we combined the thought data from both samples (*SI Appendix*, Table S1) and decomposed these in a single principal components analysis (PCA). Based on eigenvalues >1, five components—accounting for 53% of the total variance—were retained for further analysis (see *SI Appendix*, Fig. S1 for scree plot): 1) "future-directed problem solving"—describing patterns of thought with the highest loadings on "problem solving," "future goals," "controlled," and "rehearsing future"; 2) "pleasant engagement"—with the highest loadings on "positive," "wanted," "current goals," and "task"; 3) "episodic social cognition"—with the highest loadings on "close others," "important," "self," and "future"; 4) "imagery"—with the highest loadings on "vivid," "images," and "detailed"; and 5) "detailed task focus"—with the highest loadings on "words," "task," "detailed," and "current goals." Item loadings on these components are presented as word clouds in Fig. 1*C* (see *SI Appendix*, Table S2 for exact component loadings). To ensure that the thought patterns identified across samples were present in both samples, we ran a PCA on each sample separately (specifying five components for extraction) and correlated each participant's PCA score from this analysis with their PCA score from the combined analysis, revealing a high correspondence between patterns seen in the two samples (see *SI Appendix*, Fig. S2 for scatterplots).

**Comparing Thought Patterns between 1) Pre- and during Lockdown Samples, 2) Age Groups, and 3) Social Environments.** Having identified five patterns of thought, we examined the influence that lockdown, and changes to social interactions during lockdown, had on ongoing thought by comparison with the baseline group. We performed a series of LMMs in which each of the five thought patterns was the outcome measure (see *Materials and Methods*). These models included three explanatory variables and their interactions: 1) whether the sample was pre- or during lockdown, 2) whether the individual was young or older, and 3) the nature of the social environment in which the experience occurred (alone, with others not interacting, or with others and interacting). For each model, alpha was set to <0.01 (two tailed) to account for family-wise error emerging from conducting five models (i.e., 0.05/5). The reported alpha levels in our paper are unadjusted; main effects and interactions are considered

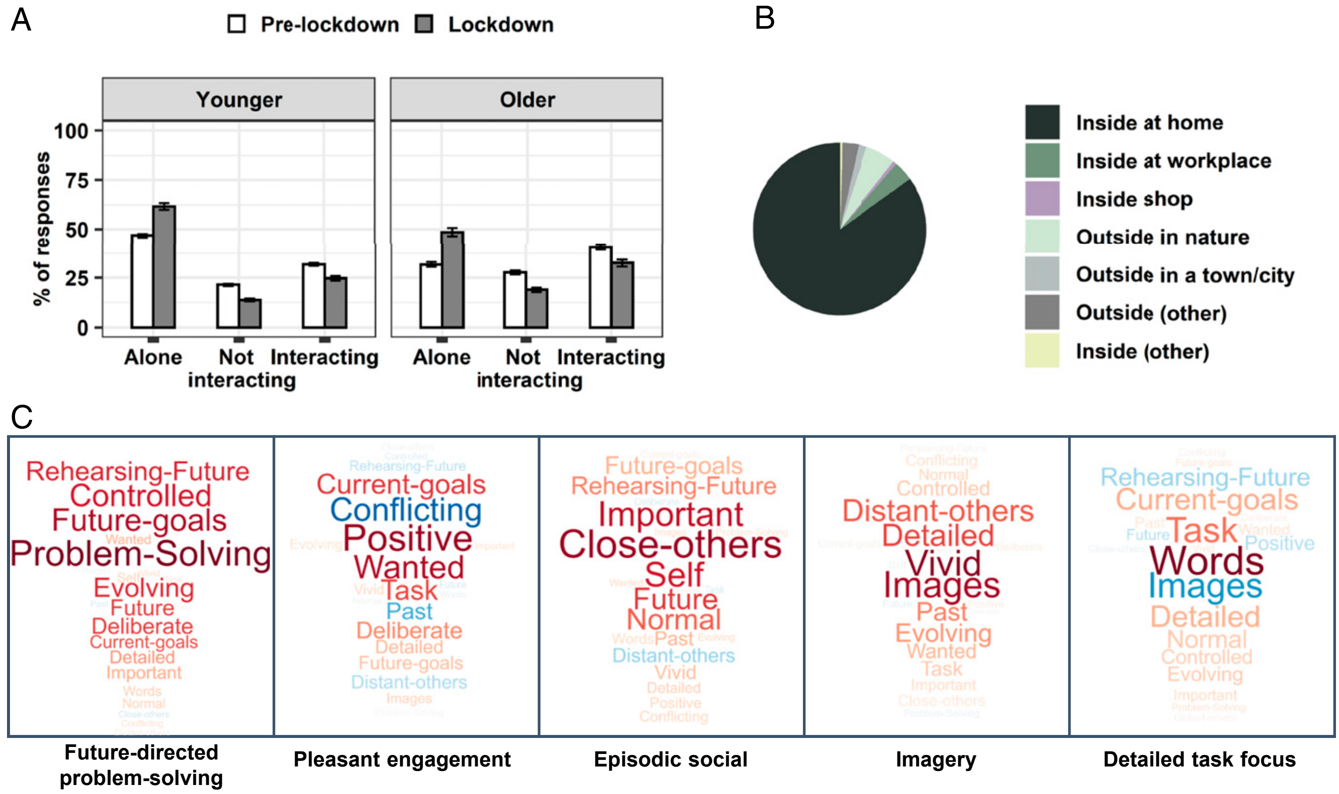


**Fig. 1.** Changes to daily life during lockdown and patterns of ongoing thought identified across both experience-sampling datasets (pre- and during lockdown). (*A*) Bar chart comparing the mean percentage of experience-sampling responses in which participants said they were 1) alone, 2) around other people but not interacting, or 3) around people and interacting, between age groups and samples, demonstrating that during lockdown, both age groups reported being alone more than prelockdown. Error bars represent 95% CIs (*N* observations = 4,955). (*B*) The pie chart shows the percentage of responses for each location option in the lockdown sample, demonstrating that the majority (85%) of responses were "inside at home" (*N* observations = 1,865). (*C*) Word clouds representing the item loadings on the five patterns of thought identified in the thought data from both samples (pre- and during lockdown) (*N* observations = 4,876) using PCA. Each word represents an experience-sampling item (22 items; *SI Appendix*, Table S1). Font size represents the magnitude of the loading, and the color describes the direction. Warm colors reflect positive loadings, while cool colors reflect negative loadings (see *SI Appendix*, Table S2 for exact component loadings).

significant only at the $P < 0.01$ level. When probing these significant main effects and interactions using pairwise comparisons, the alpha level was Bonferroni adjusted to account for the number of tests being conducted; here, the adjusted alpha levels are reported in parentheses. Estimates are unstandardized and reflect the difference between each factor level and the intercept (grand mean of all conditions). These results are summarized in Fig. 2 (see *SI Appendix*, Tables S3–S5 for ANOVA output, parameter estimates, and the variance explained by random effects).

***Model 1: Future-directed problem solving.*** There was a significant main effect of sample (pre- versus during lockdown) [$F(1) = 16.19$, $P < 0.001$]. Future-directed problem solving was lower in the lockdown sample ($b = -0.15$, 95% CI ($-0.23$, $-0.08$), $t(191) = -4.02$, $P < 0.001$). There was also a significant main effect of age group [$F(1) = 6.33$, $P = 0.013$], with future-directed problem solving higher in younger participants [$b = 0.10$, 95% CI (0.02, 0.17), $t(188) = 2.52$, $P = 0.012$]. There was also a significant main effect of social environment [$F(2) = 31.36$, $P < 0.001$], with future-directed problem solving lower when interacting with other people [$b = -0.17$, 95% CI ($-0.21$, $-0.12$), $t(4850) = -7.52$, $P < 0.001$]. Therefore, the lockdown was associated with a reduction in future-directed problem solving regardless of social environment or age group.

***Model 2: Pleasant engagement.*** Levels of pleasant engagement significantly varied by age group [$F(1) = 19.82$, $P < 0.001$] and were lower in younger participants [$b = -0.19$, 95% CI ($-0.27$, $-0.10$), $t(191) = -4.45$, $P < 0.001$). There was a significant main effect of social environment [$F(2) = 5.43$, $P = 0.004$], with pleasant engagement highest when participants were interacting with others [$b = 0.07$, 95% CI (0.03, 0.11), $t(4833) = 3.29$, $P < 0.001$] and lowest when around people but not interacting [$b = -0.05$, 95% CI ($-0.10$, $-0.00$), $t(4802) = -1.99$, $P = 0.046$]. There was also a significant interaction between age group and social environment [$F(2) = 5.60$, $P = 0.004$]. Pairwise comparisons at each level of social environment split by age group (Bonferroni adjusted for six tests) revealed that for younger participants, pleasant engagement was significantly higher when interacting with other people compared to when alone [$b = 0.20$, 95% CI (0.09, 0.31), $t(4808) = 4.90$, $P < 0.001$] or when around other people but not interacting [$b = 0.22$, 95% CI (0.09, 0.36), $t(4786) = 4.43$, $P < 0.001$]. For older participants, however, pleasant engagement did not significantly vary across social environments ($P > 0.05$). Regardless of the lockdown, therefore, social situations were characterized by higher levels of pleasant engagement for younger individuals.

***Model 3: Episodic social cognition.*** There was a significant main effect of social environment [$F(2) = 35.20$, $P < 0.001$] with episodic social cognition highest when interacting with others [$b = 0.19$, 95% CI (0.14, 0.23), $t(4840) = 8.37$, $P < 0.001$] and lowest when around people but not interacting [$b = -0.11$, 95% CI ($-0.16$, $-0.06$), $t(4815) = -4.35$, $P < 0.001$). There was a significant main effect of age group [$F(1) = 6.10$, $P = 0.014$]. Episodic social cognition was higher in younger participants [$b = 0.10$, 95% CI (0.02, 0.18), $t(193) = 2.47$, $P = 0.014$]. There was

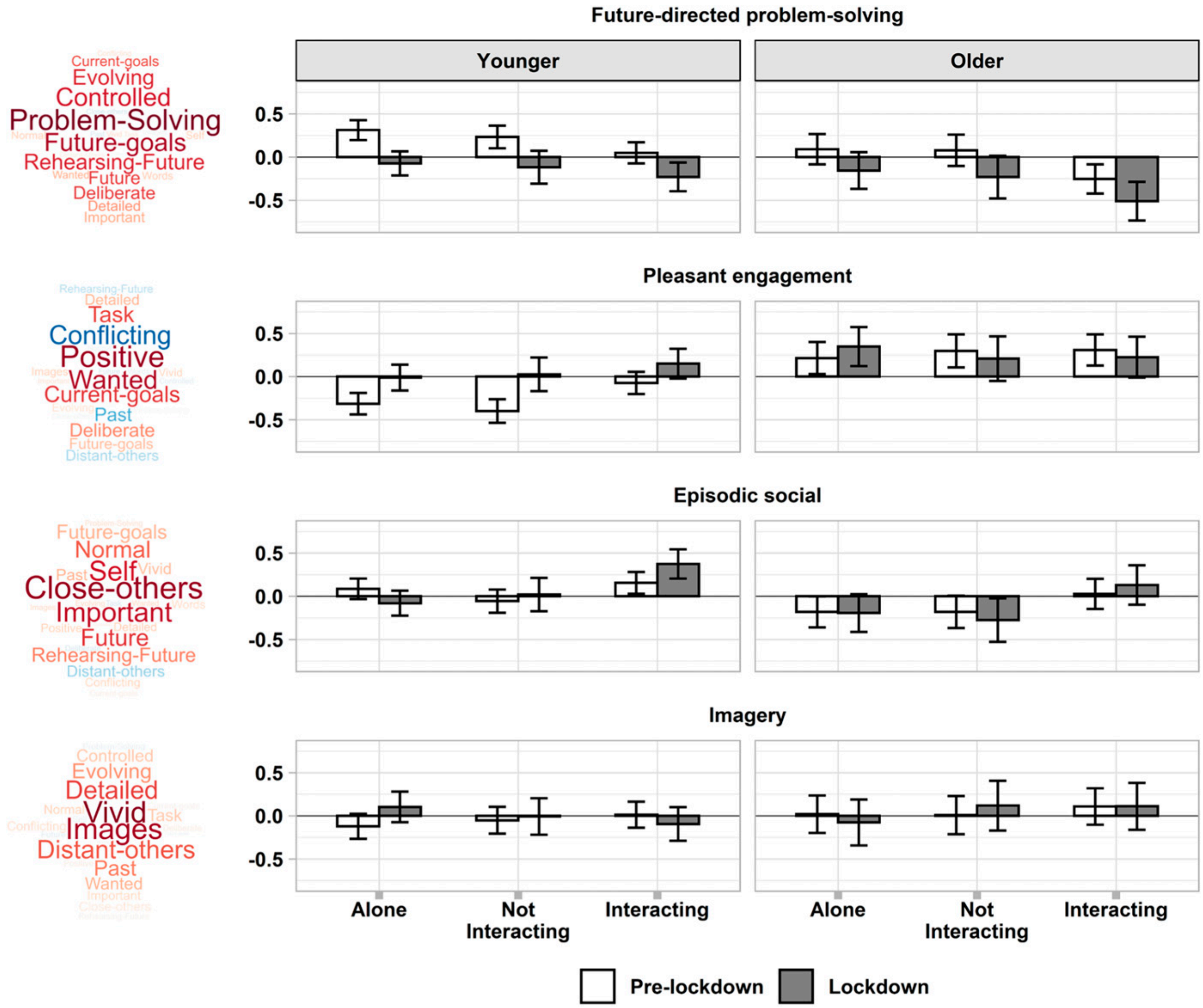


**Fig. 2.** A summary of the LMMs' results comparing the prevalence of each thought pattern between 1) pre- and during-lockdown samples, 2) age groups, and 3) social environments. On the left-hand side, there are the word clouds representing each thought pattern. Each word represents an experience-sampling item (*SI Appendix*, Table S1). Font size represents the magnitude of the loading, and the color describes the direction. Warm colors reflect positive loadings, while cool colors reflect negative loadings. The *y*-axis of each graph shows the predicted means for each thought pattern. The *x*-axis shows the social environment options: 1) alone, 2) around people but not interacting, and 3) around people and interacting. White bars represent the prelockdown sample, and gray bars represent the lockdown sample. Each bar graph is split by age group, with young participants on the left and older on the right. Error bars represent the 95% CIs for each predicted mean. In total, 195 participants (4,870 observations) were included in this analysis.

also a significant interaction between sample (pre- versus during lockdown) and social environment [$F(2) = 6.06$, $P = 0.002$]. This interaction indicated that although episodic social cognition was most prevalent when interacting with others in both samples, the increase in episodic social cognition between "interacting" with both "alone" [unadjusted, $b = 0.25$, 95% CI (0.11, 0.39), $t(4844) = 3.44$, $P < 0.001$] and "not interacting" [unadjusted, $b = 0.17$, 95% CI (0.01, 0.34), $t(4795) = 2.03$, $P = 0.042$] was greater in the lockdown sample. During lockdown, therefore, although social interactions were less frequent, when they did occur, they were associated with greater evidence of episodic social cognition.

***Model 4: Imagery.*** There was a significant three-way interaction between sample, age group, and social environment [$F(2) = 5.85$, $P = 0.003$]. Pairwise comparisons at each level of social environment, split by sample and age group (Bonferroni adjusted for 12 tests), revealed that for younger participants, the direction of the effect of social environment on levels of imagery differed between samples. Prelockdown, younger participants reported less imagery when they were alone compared to when they were interacting with others [$b = -0.14$, 95% CI ($-0.27$, $-0.01$), $t(4745) = -2.98$, $P = 0.035$], and during lockdown, younger participants reported more imagery when they were alone compared to when they were interacting with others [$b = 0.20$, 95% CI (0.01, 0.38), $t(4855) = 3.05$, $P = 0.028$]. A comparison of these contrasts confirmed that this difference was significant [unadjusted, $b = -0.33$, 95% CI ($-0.49$, $-0.18$), $t(4845) = -4.21$, $P < 0.001$]. Therefore, during lockdown, younger participants reported more imagery when they were alone compared to when interacting with others.

***Model 5: Detailed task focus.*** There were no significant main effects or interactions ($P > 0.05$). Therefore, the lockdown had no significant impact on the overall prevalence of detailed task focus.

**Comparing Thought Patterns between 1) Current Activities and 2) Age Groups during Lockdown.** To understand how changes to people's daily routine, including changes to working, influenced patterns of ongoing thought during lockdown, we next explored the links between ongoing thought patterns and ongoing activities. In the baseline sample, we had not obtained information about concurrent activities; however, in the lockdown sample, we asked participants to describe the primary activity they were performing (see *Materials and Methods*). The 24 options were condensed into five categories for analysis: 1) working, 2) leisure activities, 3) social interactions, 4) media consumption, and 5) essential tasks (*SI Appendix*). We conducted a series of models examining whether patterns of thought varied significantly between activity categories and whether there were age-related differences (see *Materials and Methods*). As before, the alpha level was set to <0.01 (two tailed) to account for family-wise error emerging from conducting five models. These results are summarized in Fig. 3 (see *SI Appendix*, Tables S7–S9 for ANOVA output, parameter estimates, and the variance explained by random effects).

***Model 1: Future-directed problem solving.*** There was a significant main effect of activity [$F(4) = 33.67$, $P < 0.001$]. Future-directed problem solving was higher when participants were working during lockdown [$b = 0.62$, 95% CI (0.48, 0.77), $t(1689) = 8.62$, $P < 0.001$] and lower when consuming media [$b = -0.36$, 95% CI (−0.44, −0.28), $t(1743) = -8.92$, $P < 0.001$] or engaging in essential tasks [$b = -0.22$, 95% CI (−0.30, −0.14), $t(1727) = -5.59$, $P < 0.001$]. Therefore, while future-directed problem solving was significantly lower in the lockdown sample, this pattern of thought was reinstated when individuals engaged in work.

***Model 2: Pleasant engagement.*** There was a significant main effect of activity [$F(4) = 18.93$, $P < 0.001$]. Pleasant engagement was higher during leisure activities [$b = 0.27$, 95% CI (0.19, 0.36), $t(1712) = 6.36$, $P < 0.001$] and lower when participants consumed media [$b = -0.21$, 95% CI (−0.29, −0.13), $t(1730) = -5.14$, $P < 0.001$] or during social interactions [$b = -0.12$, 95% CI (−0.23, −0.00), $t(1719) = -2.03$, $P = 0.043$]. There was also a significant interaction between activity and age group [$F(4) = 5.71$, $P < 0.001$]. Pairwise comparisons at each level of age group split by activity (Bonferroni adjusted for five tests) revealed that pleasant engagement was higher for older participants when working compared to younger participants [$b = 0.78$, 95% CI (0.19, 1.37), $t(350) = 3.43$, $P = 0.003$].

***Model 3: Episodic social cognition.*** There was a significant main effect of activity [$F(4) = 25.58$, $P < 0.001$]. Episodic social cognition was higher during social interactions [$b = 0.52$, 95% CI (0.40, 0.64), $t(1738) = 8.72$, $P < 0.001$] and lower when consuming media [$b = -0.23$, 95% CI (−0.31, −0.14), $t(1752) = -5.42$, $P < 0.001$] or working [$b = -0.35$, 95% CI (−0.50, −0.20), $t(1696) = -4.68$, $P < 0.001$].

***Model 4: Imagery.*** There was a significant main effect of activity [$F(4) = 6.52$, $P < 0.001$]. Imagery was higher when participants consumed media [$b = 0.17$, 95% CI (0.09, 0.26), $t(1719) = 4.21$, $P < 0.001$] and lower when engaging in essential tasks [$b = -0.09$, 95% CI (−0.17, −0.01), $t(1{,}700) = -2.30$, $P = 0.022$].

***Model 5: Detailed task focus.*** There was a significant main effect of activity [$F(4) = 13.38$, $P < 0.001$]. Detailed task focus was higher when working [$b = 0.39$, 95% CI (0.25, 0.53), $t(1{,}656) = 5.44$, $P < 0.001$] or during social interactions [$b = 0.13$, 95% CI (0.02, 0.24), $t(1730) = 2.30$, $P = 0.021$] and lower when engaging in essential tasks [$b = -0.16$, 95% CI (−0.24, −0.09), $t(1{,}733) = -4.13$, $P < 0.001$], leisure activities [$b = -0.19$, 95% CI (−0.27, −0.11), $t(1{,}731) = -4.48$, $P < 0.001$), or when consuming media ($b = -0.17$, 95% CI (−0.25, −0.09), $t(1{,}741) = -4.23$, $P < 0.001$). There was also a significant interaction between activity and age group [$F(4) = 5.04$, $P < 0.001$]. Pairwise comparisons at each level of age group split by activity (Bonferroni adjusted for five tests) revealed that detailed task focus was higher when older participants engaged in social interactions compared to younger participants [$b = 0.48$, 95% CI (0.02, 0.93), $t(308) = 2.72$, $P = 0.034$].

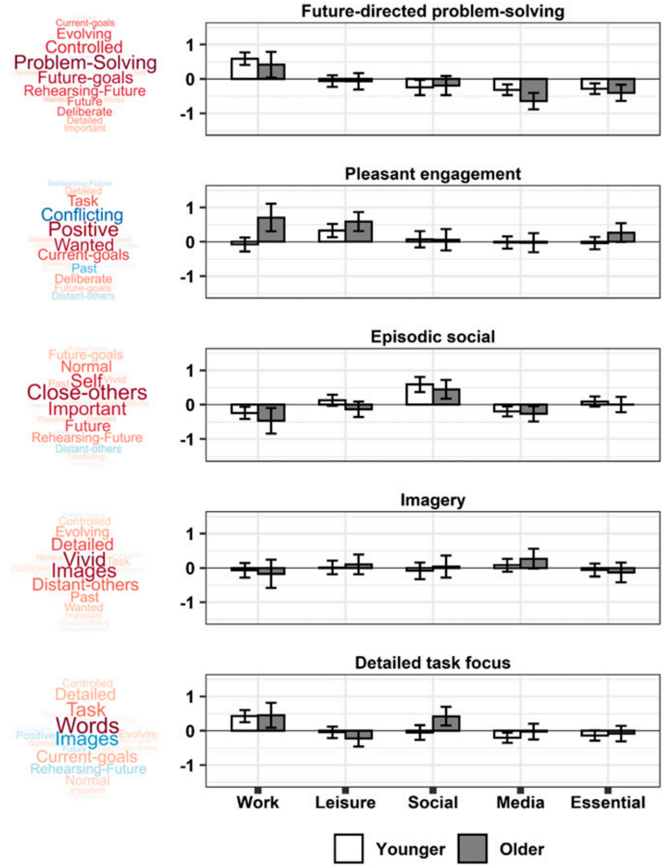


**Fig. 3.** A summary of the LMMs' results comparing the prevalence of each thought pattern between 1) current activities and 2) age groups in the lockdown sample. On the left-hand side, there are the word clouds representing each thought pattern. Each word represents an experience-sampling item (*SI Appendix*, Table S1). Font size represents the magnitude of the loading, and the color describes the direction. Warm colors reflect positive loadings, while cool colors reflect negative loadings. The *y*-axis of each graph shows the predicted means for each thought pattern. The *x*-axis shows the five activity categories: 1) working, 2) leisure activities, 3) social interactions, 4) media consumption, and 5) essential tasks (see *SI Appendix* for details). White bars represent young participants, and gray bars represent older participants. Error bars represent the 95% CIs for each predicted mean. In total, 81 participants (1,777 observations) were included in this analysis.

**Comparing Thought Patterns between 1) Virtual and Physical Social Interactions and 2) Age Groups during Lockdown.** During lockdown, while people were unable to socialize in person with people outside of their household, they could still interact virtually. In the baseline group, we did not collect information regarding whether social interactions were virtual. However, in the lockdown sample, participants reported on both their physical and virtual interactions. To examine the effects of virtual social interaction on thoughts in the lockdown sample, we conducted a series of models in which each thought pattern was the outcome measure, and interaction type and age group were the explanatory variables (*SI Appendix*). Interaction type had four levels: 1) no interaction at all, 2) virtual interaction only, 3) physical interaction only, and 4) both virtual and physical interaction (see *SI Appendix*, Table S10 for how this variable was coded). As before, the alpha level was set to <0.01 (two tailed) to account for family-wise error emerging from conducting five models. These results are summarized in *SI Appendix*, Fig. S3; see

SI Appendix, Tables S11–S13 for ANOVA output, parameter estimates, and variance explained by random effects.

We found that future-directed problem solving was less apparent when participants were physically compared to virtually interacting, while episodic social cognition was more apparent across all forms of interaction when compared to not interacting at all. In addition, although the effects did not pass the Bonferroni correction, patterns of imagery were less apparent when physically interacting compared to virtually interacting, particularly for younger participants. Finally, detailed task focus was more apparent when virtually interacting compared to when interacting both virtually and physically and not interacting at all. Notably, for older participants, detailed task focus was more apparent during virtual interactions compared to all other forms of interaction and when not interacting at all. However, it is worth noting that the cells of this analysis were unbalanced, with fewer observations for interacting—particularly virtually—compared to not interacting at all (see SI Appendix, Table S14 for number of observations per factor level by age group), so these results should be interpreted with caution.

**Relationship to Affect.** Finally, we conducted an exploratory analysis to understand whether the lockdown-related changes in ongoing thought identified in our prior analysis were independent of changes in affect (SI Appendix). Importantly, including affect did not substantially change the lockdown-related results reported in models 1, 3, and 4 comparing thought patterns between samples, age groups, and social environments. However, the main effects of age group for models 1 through 3 no longer reached significance (SI Appendix). In addition, we ran a parallel analysis in which we compared the prevalence of negative and positive affect between samples, social environments, and age groups to examine how state affect may have changed during lockdown (see SI Appendix for further details).

## Discussion

Our study set out to determine how specific features of the United Kingdom's first lockdown corresponded with changes in ongoing thought patterns in daily life, focusing on changes to socializing and working. The contents of ongoing thoughts were assessed using MDES (37), an established method with documented neural (e.g., refs. 40, 41, 43, 46) and behavioral correlates (e.g., refs. 27, 47). Our analysis identified five thought patterns: future-directed problem solving, pleasant engagement, episodic social cognition, imagery, and detailed task focus. Importantly, these five thought patterns are consistent with previous research using this method (15, 17, 40, 41, 45, 46).

One goal of our study was to assess how changes in socialization during lockdown impacted patterns of social thought in daily life. Across both samples, in-person social interaction was associated with increased episodic social cognition, reduced future-directed problem solving, and greater pleasant engagement in younger individuals. During lockdown, opportunities for social interactions were reduced, but when social interactions did occur, episodic social cognition was especially prevalent. So, although participants were less able to engage in in-person social interactions during lockdown, when those interactions were possible, they promoted greater increases in social thinking than would normally occur. Furthermore, during lockdown, all types of interaction—both virtual and in person—were associated with increased episodic social cognition, suggesting that online interactions may partly ameliorate the consequences of lockdown on social cognition. Importantly, since the lockdown was a natural experiment in how changes in socialization affect our thinking in daily life, our findings provide real-world confirmation of laboratory evidence linking social thinking to the availability of social interactions (11) and are consistent with the possibility that ongoing thought helps facilitate interactions either in the moment or in the future (11, 48). Our study, therefore, provides ecologically valid evidence to support theoretical perspectives that highlight how social interactions shape social thought patterns in daily life (11, 12).

The second goal of our study was to understand how changes in opportunities for working during lockdown influenced ongoing thought patterns in daily life. Future-directed problem solving, something generally prevalent in younger individuals, was 1) significantly reduced during lockdown relative to prelockdown but 2) was highest during lockdown when individuals were working. Our results, therefore, suggest that when external commitments are disrupted (in this case, via lockdown), future-directed problem solving is reduced unless people are working. Thus, our data support theories suggesting that the "prospective bias" in ongoing thought is related to goal-related processes, since it was disrupted by lockdown unless people were actively engaged in work (18, 25–28, 49). Moreover, given research showing goal-directed planning is reduced in dysphoric individuals (50) and that future thinking is important for maintaining mental health (24, 29, 30), our study raises the possibility that reduced opportunities for work may contribute to the negative emotional changes documented during lockdown (4, 5, 10) via a reduction in future-related thinking—an important question for future work to explore.

Our final goal was to understand whether lockdown differentially impacted thinking patterns in older and young individuals. Consistent with prior research (31–33), we found evidence for age differences in ongoing thought patterns. For example, younger individuals reported higher levels of future-directed problem solving and episodic social cognition and lower levels of pleasant engagement during activities than older adults. We also found that before lockdown, younger individuals reported more imagery when interacting with others, whereas during lockdown, imagery was higher when younger individuals were alone. This thought pattern was associated with media consumption during lockdown, so it is plausible that this increased imagery in younger adults when alone was related to an increase in media usage (51). Finally, for older participants, virtual interactions during lockdown were linked to increased detailed task focus, a pattern that might reflect the effort required when interacting online, possibly capturing the phenomenon of "Zoom fatigue" (52).

In summary, the restrictions introduced during the United Kingdom's first national lockdown brought reduced opportunities for socialization and working. In parallel with these changes in daily routine, we found changes in the patterns of thinking associated with these activities. Specifically, during lockdown, social interactions promoted a greater increase in episodic social thinking than prelockdown and while future-directed problem solving was significantly reduced during lockdown, this thought pattern increased when individuals engaged in work. Therefore, on the limited occasions that individuals were able to socialize or work during lockdown, these activities had a significant effect on relevant thought patterns, highlighting the important role that our daily routine has in shaping our thinking.

Although our study sheds light on how lockdown changed ongoing thought patterns in daily life, several limitations should be considered when interpreting these results. First, our study capitalized on an existing dataset to provide a baseline to understand how thought patterns changed during lockdown. While this design feature was unavoidable given the pandemic's unforeseen nature, conclusions regarding the impact of lockdown would have been stronger if we could have examined within-person changes in the same participants over time. Importantly, however, we established that the underlying structure of ongoing thought was almost identical in both samples (SI Appendix, Fig. S2), supporting the validity of the prelockdown sample as a baseline. Future work should aim to track people's thoughts in the moment longitudinally, through periods of lockdown and during periods of lockdown relaxation. Second, our analyses of the relationship between current activities (e.g., working) and ongoing thought are based only on the lockdown sample. Therefore, while our data allow the determination of how changes in working opportunities contributed to cognition during lockdown, it is unclear how working influences thought patterns in a more normal context. Finally, it is important to note that there are other influences on people's ongoing thoughts during lockdown beyond those assessed in our study. For example, the current study did not account for economic changes, fear of illness, whether an individual (or close friend/family member) contracted COVID-19 during the study, or bereavements. Nonetheless, our study suggests that in addition to other changes in life circumstances, changes to socialization and opportunities for work are important contributors to how lockdowns influence the contents of people's thoughts in daily life.

Our examination of how broad, naturally occurring changes in society influence cognition also raises important questions for future investigations of ongoing thought. Emerging evidence highlights the lockdown's consequences on mental health (4, 5, 10), so future studies should examine relationships between risk factors such as anxiety and depression and ongoing thought in daily life and during lockdowns. Furthermore, our data indicate that both younger and older adults reported being alone more in the lockdown sample than prelockdown. However, we could not make an equivalent comparison of changes in specific daily activities (including work). Therefore, it remains unclear the extent to which different daily routines in younger and older adults may contribute to age differences in thought patterns. Finally, although studies conducted before the pandemic show that features of ongoing thoughts (e.g., a focus on the future) are prevalent across cultures (14), our study used a UK sample, so it is important to understand how lockdowns change ongoing thought patterns across cultures.

We close by considering the implications of our study for understanding ongoing thought patterns in daily life. Prior studies investigating ongoing thought have focused on assessing thought within laboratory and neuroimaging contexts, revealing links between thought content and neural activity (e.g., refs. 37, 41, 43, 47, 53), cognitive ability (e.g., refs. 54, 55), affective style (e.g., refs. 15, 56, 57), and task and social contexts (11, 15). Our study complements these findings by highlighting the role that aspects of our daily routines—particularly social interactions and work—play in shaping our cognition. It is perhaps unsurprising that ongoing thought patterns are shaped by these activities since 1) we spend a large proportion of our lives interacting with others (11) and working and 2) that successful adaptation within both of these domains is critical for well-being. For example, loneliness increases the likelihood of death by 26% (58), while unemployment is associated with reduced psychological and physical well-being (59). In this way, our study illustrates that features of a person's daily routine are important in scaffolding their ongoing thought patterns and highlights that experience sampling in naturalistic contexts is an important way to understand when and how what we do influences ongoing human cognition both during lockdowns and in more normal times.

## Materials and Methods

**Participants.** The full study protocol was approved by the Psychology Department ethics committee at the University of York. All participants gave informed consent (either written or online) before taking part and were debriefed upon completion. In the prelockdown sample, younger participants were recruited between October 2016 and March 2017 from undergraduate and postgraduate student bodies and were either paid or given course credits. A total of 78 younger participants completed experience-sampling surveys (female = 57, male = 21; age: M = 19.64; SD = 1.62; and range = 18 to 27). These data have been analyzed and reported previously by Ho et al. (17). In the prelockdown sample, older participants were recruited between August 2016 and November 2016 and were paid for their time. A total of 35 older participants completed experience-sampling surveys (female = 20, male = 15; age: M = 66.80; SD = 6.88; and range = 55 to 87). In the lockdown sample, all participants were invited to participate in the daily-life experience sampling after completing an initial survey, as part of a larger project, on Prolific (https://www.prolific.co). All participants were paid for their time. A total of 91 participants completed experience-sampling surveys between April 29, 2020 and May 13, 2020. Two participants were removed from the study on day 1, as they were not currently residing in the United Kingdom, and their data were excluded. Two participants were excluded for having missing age data. Five participants were excluded because they did not fall into either the young (18 to 35 y) or older (55+ y) age groups. The final sample comprised 59 younger participants (female = 40, male = 17, self-described = 1, and prefer not to say = 1; age: M = 24.22; SD = 4.07; and range = 18 to 35) and 23 older participants (female = 13, male = 9, and self-described = 1; age: M = 63.91; SD = 7.06; and range = 55 to 78).

**Procedure.** Participants received a text message with a link to an online Qualtrics survey five times daily for 7 d at quasirandom intervals between 9:00 AM and 9:00 PM (9:45 in the lockdown sample) administered via SurveySignal (60). Each survey link expired after 2 h. In the prelockdown sample, seven older participants completed up to eight surveys a day for 10 d. However, this procedure was shortened after participant feedback that the procedure was too intensive. Rerunning our analyses after removing these additional observations did not substantially change the results. Additionally, in the prelockdown sample, 23 older participants and one younger participant opted to complete the study on paper. They were provided with a phone on which texts acted as signals (see *SI Appendix* for comparison of completion type). Participants in both samples also completed daily diary questionnaires, and participants in the lockdown sample completed an exit questionnaire at the end of the study. These questionnaires did not sample ongoing thought and are therefore not reported here.

**Experience-Sampling Surveys.** The experience-sampling survey first asked participants to consider the contents and form of their thoughts immediately before being signaled on various dimensions using a 1 to 5 Likert scale. We sought to compare thought patterns observed across both samples, so we focused on the 22 items present in both (*SI Appendix*, Table S1). The survey then asked participants to rate their emotions and feelings on various dimensions using a 1 to 5 Likert scale (see *SI Appendix*, Table S15 for the 12 affect items present in both samples that were included in supplementary analyses). Participants were also asked "Were you alone or with other people just before taking this survey?" (in the lockdown sample, the question specified "physically and not virtually"). Response options were: "Alone," "Around people but NOT interacting," or "Around people and interacting." In the lockdown sample, participants were also asked "Virtually, were you alone or with other people just before taking this survey?" Response options were the same as those for the physical interaction question. Additionally, in the lockdown sample, participants were asked to indicate their location (seven options; see Fig. 1*B*) and primary activity (24 options; *SI Appendix*) immediately before answering the survey. The activity options were based on those used in the "day reconstruction method" (61) and modified to include activities that were likely to be prevalent during lockdown. In both samples, participants were also asked several other questions about their ongoing experience (e.g., whether they had recently accessed new information regarding COVID-19), which are not the focus of this paper. All experience-sampling survey questions and response options included in the current study are available in *SI Appendix*, Tables S1, S15, and S23.

**Analysis.**

***Data and code availability statement.*** For details of the R packages used in analysis, see *SI Appendix*. All code used in the analysis and preparation of figures is available online at https://github.com/Bronte-Mckeown/pre_vs_during_lockdown_ESQ_analysis (62). All anonymized data used in the preparation of this manuscript is openly available via Mendeley data (http://dx.doi.org/10.17632/n3wz7y8mhs.1) (63).

***Assessing changes to daily life during lockdown.*** To assess whether the percentage of responses for which participants reported being alone was higher in the lockdown sample than the prelockdown sample, we first calculated the percentage of each participant's responses in which they said they were 1) alone, 2) around people but not interacting with them, or 3) around people and interacting with them. We then ran a two-way ANOVA with each participant's "alone" percentage as the outcome variable and sample (pre- versus during lockdown) and age group (young versus older) as the predictors. To examine where participants were located in the lockdown sample, we calculated the overall percentage of responses for each "location" option.

***Preparing data for PCA.*** Two experience-sampling questions ("positive" and "deliberate") in the prelockdown sample were measured on 7- rather than 5-point scales. All questions were therefore rescaled using the following computation: (observed score − 1)/(highest possible score on that scale − 1).

The rescaled questions were then $z$-scored before applying PCA to the combined data.

***PCA.*** To identify common patterns of thought between both samples, PCA with varimax rotation was applied to the combined thought data from both samples (22 items; *SI Appendix*, Table S1) using IBM SPSS Statistics (version 26). PCA was applied at the observation level in the same manner as in our previous studies (e.g., refs. 15, 24, 43). The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.84, above the commonly recommended value of 0.6, and Bartlett's test of sphericity was significant [$\chi 2(231) = 28737.22$, $P < 0.001$]. Five components, with an eigenvalue >1, were retained for inclusion as outcome variables in the LMMs. To ensure that the thought patterns identified across samples were present in both samples separately, we ran a PCA on each sample separately (specified five components for extraction) and correlated each participant's PCA score from this analysis with their PCA score from the combined analysis (see *SI Appendix*, Fig. S2 for scatterplots).

***LMMs.*** LMMs were fitted by restricted maximum-likelihood estimation in R [4.0.2 (64)] using the lme4 package [1.1.26 (65)]. We used the lmerTest package [3.1.3 (66)] to obtain $P$ values for the F- and $t$ tests returned by the lme4 package. For each set of models, the alpha level was set based on 0.05 divided by the number of models (i.e., Bonferroni-corrected alpha level). Degrees of freedom were calculated using the Satterthwaite approximation. For F-tests, type 3 sum of squares was chosen because imbalances in the data are assumed to occur randomly and not due to differences in the population (67). Contrasts were set to "contr.sum," meaning that the intercept of each model corresponds to the grand mean of all conditions and that when a factor has two levels, the parameter estimate is equal to half of the difference between the two levels (67). Estimated marginal means were calculated using the emmeans package [1.5.3 (68)]. Post hoc pairwise comparisons were also calculated using the emmeans package (68) and corrected for multiple comparisons using the Bonferroni adjustment, which adjusts both the CIs and $P$ values associated with each estimate and test. For contrasts of contrasts, custom contrasts were set manually and so could not be adjusted for multiple comparisons. Across all models, to account for multiple observations per participant, day number was nested within participant as a random intercept.

***Comparing thought patterns between 1) pre- and during lockdown samples, 2) age groups, and 3) social environments.*** We ran five LMMs—one with each thought component as the outcome variable modeling the following fixed factors and their interactions: 1) "sample" (two levels: pre- and during lockdown), 2) "age group" (two levels: younger and older), and 3) "social environment" (three levels: alone, around people but not interacting, and around people and interacting). Age group mean-centered age was included in all models as a nuisance covariate to control for age differences within age groups between the two samples. In total, 195 participants (4,870 observations) were included in these models.

Example model formula: lmer(Thought component × ∼ Sample * Age group * Social environment + Age group mean-centered age + (1|Participant/Day number)

In addition, to account for differences in age range in the younger groups between pre- and during lockdown samples, we reran these analyses while limiting the age range for the younger group to 18 to 27 y in both samples. Rerunning our analyses in this way did not change the overall interpretations of the paper (*SI Appendix*).

***Comparing thought patterns between 1) current activities and 2) age groups in the lockdown sample.*** We ran five LMMs—one with each thought component as the outcome variable modeling the following fixed factors and their interactions: 1) "activity" (five levels) and 2) "age group" (two levels). The "activity" question had 24 options, which we condensed for analyses. Any observations containing the option "other" ($n = 88$) were removed, leaving 81 participants (1,777 observations) in the model. The remaining options were grouped into five categories: 1) working, 2) leisure activities, 3) social interactions, 4) media consumption, and 5) essential tasks (see *SI Appendix* for details).

Example model formula: lmer(Thought component x ~ Activity * Age group + (1|Participant/Day number)

**Data Availability.** All code used in the analysis and preparation of figures is available online at https://github.com/Bronte-Mckeown/pre_vs_during_lockdown_ESQ_analysis (62). Anonymized experience-sampling responses have been deposited in a publicly accessible database, Mendeley data: http://dx.doi.org/10.17632/n3wz7y8mhs.1 (63). All other study data and materials are included in the article and/or *SI Appendix*.

**ACKNOWLEDGMENTS.** This project was supported by the European Research Council Consolidator Grant awarded to J.S. (WANDERINGMINDS–646927) and an award from the Dunhill Medical Trust to J.S., L.M.R., and E.J. (R422/0515).

1. B. Chiripanhura, B. Carrera, E. Monahan, Furloughing of workers across UK business: 23 March 2020 to 5 April 2020. *Office for National Statistics* (2020). https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/furloughingofworkersacrossukbusinesses/latest. Accessed 21 July 2020.
2. M. Stephens, S. Cross, G. Luckwell, Coronavirus and the impact on output in the UK economy: June 2020. Office for National Statistics (2020). https://www.ons.gov.uk/economy/grossdomesticproductgdp/articles/coronavirusandtheimpactonoutputintheukeconomy/june2020. Accessed 21 July 2020.
3. A. Campbell, S. Caul, Deaths involving COVID-19, England and Wales: Deaths occurring in May 2020. *Office for National Statistics* (2020). https://backup.ons.gov.uk/wp-content/uploads/sites/3/2020/06/Deaths-involving-COVID-19-England-and-Wales-deaths-occurring-in-May-2020.pdf. Accessed 17 June 2021.
4. R. G. White, C. Van Der Boor, Impact of the COVID-19 pandemic and initial period of lockdown on the mental health and well-being of adults in the UK. *BJPsych Open* **6**, e90 (2020).
5. J. Banks, X. Xu, The mental health effects of the first two months of lockdown during the COVID-19 pandemic in the UK. *Fisc. Stud.* **41**, 685–708 (2020).
6. J. Huckins *et al*., Mental health and behavior of college students during the early phases of the COVID-19 pandemic: Longitudinal smartphone and ecological momentary assessment study. *J. Med. Internet Res.* **22**, e20185 (2020).
7. E. Robinson *et al*., Obesity, eating behavior and physical activity during COVID-19 lockdown: A study of UK adults. *Appetite* **156**, 104853 (2021).
8. O. Giuntella, K. Hyde, S. Saccardo, S. Sadoff, Lifestyle and mental health disruptions during Covid-19. *Proc. Natl. Acad. Sci. U.S.A.* **118**, e2016632118 (2021).
9. J. M. Groarke *et al*., Loneliness in the UK during the COVID-19 pandemic: Cross-sectional results from the COVID-19 Psychological Wellbeing Study. *PLoS One* **15**, e0239698 (2020).
10. R. C. O'Connor *et al*., Mental health and well-being during the COVID-19 pandemic: Longitudinal analyses of adults in the UK COVID-19 Mental Health & Wellbeing study. *Br. J. Psychiatry*, 10.1192/bjp.2020.212 (2020).
11. J. Mildner, D. Tamir, The people around you are inside your head: Social context shapes spontaneous thought. *PsyArXiv* [Preprint] (2018). https://doi.org/10.31234/osf.io/xmzh7 (Accessed 17 June 2020).
12. G. Poerio, J. Smallwood, Daydreaming to navigate the social world: What we know, what we don't know, and why it matters. *Soc. Personal. Psychol. Compass* **10**, 605–618 (2016).
13. R. A. Mar, M. F. Mason, A. Litvack, How daydreaming relates to life satisfaction, loneliness, and social support: The importance of gender and daydream content. *Conscious. Cogn.* **21**, 401–407 (2012).
14. X. Song, X. Wang, Mind wandering in Chinese daily lives—An experience sampling study. *PLoS One* **7**, e44423 (2012).
15. D. Konu *et al*., Exploring patterns of ongoing thought under naturalistic and conventional task-based conditions. *Conscious. Cogn.* **93**, 103139 (2021).
16. G. L. Poerio, P. Totterdell, L.-M. Emerson, E. Miles, Social daydreaming and adjustment: An experience-sampling study of socio-emotional adaptation during a life transition. *Front. Psychol.* **7**, 13 (2016).
17. N. S. P. Ho *et al*., Facing up to the wandering mind: Patterns of off-task laboratory thought are associated with stronger neural recruitment of right fusiform cortex while processing facial stimuli. *Neuroimage* **214**, 116765 (2020).
18. B. Baird, J. Smallwood, J. W. Schooler, Back to the future: Autobiographical planning and the functionality of mind-wandering. *Conscious. Cogn.* **20**, 1604–1611 (2011).
19. S. R. Gold, J. P. Reilly III, Daydreaming, current concerns and personality. *Imagin. Cogn. Pers.* **5**, 117–125 (1985).
20. E. Klinger, S. G. Barta, M. E. Maxeiner, Motivational correlates of thought content frequency and commitment. *J. Pers. Soc. Psychol.* **39**, 1222 (1980).
21. D. Stawarczyk, S. Majerus, M. Maj, M. Van der Linden, A. D'Argembeau, Mind-wandering: Phenomenology and function as assessed with a novel experience sampling method. *Acta Psychol. (Amst.)* **136**, 370–381 (2011).
22. J. S. Antrobus, J. L. Singer, S. Greenberg, Studies in the stream of consciousness: Experimental enhancement and suppression of spontaneous cognitive processes. *Percept. Mot. Skills* **23**, 399–417 (1966).
23. H. B. Kappes, B. Schwörer, G. Oettingen, Needs instigate positive fantasies of idealized futures. *Eur. J. Soc. Psychol.* **42**, 299–307 (2012).
24. F. J. Ruby, J. Smallwood, H. Engen, T. Singer, How self-generated thought shapes mood—The relation between mind-wandering and mood depends on the socio-temporal content of thoughts. *PLoS One* **8**, e77554 (2013).
25. D. Stawarczyk, H. Cassol, A. D'Argembeau, Phenomenology of future-oriented mind-wandering episodes. *Front. Psychol.* **4**, 425 (2013).
26. A. D'Argembeau, O. Renaud, M. Van der Linden, Frequency, characteristics and functions of future-oriented thoughts in daily life. *Appl. Cogn. Psychol.* **25**, 96–103 (2011).
27. B. Medea *et al*., How do we decide what to do? Resting-state connectivity patterns and components of self-generated thought linked to the development of more concrete personal goals. *Exp. Brain Res.* **236**, 2469–2481 (2018).
28. E. Klinger, E. H. Koster, I. Marchetti, "Spontaneous thought and goal pursuit: From functions such as planning to dysfunctions such as rumination" in *The Oxford Handbook of Spontaneous Thought: Mind-Wandering, Creativity, and Dreaming*, K. Christoff, Kieran C. R. Fox, Eds. (Oxford University Press, New York, 2018), p. 215.

29. E. C. Hunter, R. C. O'Connor, Hopelessness and future thinking in parasuicide: The role of perfectionism. *Br. J. Clin. Psychol.* **42**, 355–365 (2003).
30. R. O'Connor, D. O'Connor, S. O'Connor, J. Smallwood, J. Miles, Hopelessness, stress, and perfectionism: The moderating effects of future thinking. *Cogn. Emot.* **18**, 1099–1120 (2004).
31. M. Irish, Z. L. Goldberg, S. Alaeddin, C. O'Callaghan, J. R. Andrews-Hanna, Age-related changes in the temporal focus and self-referential content of spontaneous cognition during periods of low cognitive demand. *Psychol. Res.* **83**, 747–760 (2019).
32. D. Maillet *et al*., Aging and the wandering brain: Age-related differences in the neural correlates of stimulus-independent thoughts. *PLoS One* **14**, e0223981 (2019).
33. D. Maillet *et al*., Age-related differences in mind-wandering in daily life. *Psychol. Aging* **33**, 643–653 (2018).
34. L. M. Giambra, Daydreaming across the life span: Late adolescent to senior citizen. *Int. J. Aging Hum. Dev.* **5**, 115–140 (1974).
35. R. Zhaoyang, M. J. Sliwinski, L. M. Martire, J. M. Smyth, Age differences in adults' daily social interactions: An ecological momentary assessment study. *Psychol. Aging* **33**, 607–618 (2018).
36. R. Larson, M. Csikszentmihalyi, "The experience sampling method" in *Flow and the Foundations of Positive Psychology*, M. E. P. Seligman, M. Csikszentmihalyi, Eds. (Springer, 2014), pp. 21–34.
37. J. Smallwood *et al*., Representing representation: Integration between the temporal lobe and the posterior cingulate influences the content and form of spontaneous thought. *PLoS One* **11**, e0152272 (2016).
38. L. M. Martinon, J. Smallwood, D. McGann, C. Hamilton, L. M. Riby, The disentanglement of the neural and experiential complexity of self-generated thoughts: A users guide to combining experience sampling with neuroimaging data. *Neuroimage* **192**, 15–25 (2019).
39. J. Smallwood *et al*., The neural correlates of ongoing conscious thought. *iScience* **24**, 102132 (2021).
40. T. Karapanagiotidis *et al*., The psychological correlates of distinct neural states occurring during wakeful rest. *Sci. Rep.* **10**, 21121 (2020).
41. D. Konu *et al*., A role for the ventromedial prefrontal cortex in self-generated episodic social cognition. *Neuroimage* **218**, 116977 (2020).
42. A. Turnbull *et al*., Left dorsolateral prefrontal cortex supports context-dependent prioritisation of off-task thought. *Nat. Commun.* **10**, 3816 (2019).
43. H.-T. Wang *et al*., Dimensions of experience: Exploring the heterogeneity of the wandering mind. *Psychol. Sci.* **29**, 56–71 (2018).
44. T. Karapanagiotidis, E. Jefferies, J. Smallwood, Interactions between the neural correlates of dispositional internally directed thought and visual imagery. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* **376**, 20190691 (2021).
45. A. Turnbull *et al*., The ebb and flow of attention: Between-subject variation in intrinsic connectivity and cognition associated with the dynamics of ongoing experience. *Neuroimage* **185**, 286–299 (2019).
46. M. Sormaz *et al*., Default mode network can support the level of detail in experience during active task states. *Proc. Natl. Acad. Sci. U.S.A.* **115**, 9318–9323 (2018).
47. A. Turnbull *et al*., Reductions in task positive neural systems occur with the passage of time and are associated with changes in ongoing thought. *Sci. Rep.* **10**, 9912 (2020).
48. M. L. Meyer, Social by default: Characterizing the social functions of the resting brain. *Curr. Dir. Psychol. Sci.* **28**, 380–386 (2019).
49. L. Kvavilashvili, J. Rummel, On the nature of everyday prospection: A review and theoretical integration of research on mind-wandering, future thinking, and prospective memory. *Rev. Gen. Psychol.* **24**, 210–237 (2020).
50. B. Plimpton, P. Patel, L. Kvavilashvili, Role of triggers and dysphoria in mind-wandering about past, present and future: A laboratory study. *Conscious. Cogn.* **33**, 261–276 (2015).
51. G. Vassilev, A "new normal"? How people spent their time after the March 2020 coronavirus lockdown. *Office for National Statistics* (2020). https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/anewnormalhowpeoplespenttheirtimeafterthemarch2020coronaviruslockdown/2020-12-09. Accessed 23 June 2021.
52. S. Cranford, Zoom fatigue, hyperfocus, and entropy of thought. *Matter* **3**, 587–589 (2020).
53. B. Mckeown *et al*., The relationship between individual variation in macroscale functional gradients and distinct aspects of ongoing thought. *Neuroimage* **220**, 117072 (2020).
54. M. J. Kane *et al*., For whom the mind wanders, and when: An experience-sampling study of working memory and executive control in daily life. *Psychol. Sci.* **18**, 614–621 (2007).
55. J. Rummel, C. D. Boywitt, Controlling the stream of thought: Working memory capacity predicts adjustment of mind-wandering to situational demands. *Psychon. Bull. Rev.* **21**, 1309–1315 (2014).
56. Y.-Q. Deng, S. Li, Y.-Y. Tang, The relationship between wandering mind, depression and mindfulness. *Mindfulness* **5**, 124–128 (2014).
57. F. Hoffmann, C. Banzhaf, P. Kanske, F. Bermpohl, T. Singer, Where the depressed mind wanders: Self-generated thought patterns as assessed through experience sampling as a state marker of depression. *J. Affect. Disord.* **198**, 127–134 (2016).
58. J. Holt-Lunstad, T. B. Smith, M. Baker, T. Harris, D. Stephenson, Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspect. Psychol. Sci.* **10**, 227–237 (2015).
59. F. McKee-Ryan, Z. Song, C. R. Wanberg, A. J. Kinicki, Psychological and physical well-being during unemployment: A meta-analytic study. *J. Appl. Psychol.* **90**, 53–76 (2005).
60. W. Hofmann, P. V. Patel, SurveySignal: A convenient solution for experience sampling research using participants' own smartphones. *Soc. Sci. Comput. Rev.* **33**, 235–253 (2015).
61. D. Kahneman, A. B. Krueger, D. A. Schkade, N. Schwarz, A. A. Stone, A survey method for characterizing daily life experience: The day reconstruction method. *Science* **306**, 1776–1780 (2004).
62. B. McKeown, pre vs during lockdown ESQ analysis. GitHub. https://github.com/Bronte-Mckeown/pre_vs_during_lockdown_ESQ_analysis. Deposited 16 September 2021.
63. B. Mckeown *et al*., The impact of social isolation and changes in work patterns on ongoing thought during the first COVID-19 lockdown in the United Kingdom. *Mendeley Data*. http://dx.doi.org/10.17632/n3wz7y8mhs.1. Deposited 17 September 2021.
64. R Core Team, *R: A Language and Environment for Statistical Computing* (R Foundation for Statistical Computing, Vienna, Austria, 2020). https://www.r-project.org/.
65. D. Bates, M. Maechler, B. Bolker, S. Walker, Fitting linear mixed-effects models using lme4. *J. Stat. Softw.* **67**, 1–48 (2015).
66. A. Kuznetsova, P. B. Brockhoff, R. H. Christensen, lmerTest package: Tests in linear mixed effects models. *J. Stat. Softw.* **82**, 1–26 (2017).
67. H. Singmann, D. Kellen, An introduction to mixed models for experimental psychology. *New Methods Cogn. Psychol.* **28**, 4–31 (2019).
68. R. Lenth, Emmeans: Estimated marginal means, aka least-squares means. R package version 1.5.3 (2020). https://CRAN.R-project.org/package=emmeans. Accessed 20 July 2020.