Journal of Experimental Psychology: General

The People Around You Are Inside Your Head: Social Context Shapes Spontaneous Thought

Judith N. Mildner and Diana I. Tamir

Online First Publication, June 17, 2021. http://dx.doi.org/10.1037/xge0001057

AMERICAN PSYCHOLOGICAL ASSOCIATION

Journal of Experimental Psychology: General

ISSN: 0096-3445

https://doi.org/10.1037/xge0001057

The People Around You Are Inside Your Head: Social Context Shapes Spontaneous Thought

Judith N. Mildner and Diana I. Tamir
Department of Psychology, Princeton University

Humans are highly social. We spend most of our time interacting with the social world, and we spend most of our thoughts thinking about the social world. Are we social beings by default, or is our sociality a response to the social world? On the one hand, fundamental social needs may drive social behavior. According to this account, social thoughts fulfill social needs when the environment is insufficiently social. On the other hand, spontaneous thoughts may process incoming information. According to this account, social thoughts reflect the social information in the environment. To arbitrate between these possibilities, we assessed the content of spontaneous thought during mind wandering in three social contexts: solitude (Study 1), social presence (Study 2), and social interaction (Study 3). Additionally, in Study 1, we used functional neuroimaging to measure neural activity while participants considered social and nonsocial targets. Results consistently showed that spontaneous thought reflects the sociality of the world around us: Solitude decreased spontaneous social thought and decreased neural activity in the mentalizing network when thinking about a close friend. Social presence did not change spontaneous social thought. Social interaction increased spontaneous social thought. Finally, individual differences analyses (Study 4) showed that people in more social environments have more social thoughts. Together, the results show a pattern of increasing social thought in increasingly social environments. The predominance of social content in spontaneous thought can thus be explained by the predominance of social content in the world around us, rather than our innate, fundamental social needs.

Keywords: spontaneous thought, mind wandering, social context, social cognition

Supplemental materials: https://doi.org/10.1037/xge0001057.supp

The human mind is expansive; it is not limited by time, space, or even reality. We are capable of considering everything from the mundane to the fantastic. We can think about the sights and sounds that currently surround us or time travel into the past or far into the future. We can think about worms and wormholes, order and chaos, friends and fairies, and everything in between. With this vast landscape of thought at our minds' doorstep, what determines the content of our thoughts at any given time?

Judith N. Mildner https://orcid.org/0000-0003-2026-4583

Some of the ideas and data in this article were presented as posters at the Annual Convention of the Society for Personality and Social Psychology (2017), the New York Social and Affective Neuroscience Meeting (2018), the Social and Affective Neuroscience Annual Meeting (2018), the Association for Psychological Science Annual Convention (2018), and in a talk at a meeting of the European Society for Social and Affective Neuroscience (2018). Data and materials are available at https://osf.io/cew8b/, and a preprint of this article has been posted on PsyArxiv: https://psyarxiv.com/xmzh7/.

Correspondence concerning this article should be addressed to Judith N. Mildner, Department of Psychology, Princeton University, Peretsman-Scully Hall, Princeton, NJ 08544, United States. Email: jmildner@princeton.edu

People overwhelmingly think about other people. In a large-scale survey on the content of people's thought, 73% of respondents reported that their daydreams were primarily about other people (Mar et al., 2012). In an experience sampling study, 70% of momentary thoughts were about people (Song & Wang, 2012). Neuroimaging research likewise suggests that our minds default to thinking about social content: The network of neural regions active at rest, the default network, becomes active when people engage in explicit social cognition (Buckner et al., 2008; Fox et al., 2015; Schilbach et al., 2012; Spreng & Grady, 2010). Indeed, participants frequently think about other people during rest inside an MRI scanner (Diaz et al., 2013). Although spontaneous thought is multifaceted, social cognition is one of the clearest components of spontaneous thought (Andrews-Hanna et al., 2014). In other words, people's minds default to thinking about the social world (Lieberman, 2013; Meyer, 2019).

This focus on social thought is perhaps unsurprising given that humans are embedded in a highly social world. People in the United States spend 45% of their waking lives in the presence of another person and at least 20% directly interacting with others (U.S. Bureau of Labor Statistics, 2016). Every day, people exhibit countless social behaviors, large and small, in service of their need for social connection. People choose social presence over social isolation, interact with others, groom their reputation and relationships, and serve others' needs (Baumeister & Leary, 1995;

Chartrand & Bargh, 1999; Fantz, 1963; Jolly et al., 2019; Morelli et al., 2015). From simple preferences to complex and potentially costly actions, people's behaviors show a profound tendency toward the social.

When it comes to explaining the prevalence of social thought, the outsized presence of the social world raises a chicken and egg problem. Is our world social because our thoughts are inherently social, with both reflecting a fundamental need to connect with others (Baumeister & Leary, 1995; Lieberman, 2013)? Or are our thoughts social because our world is, with thoughts helping us to process our social environment?

A number of influential thinkers have argued that humans are inherently social, driven at all costs to connect with others (Baumeister & Leary, 1995; Lieberman, 2013). This account suggests that our thoughts may be social simply because we are inherently social beings. That is, people might think about the social world in order to help satiate our social needs. In this account, when the environment fails to provide people with sufficient social stimuli, the mind should fill that void by thinking about social content. There is evidence that our minds indeed work in this way: People who feel lonely attend more to social stimuli (Gardner et al., 2005; Pickett et al., 2004), and people with heightened social motivation ascribe more human characteristics to nonhuman entities (Epley et al., 2007). These findings suggest that the less social content in the environment, the more people engage in social thought. Moreover, these social thoughts serve their purpose of fulfilling social needs. For example, in one experience sampling study, people reported increased feelings of connectedness and happiness after they daydreamed about a loved one, but only if they lacked these positive social feelings before the daydream (Poerio et al., 2015). In another study, people completed a loneliness induction and then were randomly assigned to daydream about a close other, daydream about themselves, or complete a control task. People who daydreamed about a close other reported increased positive social feelings, love, and belonging (Poerio et al., 2016). Thus, the contents of thought can help regulate social needs. As such, the social environment may shape social thought because it determines the extent to which social needs are met. If spontaneous social thought reflects social needs, then the less social the environment, the more social spontaneous thought. We refer to this as the *social needs hypothesis*.

However, it is also possible that people become social thinkers because they live in a social world. That is, people's thoughts might gravitate toward the social simply because the world around them is so social. Social information may propagate throughout our thoughts as a spontaneous extension of responses to environmental cues (Northoff, 2018). Environmental cues activate not just associated thoughts (Bar et al., 2007) but also associated concerns or unfulfilled goals (Klinger, 1971, 2013). As such, the social environment might be an ongoing source of cues that activate current social concerns. This focus on the social environment in spontaneous thought may help to process incoming social information (Meyer, 2019; Meyer et al., 2018) and prepare us to engage with the social world (Meyer, 2019; Spunt et al., 2015). If spontaneous social thought reflects social information in the environment, then the more social the environment, the more social spontaneous thought. We refer to this as the *social processing hypothesis*.

The social needs and social processing hypotheses make divergent predictions about the relation between social environment and the content of thought. Here, we arbitrate between these hypotheses with three studies that assess thought content in environments that span a wide range of available social information: after a period of solitude (Study 1), during mere social presence (Study 2), and after social interaction (Study 3). In all three studies, we measured spontaneous thought content during mind wandering. Study 1 also assessed neural activity during social thought using functional MRI (fMRI). Additionally, we explored whether individual differences in social environment predict social thought (Study 4). These studies are presented in the order they were conducted. If the social needs hypothesis is true, social content should decrease with increasingly social environments as the need for sociality is fulfilled. If the social processing hypothesis is true, social thought content should increase in more social environments as the amount of external social information increases.

Study 1: Solitude

In this study, participants encountered no social information for an extended period of time—a 7-hr period of solitude. This allows us to measure the impact of a minimally social environment on the content of social thought, measured both behaviorally and neurally.

Method

Data and code have been deposited on the Open Science Framework (https://osf.io/cew8b/) and are freely available. We report how we determined sample size, all data exclusions, all manipulations, and all measures in the study.

Participants

A total sample size of 80 participants, 40 per condition, was set a priori based on data from a pilot study that employed a similar solitude manipulation. Data collection stopped once that target was reached for all conditions. In the pilot data, this sample size allowed for 80% power to detect the expected effect of interest within a neural region of interest. Participants were recruited from Princeton University's paid subject pool, which consists mostly of students but also includes some staff and community members. To balance conditions, we scheduled control and experimental participants on the same day where possible. We collected data until we reached a sample size of 80 in the fMRI portion of the study, with participants tallied at the end of each day. We recruited a total of 87 participants (age M = 19.9, SD = 1.9, range = 18–28; 58.6% female; 36.8% White/European American, 17.2% Black/African American, 16.1% biracial or multiracial, 12.6% East Asian/East Asian American, 8.0% South Asian/South Asian American, 6.9% Latino/Hispanic American) who were right-handed, met the safety criteria for MRI scanning, and reported no history of anxiety or depression and no psychoactive medication. Six participants were unable to complete the scanning session due to technical difficulties (n = 3) or peripheral nerve stimulation (n = 3), leaving a total of 81 participants in the fMRI portion of this study, 39 in the solitude condition, and 42 in the control condition.

All participants who complied with task instructions on the mind wandering task were included in the behavioral analyses. Participants were excluded based on the following a priori criteria, used in this and all subsequent studies: leaving more than 20% of

responses blank (solitude $n = 2$, control $n = 1$), taking longer than 15 s to respond to a prompt more than twice over the course of the experiment ($n = 0$), and reporting no mind wandering (i.e., paying attention to the reading) while moving through the text too quickly to read (solitude $n = 3$, control $n = 2$). The latter was operationalized as spending less than 1 s on the two pages preceding a probe, then answering "no" when asked if they were mind wandering. After exclusions, the sample size for the behavioral analyses was 79, 36 in the solitude condition, and 43 in the control condition. Informed consent was obtained from all participants in accordance with the Princeton University Institutional Review Board.

Experimental Manipulation

Participants were randomly assigned to one of two conditions: solitude or control. On the day of the experiment, all participants first provided informed written consent. Participants then completed a mock MRI scanning session to ensure they were familiar and comfortable with the MRI scanning procedure. Participants in the control condition left the lab after the mock MRI session to go about their day as normal. They came back to the lab 7 hr later to complete the remainder of the experiment. Participants in the solitude condition spent the next 7 hr alone in a room. The room contained no reference to people or social stimuli. The room contained only puzzles, Sudoku, drawing supplies, a coloring book, a mini basketball set, and a laptop with no Internet access. The laptop had nonsocial games, books, nature videos, and basic word processing software. Participants had no access to any other electronic devices. Snacks, water, and a lunch of the participant's choosing were provided. Participants were allowed to bring their own drawing, coloring, writing, or studying supplies. All materials in the room, including items participants brought, were screened to ensure they contained no social stimuli. Participants were instructed to put in a pair of earplugs whenever they went to the restroom to limit their exposure to conversations in the hallway.

To ensure participants' comfort and safety, the laptop had a custom applet installed that participants could use to contact the researcher or stop the experiment. Participants were told they could use it any time they had an urgent question or wanted to stop the study for any reason. When a participant used the applet, an alarm would go off on the experimenter's computer, and the experimenter could see the participant's message and respond by sending a notification to the participant's laptop. This applet was used by five participants to request a fork, napkins, or feminine hygiene products or to report technical difficulties during a task.

Participants in the control condition reported on their social behaviors every hour. These participants engaged in more social interaction, as expected: They spent, on average, 102 ($SD = 94$) min interacting with other people face-to-face and 86 ($SD = 82$) min around other people but not interacting with them. On average, they also sent 20 ($SD = 24$) text or instant messages, checked social media eight ($SD = 7$) times, and sent two ($SD = 3$) emails.

Experience Sampling

Participants completed seven short surveys throughout the day, one at the start of the experiment (Hour 0), and one at the end of every hour for the subsequent 6 hr. In the solitude condition, participants received a notification on the laptop each hour with a link to the survey. In the control condition, participants received an email with a link to the survey and could opt in to text message reminders as well (see online supplemental materials for full list of items). The experience sampling data were not analyzed as part of this study.

Mind Wandering

After 7 hr, participants completed a mind wandering task in the lab. In this task, modeled off earlier work (McVay & Kane, 2012; Reichle et al., 2010), participants read a text on the computer for a total duration of 40 min. The text was "Successful Beekeeping A-B-C's" by Terry Martyn Jr., a text selected to be relatively boring and to have minimal social content. Participants read the text at their own pace. Every 2 to 4 min, participants' reading was interrupted with a two-item probe measuring whether or not their mind was wandering and what they were thinking about. First, they responded "yes" or "no" to the question "Just prior to being asked, were you mind wandering?" Next, they provided an open-ended text response to the question "What were you thinking about?" After answering these questions, participants resumed reading the text. Each participant responded to an average of 10.98 ($SD = 2.57$) thought probes.

Responses to the first question of each probe served as a measure of self-reported mind wandering. Responses to the second question served as a measure of the content of participants' spontaneous thought. We quantified the social content of these thoughts using both an objective and a subjective measure. We used the same two measures in all studies. The objective measure used Linguistic Inquiry and Word Count software (LIWC2015; Pennebaker, 2015). LIWC counts the proportion of words in a text that fall into various psychologically relevant categories; we measured the proportion of words in each thought that fall into LIWC's "social" category, which includes words like family, friend, talk, and dance. The subjective measure of social thought was obtained using independent raters on Amazon's Mechanical Turk. Each thought was rated by 10 Mechanical Turk raters on a scale of 1–100 to indicate how social the thought was. Specifically, raters were told to focus on mentalizing with the following instructions:

> On each trial, you will rate a statement on how much it is about: reflecting on someone else's thoughts, feelings, preferences, intentions, or personality. You will rate the extent to which the statement pertains to the thoughts and feelings of other people.

Raters were excluded if they had a standard deviation of 10 points or less in their ratings (see online supplemental materials for more details). Interrater reliability was measured using intraclass correlation. The average rating of social content served as the subjective measure of social thought. The same raters also provided ratings of task-related content, memory-based simulation, introspection, and semantic information (see online supplemental materials for results on these ratings).

To measure the effect of solitude on the content of spontaneous thought, we analyzed the objective and subjective measures of social thought using a mixed-effects model for each of these variables. These models contained fixed effects for self-reported mind wandering (yes or no) and condition (solitude or control). Since each participant contributed multiple trials, the model also contained a random intercept for each participant. We did not include random slopes to ensure model convergence.

fMRI Scanning

After the mind wandering task, participants completed an fMRI scanning session. To ensure minimal social interaction for participants in the solitude condition, these participants received a notification on the computer with instructions to prepare for scanning and put in earplugs. They were then escorted to the scanner with minimal verbal instruction and eye contact. Since participants had completed mock scanning at the start of the day and they received written instructions immediately before scanning, the experimenter was able to scan participants safely and comfortably while speaking only one to three sentences throughout the scanning session.

Procedure. Scanning was conducted at the Princeton Neuroscience Institute with a 3 Tesla Siemens Prisma MRI scanner and 20-channel head coil. Functional scans were acquired with a T2*-weighted simultaneous multislice (SMS) echo-planar pulse sequence with 62 interleaved slices (Repetition time/echo time [TR/TE] = 2,250/32 ms, flip angle = 70°, 128 × 64 matrix, 2.0 mm thick, field of view (FOV) = 192 mm, SMS factor = 2). Participants completed four runs of 133 TRs each. Additionally, six volumes of spin echo images were acquired, with opposite phase encoding directions. These were used to calculate fieldmaps for the functional scans using FSL's Topup tool (Andersson et al., 2003). Finally, a proton density weighted structural volume was acquired (TR/TE = 8,400/11 ms, flip angle = 160°, 256 × 256 matrix, 1.5 mm thick, FOV = 218 mm). The functional data were preprocessed using SPM12 (Wellcome Trust Center for Neuroimaging) for motion correction and unwarping based on the fieldmap and using the DARTEL toolbox (Ashburner, 2007) for coregistration of functional and structural volumes, normalization to Montreal Neurological Institute (MNI) space, and smoothing with a 6-mm full width at half maximum (FWHM) kernel. Finally, low-frequency noise was removed with a high-pass filter (128 s).

Task. During scanning, participants completed a social inferences task (Tamir & Mitchell, 2012). In this task, participants judged the preferences of three targets: self, a close friend, or an unfamiliar other (i.e., Barack Obama). On each trial, participants first saw a cue that indicated the target of the judgment (e.g., self, friend's name, or Obama) for 1.5 s, followed by a brief statement (e.g., "enjoy browsing a book store for an hour"). Participants then had 3 s to rate how likely the statement was to apply to the target on a scale from 1–5, anchored on *very unlikely* to *very likely*. Participants indicated their ratings using a button box with five buttons, held in their right hand. Each statement was rated once for the self and once for either the close friend or the unfamiliar other. The task also included nonsocial control trials, where participants judged how likely an activity was to occur indoors. On these trials, participants saw the target (i.e., indoors) and a statement describing an activity for the same duration as in all other trials and made their response using the same button box and scale. Trials were presented in randomized order, with variable fixation periods between trials. Order of trials and duration of fixation periods was optimized using Optseq2 (Dale, 1999).

During the scanning session, participants also completed a control attention task and a task in which they shared or privately answered questions about themselves (see online supplemental materials for detailed description). All participants completed the attention task first, followed by the social inferences and sharing tasks in counterbalanced order. They then also completed a 7-min resting state scan. These tasks and the resting state scan were not analyzed as part of this study.

Analysis. Preprocessed fMRI data for each participant were modeled using a general linear model. The model included regressors for target (self, friend, unfamiliar other, indoors) and their temporal derivatives, as well as nuisance regressors for each of the six motion parameters calculated during motion correction.

To measure social thought during the social inferences task, we examined neural responses specifically within brain regions associated with social thought. To independently localize brain regions associated with social thought, we used Neurosynth (https://neurosynth.org), an automated meta-analysis tool, to identify regions of the brain that are associated with the terms "mentalizing" or "social cognit." The resulting statistical map was thresholded at a false discovery rate of .01. From this map, all clusters with an extent of at least 20 voxels and values in the 75th percentile or higher were extracted to form a mentalizing network region of interest. This network included ventromedial prefrontal cortex, dorsomedial prefrontal cortex, posterior cingulate cortex, bilateral temporal parietal junction, temporal pole, and a portion of superior temporal sulcus.

Results

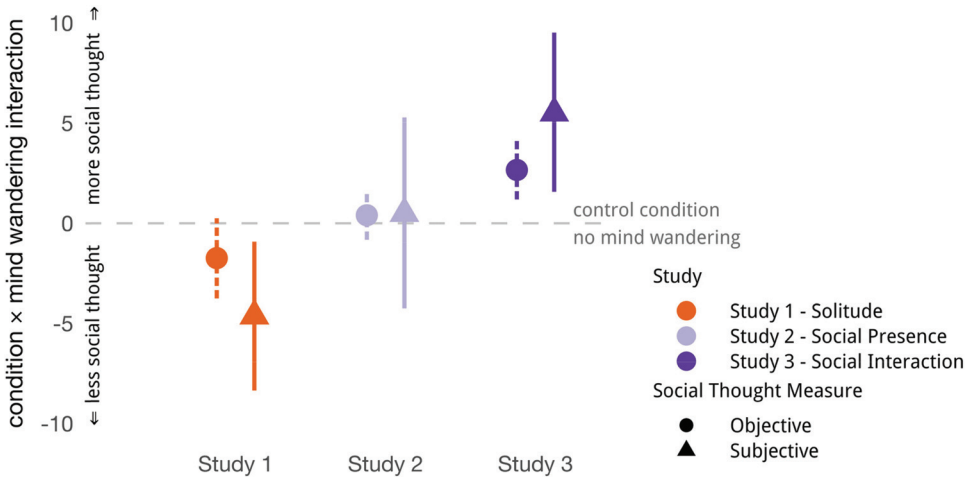
Mind Wandering

If it is the case that social context affects the content of spontaneous thought, we expected to find an interaction effect between self-reported mind wandering and condition such that participants in the solitude condition show either increased or decreased spontaneous social thoughts, relative to control participants, specifically when they report they are mind wandering. This study did not have a priori hypotheses about the direction of the effect, nor about the specificity of the effect on social thought (vs. introspection and simulation). As such, the results here were used to arbitrate between two possible hypotheses: If solitude participants show greater social thoughts, this would provide evidence in favor of the social needs hypothesis; if solitude participants show fewer social thoughts, this would provide evidence in favor of the social processing hypothesis.

In line with the social processing hypothesis, participants in the solitude condition had fewer social thoughts during mind wandering than participants in the control condition, according to the subjective measure (mind wandering, $M_{control}$ = 13.47, $SD_{control}$ = 15.12, $M_{solitude}$ = 9.65, $SD_{solitude}$ = 11.66; no mind wandering, $M_{control}$ = 12.55, $SD_{control}$ = 11.29, $M_{solitude}$ = 13.19, $SD_{solitude}$ = 12.20). That is, there was a significant negative interaction effect between mind wandering and condition ($\beta = -4.62$, SE = 1.91, p = .02). The objective measure of social thought showed a nonsignificant interaction between mind wandering and condition in the same direction ($\beta = -1.74$, SE = 1.02, p = .09; mind wandering, $M_{control}$ = 4.90, $SD_{control}$ = 6.74, $M_{solitude}$ = 3.78, $SD_{solitude}$ = 6.28; no mind wandering, $M_{control}$ = 6.95, $SD_{control}$ = 7.41, $M_{solitude}$ = 7.57, $SD_{solitude}$ = 7.30). These results are in line with the social processing hypothesis: Spontaneous social thought decreases after a period of solitude (see Figure 1).

Figure 1

In Line With the Social Processing Hypothesis, Spontaneous Social Thought Increases in Increasingly Social Environments



Note. Relative to control conditions, social thought during mind wandering decreases after a period of solitude (Study 1), remains unchanged during social presence (Study 2), and increases after social interaction (Study 3). Error bars reflect bootstrapped 95% confidence intervals. See the online article for the color version of this figure.

fMRI

To measure the effect of solitude on deliberate social thought, we examined neural activation in the mentalizing network (Figure 2A) while participants made social inferences. The magnitude of the activity in this network in response to each of the three targets—self, friend, Obama—served as a neural measure of social thought. If the social processing hypothesis is supported, there would be less activation in the mentalizing network in response to social targets for participants in the solitude condition, relative to controls. If the social needs hypothesis is supported, the opposite pattern should emerge. We expect no difference between conditions in response to the control target. Again, this study had no a priori hypotheses about the direction of this effect or about its specificity to social targets rather than the self.

The neuroimaging findings converged with the results from the mind wandering task and supported the social processing hypothesis (see Figure 2). When making inferences about the preferences of a close friend, participants in the solitude condition had less activity in the mentalizing network than controls ($M_{solitude}$ = 1.072, $M_{control}$ = 1.407), $t(72.236) = 2.09$, $p = .040$. This effect was specific to the friend condition as there were no significant group differences in this network for the self, Obama, or indoor conditions.

Together, these findings provide preliminary evidence that the social environment shapes social thought. In particular, we found that after a period of solitude, social thought decreased. The behavioral results show this effect in spontaneous thought during mind wandering, and the neural results show a similar pattern for task-related social thought about a close friend.

Study 2: Social Presence

If the social processing hypothesis is true and spontaneous social thought reflects the social environment, social thought should increase in more social environments. Study 2 measured social thought in a slightly more social environment: during mere social presence.

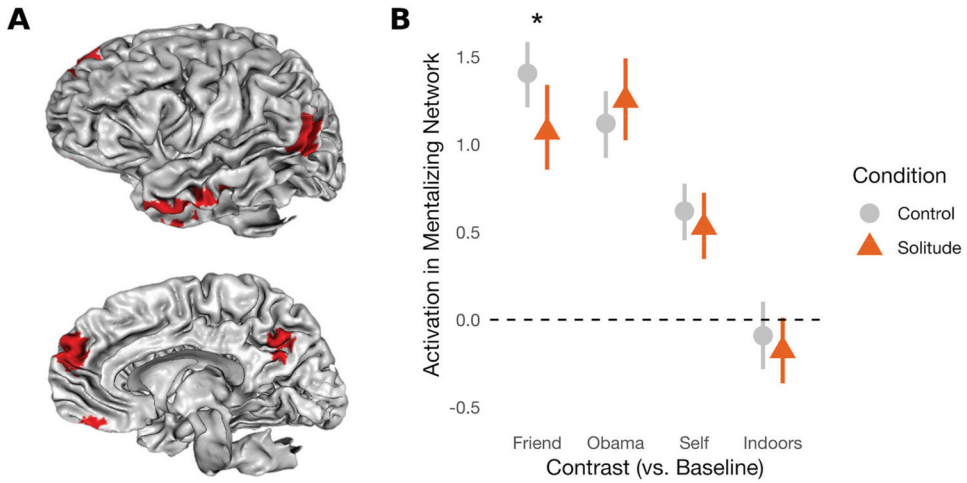
Method

Participants

Target sample size was determined using a simulation-based power analysis based on the mixed model for the subjective measure of social content in Study 1. We used the simr package (Green & MacLeod, 2016) to add simulated data based on the observed parameters in this model. With 80 participants, the simulated data set had 878 total data points and an estimated 83.9% power (95% CI [81.47, 86.13]); with 95 participants and 1,000 total data points, the simulated data set had 87.5% power to detect the interaction effect observed in Study 1. We increased the sampling rate of the paradigm in Study 2 to collect 1,000 total data points from 80 participants, and as such, we set a target sample size of 80 participants.

We stopped data collection once the target sample size was reached. Since participants came in in groups that were scheduled in advance, we tallied participants at the end of each study day. We recruited 91 participants from Princeton University's psychology subject pools (age M = 20.3, SD = 3.1, range = 18–35; 62.2% female; 47.7% White/European American, 23.3% East Asian/East Asian American, 13.3% biracial or multiracial, 5.6% Black/African American, 4.4% Latino/Hispanic American, 2.2% South Asian/South Asian American, 1.1% Middle Eastern/Arab American). Six participants were excluded for not complying with mind wandering task instructions, using the same exclusion criteria as in Study 1, leaving a sample size of 85 participants, 42 in the social presence condition, and 43 in the control condition. One

Figure 2
Mentalizing Network Activity While Thinking About a Close Other Decreases After a Period of Solitude



Note. Within the mentalizing network (A), activity while thinking about a close other decreases after a period of solitude (B). This network shows no differences between conditions for other targets (B). Error bars reflect bootstrapped 95% confidence intervals. * $p < .05$. See the online article for the color version of this figure.

participant was included who had also completed Study 1. Excluding this participant did not change the results of the study.

Experimental Manipulation

Participants were assigned to either the social presence condition or the control condition. As in Study 1, participants in the control condition completed the task while seated in a room by themselves. The social presence condition was designed to have multiple people together but not interacting. This condition mimicked mere presence manipulations in various previous studies (Markus, 1978; Schmitt et al., 1986; Zajonc, 1965). Participants in the social presence condition completed the task while seated next to one or two other participants. Participants did not get a chance to interact before the task, and all participants in this condition reported they did not know each other prior to the experiment. This ensured that mere presence was the only factor that differed between the two conditions.

Mind Wandering

Participants in all conditions completed the same mind wandering task from Study 1. To obtain more responses per participant, the task duration was extended to 45 min. To avoid having to exclude participants who completed the first study, we chose a different text. The text participants read in this version of the task was "A-B-C of Vegetable Gardening" by Eben E. Rexford (retrieved from https://www.gutenberg.org). This text contained minimal social content. Each participant responded to an average of 12.4 (SD = 1.3) thought probes.

Results

Based on the results from Study 1, we expected to find further evidence for the social processing hypothesis: There should be a positive interaction effect of mind wandering and condition on the subjective and objective measures of social thought. In other words, participants in the social presence condition should show increased spontaneous social thought relative to controls.

Results did not support this hypothesis. Mere social presence did not change the content of thought compared to completing the task in the control condition. There were no significant interaction effects for self-reported mind wandering and condition on either the objective measure of social thought ($\beta = .44$, $SE = .46$, $p = .54$; mind wandering, $M_{control} = 3.51$, $SD_{control} = 4.94$, $M_{social\ presence} = 3.68$, $SD_{social\ presence} = 5.50$; no mind wandering, $M_{control} = 3.55$, $SD_{control} = 4.55$, $M_{social\ presence} = 3.34$, $SD_{social\ presence} = 4.47$) or the subjective measure ($\beta = .50$, $SE = 2.42$, $p = .84$; mind wandering, $M_{control} = 18.27$, $SD_{control} = 18.87$, $M_{social\ presence} = 20.74$, $SD_{social\ presence} = 21.23$; no mind wandering, $M_{control} = 17.3$, $SD_{control} = 16.33$, $M_{social\ presence} = 19.27$, $SD_{social\ presence} = 17.26$). These results indicate that mere social presence does not affect the social content of spontaneous thought. That said, mere social presence during a relatively short task (45 min) may not have added sufficient social information into the environment to alter participants' social thought. In fact, to be truly comparable to Study 1, participants in this study would have had to be exposed to 7 hr of mere social presence.

Study 3: Social Interaction

Study 2 showed that mere social presence was not sufficient to increase spontaneous social thought, relative to being alone. It is possible that social processing prepares us to engage with others and, for that reason only, increases spontaneous social thought when the environment supports social interaction, rather than passive social presence. Alternatively, the mere social presence condition in Study 2 may be similar to the typical social environment experienced by our participants. As such, the difference in social

environment between the control group and mere presence group may have been too subtle to detect any difference. Study 3 used a stronger manipulation of social context than Study 2 in an attempt to fully reverse the effect observed in Study 1. We preregistered the hypothesis that introducing new social information to the environment, by having participants interact with each other, should increase spontaneous social thought (https://osf.io/hjfuq).

Method

Participants

Sample size and stopping criteria were determined in the same way as in Study 2. This study was preregistered with a sample size of 80 participants (40 per condition). We recruited 87 participants from Princeton University's psychology credit pool (age $M = 19.4$, $SD = 2.0$, range = 18–29; 64.4% female; 40.2% White/European American, 17.2% East Asian/East Asian American, 13.8% biracial or multiracial, 8.0% Black/African American, 8.0% Latino/Hispanic American, 8.0% South Asian/South Asian American, 1.1% Middle Eastern/Arab American). Two participants were excluded because they already knew each other prior to the manipulation. Three participants were excluded based on the same criteria from Studies 1 and 2, leaving a final sample of 82 participants, 40 in the social interaction condition and 42 in the control condition. One participant was included who had also completed Study 1. Excluding this participant did not change the results of the study.

Experimental Manipulation

Participants were assigned to one of two conditions: social interaction or control. The control condition was the same as in Studies 1 and 2: Participants did the mind wandering task while they were alone after going about their day as normal. In the social interaction condition, two participants came to the lab at the same time. They first completed the fast friends procedure (Aron et al., 1997). In this procedure, the pair of participants gets index cards with questions on them. They take turns reading and answering each question out loud. The questions are designed to elicit interpersonal closeness between two strangers. As the participants go through the stacks of cards, the questions become increasingly personal in nature. After 30 min, the fast friends procedure ended, and participants began the mind wandering task as described in Study 1, while sitting side by side.

Mind Wandering

Participants in both conditions completed the same mind wandering task from Study 2, with text from "Animals of the Past" by Frederic A. Lucas (retrieved from https://www.gutenberg.org). Each participant responded to an average of 11.8 ($SD = 1.4$) thought probes.

Results

We used the same analysis strategy described in Study 1 to measure the effect of social interaction on subsequent spontaneous thought content. Analyses tested the preregistered hypothesis that social interaction should increase social thought. That is, in contrast to the results from Study 1, which showed that isolated participants had less social thought during mind wandering (a negative interaction between self-reported mind wandering and condition), here we expected to see that social interaction participants have more social thought during mind wandering (a positive interaction between mind wandering and condition).

As predicted, social thought during mind wandering increased for participants in the social interaction condition relative to controls. There were significant interaction effects between mind wandering and condition on both the subjective measure of social thought ($\beta = 5.51$, $SE = 2.02$, $p = .007$; mind wandering, $M_{\text{control}} = 16.26$, $SD_{\text{control}} = 14.11$, $M_{\text{social interaction}} = 21.47$, $SD_{\text{social interaction}} = 22.03$; no mind wandering, $M_{\text{control}} = 14.49$, $SD_{\text{control}} = 11.8$, $M_{\text{social interaction}} = 14.22$, $SD_{\text{social interaction}} = 12.79$), as well as the objective measure ($\beta = 2.66$, $SE = .76$, $p < .001$; mind wandering, $M_{\text{control}} = 3.83$, $SD_{\text{control}} = 5.11$, $M_{\text{social interaction}} = 6.44$, $SD_{\text{social interaction}} = 8.02$; no mind wandering, $M_{\text{control}} = 3.46$, $SD_{\text{control}} = 4.75$, $M_{\text{social interaction}} = 3.54$, $SD_{\text{social interaction}} = 4.86$), such that participants in the social interaction condition had more social thought during mind wandering. Taken together, the three studies show a pattern of increasing spontaneous social thought in increasingly social environments (see Figure 1), where, compared to a control condition, solitude decreases social thought (Study 1), mere presence does not affect social thought (Study 2), and social interaction increases social thought (Study 3).

Study 4: Individual Differences in Social Needs

Studies 1–3 found consistent support for the social processing hypothesis. However, it is still possible that social needs shape social thought independently of the quantity of social content in the environment. In Study 4, we conducted exploratory analyses that capitalize on the natural variance in participants' social environments. All participants in the control condition in Studies 1–3 ($N = 128$) completed the mind wandering task in the same social environment. However, they arrived at the experiment after experiencing very different social lives. We assessed the richness of their ongoing social world with measures of loneliness (Russell, 1996), need to belong (Leary et al., 2013), and tendency and efficacy in seeking out interpersonal regulation (Williams et al., 2018) after the mind wandering task. According to the social needs hypothesis, high scores on all of these measures should predict more social thought; lonely individuals have unfulfilled social needs, and individuals with high need to belong and interpersonal regulation likely have high social needs by default. In contrast, according to the social processing hypothesis, high scores on need to belong and interpersonal regulation but low scores on loneliness should predict more social thought; individuals with high need to belong and interpersonal regulation likely seek out social environments regularly, whereas lonely individuals likely inhabit less social environments. Thus, we used these individual difference measures to test these competing predictions, focusing on loneliness in particular as the measure that offers the only distinction between these two hypotheses.

Method

Participants

All control group participants used in the first three studies were also used in this study. This made for a total sample size of 128 participants.

Measures

The content of spontaneous thought was measured both objectively and subjectively, as in Studies 1–3. Social needs were measured using the UCLA Loneliness Scale (Russell, 1996), the Need to Belong (NTB) Scale (Leary et al., 2013), and the Interpersonal Regulation Questionnaire (IRQ; Williams et al., 2018).

The UCLA Loneliness Scale (Russell, 1996) measures loneliness in 20 items such as "How often do you feel left out?" and "How often do you feel part of a group of friends?" that participants respond to using a 4-point scale of *never*, *rarely*, *sometimes*, or *always*. After reverse coding positively worded items, all responses are summed to yield a loneliness score with a maximum of 80.

The NTB Scale (Leary et al., 2013) is a 10-item questionnaire that includes items like "I want other people to accept me" and "I do not like being alone." Participants respond to these items using a 5-point Likert scale of *strongly disagree* to *strongly agree*. Responses are summed to yield a NTB score with a maximum of 50.

The IRQ (Williams et al., 2018) measures interpersonal emotion regulation strategies in terms of tendency to seek out other people for emotion regulation and efficacy of seeking out others for emotion regulation. Tendency and efficacy are measured for both positive and negative emotions. Therefore, there are four subscales: tendency-positive, tendency-negative, efficacy-positive, and efficacy-negative. Each subscale is measured in four items, for a total of 16 items. For each subscale, responses are averaged to yield a score with a maximum of 7. The average of all items serves as an overall score.

For each of the survey scales, we fit linear models with social thought as the outcome variable and self-reported mind wandering, the survey score, and their interaction as predictors. To account for multiple observations of thought content per participant and the nesting of participants in different studies, the model also included random intercepts for each participant and for study. As such, there were two models per survey measure: one for the objective and subjective measure of social thought, respectively. The questionnaires described above are the only questionnaires related to social needs administered in these studies.

Results

Analyses of the main effect of objective measure of social thought supported the social processing account: The more an individual spontaneously thought about social content, the lower their loneliness ($\beta = -.066$, $SE = .027$, $p = .014$). The subjective measure of social thought showed no relation with loneliness ($\beta = -.019$, $SE = .084$, $p = .82$). NTB and IRQ scores did not correlate with objective social thought (NTB: $\beta = .056$, $SE = .034$, $p = .10$; IRQ: $\beta = .003$, $SE = .214$, $p = .98$) or subjective social thought (NTB: $\beta = .183$, $SE = .106$, $p = .09$; IRQ: $\beta = .930$, $SE = .681$, $p = .27$). There were no significant interactions between self-reported mind wandering and survey scores for any measure, suggesting that social thought was similarly impacted during both spontaneous mind wandering thoughts and non-mind-wandering thoughts.

Since higher loneliness was correlated with fewer social thoughts, these results provide tentative support for the social processing account, and against the social needs account. However, this does not appear to be specific to _spontaneous_ thought.

General Discussion

Spontaneous thoughts predominantly feature other people. Here, we examined why people's thoughts gravitate toward the social world. Are we social beings by default, driven to think social thoughts and seek out social environments by a fundamental need for social connection? Or do our social thoughts reflect our constant exposure to the social world around us? The current studies help to arbitrate between two respective hypotheses about how the social environment impacts social thought: social processing and social needs. Across three studies, we found consistent evidence for the social processing hypothesis: Spontaneous social thought matches the social content available in the environment. Spontaneous social thought decreased after a period of solitude (Study 1), remained stable during mere social presence (Study 2), and increased after social interaction (Study 3). These findings consistently show that increasingly social environments produce increasingly social thought. This pattern of results suggests that people may think about the social world because they are so embedded in it, not because they need to.

This interpretation of the data is subject to some important caveats. First, the effect size in any individual study is small. Second, we operationalized social thought in two ways, using an objective and a subjective measure, which could inflate the false positive rate. Third, the effect of social isolation on social thought in Study 1 was only statistically significant in the subjective measure of social thought but not the objective measure. That said, the effect of social interaction on social thought in Study 3 was statistically significant in both the subjective and objective measure of social thought. Moreover, the pattern of results is consistent with the social processing account across all three studies, including across both behavioral and neural measures. As such, we interpret the results as evidence for the social processing hypothesis.

The social environment likewise shaped task-related social thought. After a period of solitude, neural activation in brain regions associated with social thought decreased. This effect was specific to social thought about a socially relevant target, a close friend. Solitude did not alter neural activity while considering an unfamiliar other, the self, or a nonsocial target. People rely on more specific information when making inferences about a close other and on more generic social knowledge when making inferences about a more distal other (Ames, 2004; Tamir & Mitchell, 2013; Zhao et al., 2020). This process is associated with activity in the medial prefrontal cortex, a core hub in the mentalizing network, which responds more strongly to close others than strangers (Krienen et al., 2010; Welborn & Lieberman, 2015). Therefore, social isolation may specifically decrease this deep, person-specific processing of

social information. Future research should test how social context influences thought about more nuanced categories of social content, including content ranging in social relevance, as well as additional types of spontaneous and task-directed social thought, like theory of mind, perspective taking, and empathy.

Exploratory analyses suggested that individuals who tend to experience less social interaction in their daily life also have fewer spontaneous social thoughts. Participants with insufficient meaningful social interaction showed less social thought. This finding contrasts with previous work showing increased sensitivity to social stimuli with increased loneliness (Gardner et al., 2005). However, this finding is consistent with the social processing account to the extent that loneliness reflects less social environments. To be sure of the implications of this finding for the social processing account, future work should assess the relation between these individual difference measures and experienced—rather than inferred—social interaction. Further, it is possible that these individual difference measures are insufficient to test the social needs account. Future work should directly manipulate social needs to provide a full test of the social needs hypothesis.

Here, we found consistent evidence that spontaneous social thought reflects the social environment. This finding raises the possibility that spontaneous thought helps people to process new information in the social world. Such spontaneous processing can serve an important function: Processing new information during rest can boost memory for this information (Ellenbogen et al., 2007; Tambini et al., 2010). In a recent neuroimaging study, brain regions associated with social thought showed increased coupling during periods of rest that followed a social task. Moreover, this neural coupling predicted performance on a subsequent memory test (Meyer et al., 2018). Social information from the external world propagated into spontaneous social processing during rest, and this social processing benefited retention of the new social information. Thus, it is likely that spontaneous social thought serves an adaptive purpose: It helps people integrate new social information to support later social cognition (Meyer, 2019). Future work should examine potential benefits of spontaneous social thought for social functioning.

These findings contextualize the claim that humans are social by default (Lieberman, 2013; Meyer, 2019; Schilbach et al., 2008). We may spend a majority of our time thinking about the social world (Mar et al., 2012), devote our default neural activity to social tasks (Diaz et al., 2013; Meyer et al., 2018; Schilbach et al., 2008), and make social and prosocial decisions by default (Baumeister & Leary, 1995; Chartrand & Bargh, 1999; Jolly et al., 2019). However, these defaults seem to be a *response* to the sociality of the world around us, rather than the *source* of our world's sociality. That is, people may be so doggedly social because we have learned that it is necessary to attend to the social world; this sociality may then persist because people are adept at learning the necessary social skills early in development (Atzil et al., 2018). If a person lives a day, or a life, with the din of the social world on mute, their mind will then no longer gravitate toward the social (Senju, 2013). We look forward to future work that further teases apart the extent to which our social drives are innate or just overlearned (Tamir & Hughes, 2018), perhaps by studying natural experiments in social isolation, with periods of isolation earlier in development or longer than those studied here. The social distancing policies enforced to combat the COVID-19 pandemic may offer one such natural experiment.

Because the social world is such a profound factor in shaping much of human life (Baumeister & Leary, 1995; Fiske et al., 2010), sociality provides an ideal case for testing the role of the environment in shaping thought. However, we do not expect *only* social experiences to be reflected in spontaneous thought. Instead, spontaneous thought often reflects one's salient, important, or recent experiences, social or not. Indeed, research has shown that people (and animals) spontaneously replay recent experiences from their episodic memory during periods of quiet rest (Ellenbogen et al., 2007; Tambini et al., 2010). This memory replay is essential for optimal memory consolidation (Fachechi et al., 2019; Wamsley, 2019). Thus, the effects here are likely not limited to social information alone; nonsocial environmental factors or experiences should similarly shape spontaneous thought.

When people's minds wander, their thoughts overwhelmingly gravitate toward the social world. As Michael Gazzaniga (2008) put it,

> When you get up in the morning, you do not think about triangles and squares... You think about status. You think about where you are in relation to your peers. You're thinking about your spouse, about your kids, about your boss. Ninety-nine percent of your time is spent thinking about other people's thoughts about you, their intentions.

While Gazzaniga may have overestimated the extent of our spontaneous social thought, he was right that other people occupy the preponderance of our mental life. Here, we shed light on the source of that preoccupation. Simply, the external social world is reflected in internal thoughts: The more social information in the environment, the more social our thoughts.

Context of the Research

Social psychologists often assume that people are innately, or invariably, social. Indeed, humans are highly social; people thrive when they have social connections and falter when they are deprived of social connections. However, we propose that people may not be social by default, but rather as a response to the sociality of their environment. With this research, we set out to examine how the social world shapes the content of our spontaneous thought. Our findings suggest that people think about the social world because the world contains a lot of social stimuli to process—evidence in favor of a social processing hypothesis. Our findings do not support the hypothesis that people think about the social world in order to fulfill insatiable social needs. In future work, we plan to extend these findings to real-world changes in social environments. Our experiments induced only short-term changes in people's social environments. In the real world, people can experience prolonged and disruptive changes to their social world. The COVID-19 pandemic has created an unprecedented upheaval of

people's social environments; this natural experiment in social distancing allows us to measure the impact of the social environment on thought samples collected throughout the pandemic. Through this project and others, we aim to further our understanding of the relationship between the environment and spontaneous thought.

References

Allport, G. W., & Ross, J. M. (1967). Personal religious orientation and prejudice. *Journal of Personality and Social Psychology*, *5*(4), 432–443. https://doi.org/10.1037/h0021212

Ames, D. R. (2004). Inside the mind reader's tool kit: Projection and stereotyping in mental state inference. *Journal of Personality and Social Psychology*, *87*(3), 340–353. https://doi.org/10.1037/0022-3514.87.3.340

Andersson, J., Skare, S., & Ashburner, J. (2003). How to correct susceptibility distortions in spin-echo echo-planar images: Application to diffusion tensor imaging. *NeuroImage*, *20*(2), 870–888. https://doi.org/10.1016/S1053-8119(03)00336-7

Andrews-Hanna, J. R., Smallwood, J., & Spreng, R. N. (2014). The default network and self-generated thought: Component processes, dynamic control, and clinical relevance. *Annals of the New York Academy of Sciences*, *1316*(1), 29–52. https://doi.org/10.1111/nyas.12360

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, *63*(4), 596–612. https://doi.org/10.1037/0022-3514.63.4.596

Aron, A., Melinat, E., Aron, E. N., Vallone, R., & Bator, R. J. (1997). The experimental generation of interpersonal closeness: A procedure and some preliminary findings. *Personality and Social Psychology Bulletin*, *23*(4), 363–377. https://doi.org/10.1177/0146167297234003

Ashburner, J. (2007). A fast diffeomorphic image registration algorithm. *NeuroImage*, *38*(1), 95–113. https://doi.org/10.1016/j.neuroimage.2007.07.007

Atzil, S., Gao, W., Fradkin, I., & Barrett, L. F. (2018). Growing a social brain. *Nature Human Behaviour*, *2*(9), 624–636. https://doi.org/10.1038/s41562-018-0384-6

Bar, M., Aminoff, E., Mason, M., & Fenske, M. (2007). The units of thought. *Hippocampus*, *17*(6), 420–428. https://doi.org/10.1002/hipo.20287

Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, *34*(2), 163–175. https://doi.org/10.1023/B:JADD.0000022607.19833.00

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497–529. https://doi.org/10.1037/0033-2909.117.3.497

Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network. *Annals of the New York Academy of Sciences*, *1124*(1), 1–38. https://doi.org/10.1196/annals.1440.011

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology*, *76*(6), 893–910. https://doi.org/10.1037/0022-3514.76.6.893

Crocker, J., Luhtanen, R. K., Cooper, M. L., & Bouvrette, A. (2003). Contingencies of self-worth in college students: Theory and measurement. *Journal of Personality and Social Psychology*, *85*(5), 894–908. https://doi.org/10.1037/0022-3514.85.5.894

Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*, *24*(4), 349–354. https://doi.org/10.1037/h0047358

Dale, A. M. (1999). Optimal experimental design for event-related fMRI. *Human Brain Mapping*, *8*(2–3), 109–114. https://doi.org/10.1002/(SICI)1097-0193(1999)8:2/3<109::AID-HBM7>3.0.CO;2-W

Diaz, B. A., Van Der Sluis, S., Moens, S., Benjamins, J. S., Migliorati, F., Stoffers, D., Den Braber, A., Poil, S.-S., Hardstone, R., Van't Ent, D., Boomsma, D. I., De Geus, E., Mansvelder, H. D., Van Someren, E. J. W., & Linkenkaer-Hansen, K. (2013). The Amsterdam Resting-State Questionnaire reveals multiple phenotypes of resting-state cognition. *Frontiers in Human Neuroscience*, *7*, Article 446. https://doi.org/10.3389/fnhum.2013.00446

Ellenbogen, J. M., Hu, P. T., Payne, J. D., Titone, D., & Walker, M. P. (2007). Human relational memory requires time and sleep. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(18), 7723–7728. https://doi.org/10.1073/pnas.0700094104

Epley, N., Waytz, A., & Cacioppo, J. (2007). On seeing human: A three-factor theory of anthropomorphism. *Psychological Review*, *114*(4), 864–886. https://doi.org/10.1037/0033-295X.114.4.864

Fachechi, A., Agliari, E., & Barra, A. (2019). Dreaming neural networks: Forgetting spurious memories and reinforcing pure ones. *Neural Networks*, *112*, 24–40. https://doi.org/10.1016/j.neunet.2019.01.006

Fan, J., McCandliss, B. D., Fossella, J., Flombaum, J. I., & Posner, M. I. (2005). The activation of attentional networks. *NeuroImage*, *26*(2), 471–479. https://doi.org/10.1016/j.neuroimage.2005.02.004

Fantz, R. L. (1963). Pattern vision in newborn infants. *Science*, *140*(3564), 296–297. https://doi.org/10.1126/science.140.3564.296

Fiske, S. T., Gilbert, D. T., & Lindzey, G. (2010). *Handbook of social psychology*. Wiley. https://doi.org/10.1002/9780470561119

Fox, K. C. R., Spreng, R. N., Ellamil, M., Andrews-Hanna, J. R., & Christoff, K. (2015). The wandering brain: Meta-analysis of functional neuroimaging studies of mind-wandering and related spontaneous thought processes. *NeuroImage*, *111*, 611–621. https://doi.org/10.1016/j.neuroimage.2015.02.039

Gardner, W., Pickett, C., Jefferis, V., & Knowles, M. (2005). On the outside looking in: Loneliness and social monitoring. *Personality and Social Psychology Bulletin*, *31*(11), 1549–1560. https://doi.org/10.1177/0146167205277208

Gazzaniga, M. (2008). *The seed salon: Tom Wolfe + Michael Gazzaniga*. Seed Magazine. https://web.archive.org/web/20081226094311/http://www.seedmagazine.com/news/2008/07/tom_wolfe_michael_gazzaniga.php

Green, P., & MacLeod, C. J. (2016). SIMR: An R package for power analysis of generalized linear mixed models by simulation. *Methods in Ecology and Evolution*, *7*(4), 493–498.

John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative Big Five trait taxonomy: History, measurement, and conceptual issues. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (3rd ed., pp. 114–158). Guilford Press.

Jolly, E., Tamir, D. I., Burum, B., & Mitchell, J. P. (2019). Wanting without enjoying: The social value of sharing experiences. *PLoS ONE*, *14*(4), Article e0215318. https://doi.org/10.1371/journal.pone.0215318

Klinger, E. (1971). *Structure and functions of fantasy*. Wiley-Interscience.

Klinger, E. (2013). Goal commitments and the content of thoughts and dreams: Basic principles. *Frontiers in Psychology*, *4*, Article 415. https://doi.org/10.3389/fpsyg.2013.00415

Krienen, F. M., Tu, P.-C., & Buckner, R. L. (2010). Clan mentality: Evidence that the medial prefrontal cortex responds to close others. *The Journal of Neuroscience*, *30*(41), 13906–13915. https://doi.org/10.1523/JNEUROSCI.2180-10.2010

Leary, M. R., Kelly, K. M., Cottrell, C. A., & Schreindorfer, L. S. (2013). Construct validity of the Need to Belong Scale: Mapping the nomological network. *Journal of Personality Assessment*, *95*(6), 610–624. https://doi.org/10.1080/00223891.2013.819511

Lieberman, M. D. (2013). *Social: Why our brains are wired to connect*. Crown Publishers/Random House.

Lombrozo, T., & Carey, S. (2006). Functional explanation and the function of explanation. *Cognition*, *99*(2), 167–204. https://doi.org/10.1016/j.cognition.2004.12.009

Lombrozo, T., & Gwynne, N. Z. (2014). Explanation and inference: Mechanistic and functional explanations guide property generalization. *Frontiers in Human Neuroscience*, *8*, Article 700. https://doi.org/10.3389/fnhum.2014.00700

Mar, R. A., Mason, M. F., & Litvack, A. (2012). How daydreaming relates to life satisfaction, loneliness, and social support: The importance of gender and daydream content. *Consciousness and Cognition*, *21*(1), 401–407. https://doi.org/10.1016/j.concog.2011.08.001

Markus, H. (1978). The effect of mere presence on social facilitation: An unobtrusive test. *Journal of Experimental Social Psychology*, *14*(4), 389–397. https://doi.org/10.1016/0022-1031(78)90034-3

McVay, J. C., & Kane, M. J. (2012). Why does working memory capacity predict variation in reading comprehension? On the influence of mind wandering and executive attention. *Journal of Experimental Psychology: General*, *141*(2), 302–320. https://doi.org/10.1037/a0025250

Meyer, M. L. (2019). Social by default: Characterizing the social functions of the resting brain. *Current Directions in Psychological Science*, *28*(4), 380–386. https://doi.org/10.1177/0963721419857759

Meyer, M. L., Davachi, L., Ochsner, K. N., & Lieberman, M. D. (2018). Evidence that default network connectivity during rest consolidates social information. *Cerebral Cortex*, *29*(5), 1910–1920. https://doi.org/10.1093/cercor/bhy071

Miller, L. C., Murphy, R., & Buss, A. H. (1981). Consciousness of body: Private and public. *Journal of Personality and Social Psychology*, *41*(2), 397–406. https://doi.org/10.1037/0022-3514.41.2.397

Morelli, S. A., Lieberman, M. D., & Zaki, J. (2015). The emerging study of positive empathy. *Social and Personality Psychology Compass*, *9*(2), 57–68. https://doi.org/10.1111/spc3.12157

Northoff, G. (2018). How does the brain's spontaneous activity generate our thoughts? Spatiotemporal theory of task-unrelated thought (STTT). In K. Christoff & K. C. R. Fox (Eds), *The Oxford handbook of spontaneous thought* (pp. 55–70). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780190464745.013.9

Pennebaker, J. W. (2015). *Linguistic inquiry and word count: LIWC2015*. Pennebaker Conglomerates.

Pickett, C. L., Gardner, W. L., & Knowles, M. (2004). Getting a cue: The need to belong and enhanced sensitivity to social cues. *Personality and Social Psychology Bulletin*, *30*(9), 1095–1107. https://doi.org/10.1177/0146167203262085

Poerio, G. L., Totterdell, P., Emerson, L.-M., & Miles, E. (2015). Love is the triumph of the imagination: Daydreams about significant others are associated with increased happiness, love and connection. *Consciousness and Cognition*, *33*, 135–144. https://doi.org/10.1016/j.concog.2014.12.011

Poerio, G. L., Totterdell, P., Emerson, L.-M., & Miles, E. (2016). Helping the heart grow fonder during absence: Daydreaming about significant others replenishes connectedness after induced loneliness. *Cognition and Emotion*, *30*(6), 1197–1207. https://doi.org/10.1080/02699931.2015.1049516

Quoidbach, J., Gruber, J., Mikolajczak, M., Kogan, A., Kotsou, I., & Norton, M. I. (2014). Emodiversity and the emotional ecosystem. *Journal of Experimental Psychology: General*, *143*(6), 2057–2066. https://doi.org/10.1037/a0038025

Reichle, E. D., Reineberg, A. E., & Schooler, J. W. (2010). Eye movements during mindless reading. *Psychological Science*, *21*(9), 1300–1310. https://doi.org/10.1177/0956797610378686

Rosenberg, M. (1979). *Conceiving the self*. Basic Books.

Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of Personality Assessment*, *66*(1), 20–40. https://doi.org/10.1207/s15327752jpa6601_2

Schilbach, L., Bzdok, D., Timmermans, B., Fox, P. T., Laird, A. R., Vogeley, K., & Eickhoff, S. B. (2012). Introspective minds: Using ALE meta-analyses to study commonalities in the neural correlates of emotional processing, social & unconstrained cognition. *PLoS ONE*, *7*(2), Article e30920. https://doi.org/10.1371/journal.pone.0030920

Schilbach, L., Eickhoff, S. B., Rotarska-Jagiela, A., Fink, G. R., & Vogeley, K. (2008). Minds at rest? Social cognition as the default mode of cognizing and its putative relationship to the "default system" of the brain. *Consciousness and Cognition*, *17*(2), 457–467. https://doi.org/10.1016/j.concog.2008.03.013

Schmitt, B., Gilovich, T., Goore, N., & Joseph, L. (1986). Mere presence and social facilitation: One more time. *Journal of Experimental Social Psychology*, *22*(3), 242–248. https://doi.org/10.1016/0022-1031(86)90027-2

Senju, A. (2013). Atypical development of spontaneous social cognition in autism spectrum disorders. *Brain & Development*, *35*(2), 96–101. https://doi.org/10.1016/j.braindev.2012.08.002

Song, X., & Wang, X. (2012). Mind wandering in Chinese daily lives – An experience sampling study. *PLoS ONE*, *7*(9), Article e44423. https://doi.org/10.1371/journal.pone.0044423

Spreng, R. N., & Grady, C. L. (2010). Patterns of brain activity supporting autobiographical memory, prospection, and theory of mind, and their relationship to the default mode network. *Journal of Cognitive Neuroscience*, *22*(6), 1112–1123. https://doi.org/10.1162/jocn.2009.21282

Spunt, R. P., Meyer, M. L., & Lieberman, M. D. (2015). The default mode of human brain function primes the intentional stance. *Journal of Cognitive Neuroscience*, *27*(6), 1116–1124. https://doi.org/10.1162/jocn_a_00785

Tambini, A., Ketz, N., & Davachi, L. (2010). Enhanced brain correlations during rest are related to memory for recent experiences. *Neuron*, *65*(2), 280–290. https://doi.org/10.1016/j.neuron.2010.01.001

Tamir, D. I., & Hughes, B. L. (2018). Social rewards: From basic social building blocks to complex social behavior. *Perspectives on Psychological Science*, *13*(6), 700–717. https://doi.org/10.1177/1745691618776263

Tamir, D. I., & Mitchell, J. P. (2012). Disclosing information about the self is intrinsically rewarding. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(21), 8038–8043. https://doi.org/10.1073/pnas.1202129109

Tamir, D. I., & Mitchell, J. P. (2013). Anchoring and adjustment during social inferences. *Journal of Experimental Psychology: General*, *142*(1), 151–162. https://doi.org/10.1037/a0028232

Underwood, L. G. (2006). Ordinary spiritual experience: Qualitative research, interpretive guidelines, and population distribution for the Daily Spiritual Experience Scale. *Archiv Für Religionspsychologie*, *28*(1), 181–218. https://doi.org/10.1163/008467206777832562

U.S. Bureau of Labor Statistics. (2016). *American time use survey (2003–2016)*. https://www.bls.gov/tus/datafiles_0316.htm

Vallacher, R. R., & Wegner, D. M. (1989). Levels of personal agency: Individual variation in action identification. *Journal of Personality and Social Psychology*, *57*(4), 660–671. https://doi.org/10.1037/0022-3514.57.4.660

Wamsley, E. J. (2019). Memory consolidation during waking rest. *Trends in Cognitive Sciences*, *23*(3), 171–173. https://doi.org/10.1016/j.tics.2018.12.007

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Webster, D. M., & Kruglanski, A. W. (1994). Individual differences in need for cognitive closure. *Journal of Personality and Social Psychology*, *67*(6), 1049–1062. https://doi.org/10.1037/0022-3514.67.6.1049

Welborn, B. L., & Lieberman, M. D. (2015). Person-specific theory of mind in medial pFC. *Journal of Cognitive Neuroscience*, *27*(1), 1–12. https://doi.org/10.1162/jocn_a_00700

Williams, J. J., & Lombrozo, T. (2010). The role of explanation in discovery and generalization: Evidence from category learning. *Cognitive Science*, *34*(5), 776–806. https://doi.org/10.1111/j.1551-6709.2010.01113.x

Williams, W. C., Morelli, S. A., Ong, D. C., & Zaki, J. (2018). Interpersonal emotion regulation: Implications for affiliation, perceived support, relationships, and well-being. *Journal of Personality and Social Psychology*, *115*(2), 224–254. https://doi.org/10.1037/pspi0000132

Zajonc, R. B. (1965). Social facilitation. *Science*, *149*(3681), 269–274. https://doi.org/10.1126/science.149.3681.269

Zhao, X., Cusimano, C. J., & Malle, B. F. (2015). In search of triggering conditions for spontaneous visual perspective taking. *Proceedings of the 37th Annual Conference of the Cognitive Science Society* (pp. 2811–2816). Cognitive Science Society.

Zhao, Z., Thornton, M. A., & Tamir, D. I. (2020). Accurate emotion prediction in dyads and groups and its potential social benefits. *Emotion*. Advance online publication. https://doi.org/10.1037/emo0000890

Received June 25, 2019
Revision received September 17, 2020
Accepted January 19, 2021 ■