RESEARCH BRIEF · THE EVIDENCE, PLAINLY

Worry Is a Physical Event

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The stressors in a working life are mostly brief, and human physiology is built for brief. The perseverative cognition hypothesis proposes that what actually extends stress-related activation is repetitive thought: rumination about what happened and worry about what might. Two decades of evidence now sit behind it, including a 60-study meta-analysis, field measurements of cortisol and heart rate variability in ordinary evenings, and a 2026 meta-analysis that sharpened the claim by narrowing it. This brief separates the part that is well supported from the part that is not, and grades every study by tier.

WHAT WAS ACTUALLY STUDIED

01 Brosschot, Gerin & Thayer (2006), Journal of Psychosomatic Research

TIER 1 · THEORETICAL REVIEW

The paper that named the construct. The authors argued that biopsychological models of stress and health had focused almost entirely on physiological activation during a stressor, and had largely ignored activation occurring in anticipation of or following one. Their proposal was that perseverative cognition, expressed as worry and rumination, moderates the health consequences of stressors precisely because it prolongs stress-related affective and physiological activation on both sides of the event. They reviewed evidence linking worry, rumination, and anticipatory stress to enhanced cardiovascular, endocrine, immune, and neurovisceral activity, and described the support as preliminary. This is a framing paper, not a data paper, and its value is that it produced a testable claim that later work could confirm or narrow.

02 Ottaviani et al. (2016), Psychological Bulletin

TIER 1 · SYSTEMATIC REVIEW AND META-ANALYSIS

Sixty studies of healthy subjects, meta-analyzed separately for each physiological parameter. Perseverative cognition was associated with higher systolic blood pressure (g = .45) and diastolic blood pressure (g = .51) in experimental studies, higher heart rate (g = .28 experimental, g = .20 correlational), higher cortisol (g = .36 experimental, g = .32 correlational), and lower heart rate variability (g = .15 experimental, g = .27 correlational). Significant moderators included sex, ethnicity, the type of induction used, state versus trait assessment, whether the focus was worry or rumination, the duration of physiological assessment, and study quality. The authors reported that results were not influenced by publication bias with the exception of blood pressure, a qualification that is rarely carried forward when this meta-analysis is cited.

03 Cropley, Rydstedt, Devereux & Middleton (2015), Stress and Health

TIER 2 · FIELD STUDY, NATURALISTIC SAMPLING

One hundred and eight schoolteachers completed a short diary about their work-related thoughts on a mid-week evening and provided a saliva sample at 10 p.m., then four further samples the next morning at awakening and at 15, 30, and 45 minutes. Participants were split at the median into high and low work-rumination groups. Cortisol secretion at 10 p.m. was significantly greater in the high ruminators, and the effect was not explained by leisure activities or work patterns during the evening. In the morning, high ruminators showed a flattened cortisol awakening response relative to low ruminators, an effect that appeared to be associated with sleep disturbance during the night. A median split is a blunt instrument and a single evening is a single evening, but the design puts the measurement in an ordinary living room rather than a laboratory.

04 Cropley et al. (2017), Frontiers in Human Neuroscience

TIER 2 · SMALL FIELD STUDY

Thirty-six participants, classified as low (n = 17) or high (n = 19) ruminators on the affective subscale of a work-related rumination measure, wore a wrist sensor band while carrying out their normal evening routines. Heart rate variability was sampled between 8 p.m. and 10 p.m. across three consecutive workday evenings. High affective ruminators showed lower root mean square of successive differences, indicating lower parasympathetic activity, during their own leisure time. There was no significant difference between groups in heart rate or in activity level during the recording windows, which rules out the most obvious confound. The sample is small and the device is consumer grade rather than research grade, so this study is corroborating rather than load-bearing.

05 Lim, Mueller & O'Brien (2026), International Journal of Psychophysiology

TIER 1 · SERIES OF META-ANALYSES

Six meta-analyses of laboratory studies in healthy samples, separating resting, reactivity, and recovery conditions, which prior syntheses had pooled. Twenty-eight eligible studies yielded 60 effect sizes, analyzed with random-effects models. Perseverative cognition was significantly associated with lower resting vagally mediated heart rate variability (k = 14, g = 0.46, 95 percent CI 0.26 to 0.66), with within-subjects reactivity (k = 18, g = 0.22, CI 0.11 to 0.33), and with within-subjects recovery (k = 9, g = 0.19, CI 0.03 to 0.36). Between-subjects effect sizes were non-significant. Significant heterogeneity was detected across the meta-analyses and was not accounted for by age, sex, perseverative cognition subtype, recording duration, or study quality. Sensitivity analyses supported the stability of the findings. The authors conclude that within-subjects designs appear most sensitive for detecting these relationships.

06 Fusaro et al. (2026), Psychophysiology

TIER 2 · WITHIN-SUBJECTS LABORATORY EXPERIMENT

A counterbalanced within-subjects design with two sessions. In one, participants recalled and described a personally salient, recurrent, emotionally distressing event, which is a standard perseverative cognition induction. In the other, they described the plot of a dramatic but non-self-referential film or book. Compared with the control condition, the induction produced higher self-reported thought distraction, greater negative affect, elevated heart rate, and reduced vagally mediated heart rate variability. It also reduced interpersonal engagement propensity, measured as preferred interpersonal closeness. Greater thought distraction and lower heart rate variability were both associated with the reduction in preferred closeness. The sample is healthy adults in a laboratory and the outcomes are proxies for social engagement rather than observed social behavior.

07 McGowan & Behar (2012), Behavior Modification

TIER 2 · RANDOMIZED CONTROLLED TRIAL, SMALL

Fifty-three participants with high trait worry were randomly assigned to two weeks of either stimulus control training, consisting of a 30-minute time-restricted and place-restricted worry period each day, or a control condition called focused worry, in which participants were instructed not to avoid naturally occurring worry so that worry and anxiety would not paradoxically increase. That control is a stronger comparison than a waitlist, because it holds the act of attending to worry constant and varies only the containment. At post-training, stimulus control was superior on measures of worry, anxiety, negative affect, and insomnia, and produced clinically significant change on worry and anxiety. It was not superior on depression or positive affect. No physiological measures were taken.

08 Ciobotaru et al. (2026), Brain and Behavior

TIER 2 · PREREGISTERED DOUBLE-BLIND WITHIN-PARTICIPANT TRIAL

Included here as counter-evidence rather than support. A Bayesian optimization algorithm tailored transcranial alternating current stimulation parameters to individual UK schoolteachers experiencing elevated work-related rumination. The development phase ran 80 burn-in and 319 personalized home-based sessions with 67 teachers. In the preregistered, double-blind, within-participant follow-up, 38 teachers received both personalized and sham stimulation in counterbalanced order. Both conditions reduced rumination, and no significant difference was observed between them. Higher stimulation amplitudes were associated with greater reductions in daytime sleepiness, and in the development phase with reduced sleep fragmentation. The authors report the intervention as feasible and well tolerated, and are explicit that personalized stimulation did not outperform sham.

WHAT THEY FOUND

Repetitive thought shows up in the body, across several measurement systems at once. Pooling 60 studies of healthy people, perseverative cognition was associated with higher systolic and diastolic blood pressure, higher heart rate, higher cortisol, and lower heart rate variability. Effect sizes ranged from small to moderate, roughly g = .15 to g = .51 depending on the parameter and the design. These are the magnitudes real physiology produces, not the magnitudes a headline implies (Ottaviani et al., 2016).

The effect is measurable in ordinary life, not only under laboratory induction. Among 108 schoolteachers sampled on a normal mid-week evening, those classified as high work-ruminators had significantly greater salivary cortisol at 10 p.m. than low ruminators, and the difference was not explained by what they had done with their evening. The same group also showed a flattened cortisol awakening response the following morning, apparently linked to sleep disturbance during the night (Cropley et al., 2015).

10 p.m.

the hour at which schoolteachers who ruminated about work still showed higher salivary cortisol than those who did not, on an ordinary mid-week evening with the workday long over (Cropley et al., 2015, 108 participants).

The autonomic side of it is visible during leisure time. Wrist-sensor recordings taken between 8 p.m. and 10 p.m. across three consecutive workday evenings found lower parasympathetic activity, indexed by RMSSD, in high affective ruminators than in low ruminators, with no difference in heart rate or in how much either group was moving around. Thirty-six people on a consumer device is corroboration, not proof (Cropley et al., 2017).

A 2026 meta-analysis sharpened the heart rate variability claim by narrowing it. Across 28 laboratory studies and 60 effect sizes, perseverative cognition was associated with lower vagally mediated heart rate variability at rest ($g = 0.46$), during reactivity ($g = 0.22$), and during recovery ($g = 0.19$). Those reactivity and recovery effects were within-subjects. The between-subjects effect sizes were non-significant. The practical translation is that this is a signal you read by comparing a person to themselves, not by comparing people to each other (Lim et al., 2026).

Perseverative cognition also reduces the pull toward other people, at least in the laboratory. After an induction in which participants recalled a recurrent distressing event, heart rate rose, heart rate variability fell, negative affect and thought distraction rose, and preferred interpersonal closeness dropped relative to a control condition. Both the cognitive interference and the reduced parasympathetic regulation were associated with the drop in preferred closeness. Social withdrawal arrives with the physiology rather than as a separate decision (Fusaro et al., 2026).

One containment strategy has controlled support and one popular device strategy does not. A randomized trial in 53 high trait worriers found that two weeks of a daily 30-minute time-restricted and place-restricted worry period beat an active control on worry, anxiety, negative affect, and insomnia, though not on depression or positive affect (McGowan & Behar, 2012). A preregistered, double-blind 2026 trial of algorithm-personalized home transcranial alternating current stimulation in 38 schoolteachers with high work rumination found that both the personalized and the sham condition reduced rumination, with no significant difference between them (Ciobotaru et al., 2026).

WHERE THE EVIDENCE STANDS

Eight sources, and the honest reading holds a strong mechanism claim apart from a much weaker causal one.

The well-supported claim is that repetitive thought is accompanied by measurable physiological activation, and that the activation is not confined to the moment of the stressor. This has been shown under laboratory induction and in naturalistic evening sampling, across cardiovascular, autonomic, and endocrine measures, in a 60-study meta-analysis and again in a 2026 meta-analysis restricted to heart rate variability (Ottaviani et al., 2016; Lim et al., 2026; Cropley et al., 2015; Cropley et al., 2017). The construct was proposed twenty years ago as an explanation for why brief stressors seem to produce long physiological consequences, and the accumulated data are consistent with it (Brosschot et al., 2006).

The under-supported claim is the causal chain the construct was built to explain. Almost all of this evidence is correlational or short-term experimental. Nothing in it demonstrates that a person's habitual worry causes their long-term disease outcomes, and the original authors described their own supporting evidence as preliminary. The 2016 meta-analysis also disclosed that its blood pressure results, alone among the parameters examined, showed signs of publication bias. The 2026 meta-analysis found substantial heterogeneity that none of its moderators explained, and found the between-subjects effects non-significant, which means this literature is currently better at describing changes within a person than at ranking people against each other.

What survives both readings is a smaller and more usable claim, and it happens to be the one a person can act on. The duration of physiological activation after a stressor is measurable, it varies with what someone does with their attention afterward, and at least one behavioral containment strategy has beaten an active control in a randomized trial (McGowan & Behar, 2012). Meanwhile the most technologically appealing option tested this year did not beat its own sham (Ciobotaru et al., 2026). That asymmetry is the practical content of this issue. The unglamorous moves are where the controlled evidence sits.

WHAT THIS DOES NOT PROVE

Nearly all of this evidence is correlational or based on short laboratory inductions. It establishes that repetitive thought and physiological activation travel together, and it does not establish that worry causes cardiovascular or endocrine disease. The disease-outcome step remains a hypothesis, described as such by the authors who proposed it.

The 2016 meta-analysis reported that its blood pressure findings, unlike its heart rate, cortisol, and heart rate variability findings, showed evidence of publication bias. That qualification belongs with the blood pressure numbers every time they are quoted.

The 2026 heart rate variability meta-analysis found significant heterogeneity across studies that was not accounted for by age, sex, perseverative cognition subtype, recording duration, or study quality. Unexplained heterogeneity means the pooled effect sizes should be read as a rough central tendency across quite different studies, not as a stable quantity.

The same meta-analysis found between-subjects effect sizes non-significant. This is a real limit on interpretation: it means the literature does not currently support ranking one person against another on this basis, and it is a specific reason to be skeptical of any product that scores you against a population.

The two field studies are small or blunt. The cortisol study used a median split on 108 teachers across a single evening. The heart rate variability field study used 36 participants and a consumer-grade wrist device rather than research-grade equipment. Both point the same direction as the laboratory work, and neither would carry the claim alone.

The 2026 social finding used healthy adults in a laboratory, and measured preferred interpersonal closeness and related proxies rather than observed social behavior over time. Whether the same pattern produces real withdrawal from real relationships is an untested extension.

The worry postponement trial had 53 participants, ran two weeks, and measured self-reported worry, anxiety, affect, and insomnia. It took no physiological measurements at all, so it does not demonstrate that containing worry shortens physiological activation. A second randomized waitlist-controlled trial found the technique reduced worry in generalized anxiety disorder but with limited effect in hypochondriasis, so the effect is not uniform across presentations.

None of this is medical advice or a diagnostic frame. Persistent repetitive thought, chronic sleep disruption, and hopelessness are clinical matters. A newsletter is the wrong instrument for them, and a clinician is the right one.

WHAT IT MEANS FOR YOU

Measure the tail rather than the trigger, because the whole construct is about duration of activation and the length of the response after an event is the quantity this literature has been measuring for twenty years. Give the thinking a fixed time and place, because a 30-minute daily worry period beat an active control on worry, anxiety, negative affect, and insomnia in a randomized trial, which makes it one of the few moves here with controlled evidence rather than plausible mechanism. Let the body be the detector, because the field studies found the signal in cortisol at 10 p.m. and in parasympathetic activity during ordinary leisure hours, which is to say the physiology was legible on evenings when the person was not thinking of themselves as stressed. Be slow to buy the device, because the most sophisticated intervention tested this year, algorithm-personalized home neurostimulation in a preregistered double-blind trial, reduced rumination exactly as much as its sham did. And keep the appointment with people, because a laboratory induction of perseverative cognition reduced preferred interpersonal closeness along with heart rate variability, which suggests that wanting less contact during a hard stretch is part of the pattern rather than a preference arrived at freely. The newsletter walks through those five moves. The research above is why they are the five, and where each one runs out.

GO TO THE SOURCE

TIER 1 · THEORETICAL REVIEW Brosschot, J. F., Gerin, W., & Thayer, J. F. (2006). The perseverative cognition hypothesis: a review of worry, prolonged stress-related physiological activation, and health. Journal of Psychosomatic Research, 60(2), 113-124. doi.org/10.1016/j.jpsychores.2005.06.074

TIER 1 · SYSTEMATIC REVIEW AND META-ANALYSIS Ottaviani, C., Thayer, J. F., Verkuil, B., Lonigro, A., Medea, B., Couyoumdjian, A., & Brosschot, J. F. (2016). Physiological concomitants of perseverative cognition: A systematic review and meta-analysis. Psychological Bulletin, 142(3), 231-259. doi.org/10.1037/bul0000036

TIER 2 · FIELD STUDY Cropley, M., Rydstedt, L. W., Devereux, J. J., & Middleton, B. (2015). The relationship between work-related rumination and evening and morning salivary cortisol secretion. Stress and Health, 31(2), 150-157. doi.org/10.1002/smi.2538

TIER 2 · SMALL FIELD STUDY Cropley, M., Plans, D., Morelli, D., Sütterlin, S., Inceoglu, I., Thomas, G., & Chu, C. (2017). The association between work-related rumination and heart rate variability: A field study. Frontiers in Human Neuroscience, 11, 27. doi.org/10.3389/fnhum.2017.00027

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TIER 2 · WITHIN-SUBJECTS LABORATORY EXPERIMENT Fusaro, M., Fini, C., Cuomo, G., Kaya, S., Ottaviani, C., & Era, V. (2026). The social cost of perseverative cognition: Impairing interpersonal engagement propensity through cognitive and autonomic dysregulation. Psychophysiology, 63(8), e70379. doi.org/10.1111/psyp.70379

TIER 2 · RANDOMIZED CONTROLLED TRIAL McGowan, S. K., & Behar, E. (2012). A preliminary investigation of stimulus control training for worry: Effects on anxiety and insomnia. Behavior Modification, 37(1), 90-112. doi.org/10.1177/0145445512455661

TIER 2 · RANDOMIZED WAITLIST-CONTROLLED TRIAL Krzikalla, C., Buhlmann, U., Schug, J., Kopei, I., Gerlach, A. L., Doebler, P., Morina, N., & Andor, T. (2024). Worry postponement from the metacognitive perspective: A randomized waitlist-controlled trial. Clinical Psychology in Europe, 6(2), e12741. doi.org/10.32872/cpe.12741

TIER 2 · PREREGISTERED DOUBLE-BLIND TRIAL Ciobotaru, D., Nguyen, V., Pérez, A., Clothier, Z. E., Violante, I. R., Cropley, M., & Cohen Kadosh, R. (2026). Feasibility and effectiveness of personalized home-based neurostimulation for teachers experiencing work-related rumination. Brain and Behavior, 16(2), e71264. doi.org/10.1002/brb3.71264

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Education, not medical advice.