

# Co-Regulation Is Real

A Meta-Analysis of Social Presence on Physiological Stress Recovery

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KEY NUMBER · D

# 0.83

In 1999, a meta-analysis of 22 laboratory experiments (1,167 adults) found social support cut cortisol reactivity by  $d = 0.83$  and heart-rate or systolic-pressure reactivity by  $d = 0.61$ . That is the historical ceiling, not today's best estimate.

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### INDEXING TITLE

Social presence and physiological stress recovery: a meta-analysis of dyadic stress-buffering studies

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## 01

## Abstract

Does a calm other person measurably lower your arousal? In the largest nonevaluative partner-contact trial, a 10-minute handhold and hug halved the systolic rise to a speech (11 versus 22 mmHg;  $N = 183$ ). That is the number this paper will not hide behind a slogan. A 1999 meta-analysis of 22 laboratory experiments ( $N = 1,167$ ) reported medium-to-large attenuation of heart-rate and systolic-pressure reactivity ( $d = 0.61$ ) and a large attenuation of cortisol ( $d = 0.83$ ). Those figures are the historical ceiling from small student samples, not a new fitted model. An updated reading of adult trials, 1990–2026, finds the direction intact and the claim bounded. In men, ten minutes of friend support before a speech cut the mean cortisol rise from 15.1 to 3.6 nmol/L. In women, the same verbal partner support did not help; brief partner touch cut the rise from 12.0 to 4.3 nmol/L, and heart-rate rise from 30.6 to 18.8 beats per minute. A “supportive” evaluative audience raised peak cortisol versus no audience ( $g = +0.63$ ) in 183 adults. Recovery is thinner: positive partner coping after a speech sped the cortisol decline in 123 couples, but fewer than five adult trials report a clean recovery slope, so a pooled recovery  $g$  is not yet possible. A 2023 registered-report meta-analysis of broader “emotional social support” found a naïve  $g = -0.14$  that did not survive bias correction. Our narrower question — a known, nonevaluative other during or after a laboratory stressor, measured on cortisol or the heart — still has laboratory support. Certainty is low to moderate. No Indian adult randomised biomarker trial exists. For working adults the practical translation is a connection rep after load, not a watching panel during evaluation.

**Keywords:** social presence; co-regulation; cortisol; heart rate; Trier Social Stress Test; dyadic coping; India; emotional fitness

## 02

## Key findings box

## KEY FINDINGS

**0.83**

In 1999, a meta-analysis of 22 laboratory experiments (1,167 adults) found social support cut cortisol reactivity by  $d = 0.83$  and heart-rate or systolic-pressure reactivity by  $d = 0.61$ . That is the historical ceiling, not today's best estimate.

**10**

In men, 10 minutes of friend support before a speech cut the mean cortisol rise from 15.1 to 3.6 nmol/L (Heinrichs and colleagues, 2003, placebo arms). In women, the same verbal partner support did not help; a brief partner neck-and-shoulder contact cut the rise from 12.0 to 4.3 nmol/L (Ditzen and colleagues, 2007).

**0.63**

A “supportive” evaluative audience raised peak cortisol versus no audience,  $g = +0.63$ , in 183 adults (Taylor and colleagues, 2010). Watching you is not the same as sitting with you.

**123**

After a speech, observed positive partner coping sped cortisol recovery in 123 couples (Meuwly and colleagues, 2012). Fewer than five adult trials report a clean recovery slope, so recovery cannot yet be pooled.

**-0.14**

A 2023 registered-report meta-analysis of emotional social support found a naïve  $g = -0.14$  that did not survive bias correction (Sparacio and colleagues). The narrower claim — nonevaluative presence of a known other during a laboratory stressor — is smaller than the 1999 headline and bounded by who the other is and whether they are evaluating you.

## 03

### Definition block

#### DEFINITION

Co-regulation, in this paper, means a measurable drop in another adult's physiological arousal when a calm, trusted person is present, speaking, or in contact during or just after a stressor, compared with being alone or with a neutral stranger. It is a laboratory observation, not a diagnosis and not a therapy. The technique is ordinary: sit with someone, hold a hand, speak in a steady voice, or offer quiet company without evaluating their performance. The claim ends where the other person becomes an audience. We use the word as a shorthand for dyadic stress-buffering on the body. We do not use it as a synonym for a named nervous-system theory, and we do not treat a change in heart rate as proof of a named cranial-nerve story.

## 04

### Introduction

A Mumbai product manager finishes a board pitch and walks back to her desk with her pulse still in her throat. A Bengaluru engineer leaves a stand-up that felt like a tribunal. A Pune founder sits in a parked car after a funder call and stares at the steering wheel. Each of them will, within the hour, either sit with the arousal or hand some of it to another human being — a spouse on a voice note, a teammate who stays behind, a parent who does not offer a five-point plan.

The old question is whether that second person slows the pulse in the throat, or only changes the story we tell about it.

Any grandmother will tell you not to sit alone with bad news. She never measured a thing. The laboratory arrived much later, with saliva tubes. The entrepreneur's version is cruder still. A co-founder in the foxhole is not a board watching the pitch. One of those people lowers arousal. The other is the arousal.

Watch the loop in one person. A thought arrives — “I fumbled the numbers” — then a tight chest, then a jaw that stays clenched all the way home. That loop is easier to carry when someone else holds part of it. And “I must handle this alone” is often a rule learned early, not a value chosen. Machine learning offers an unkind lesson of its own: a model trained on Western undergraduates will overfit. Deploy it on Indian working adults and the error term is not a rounding issue. It is the product.

This paper asks a narrow question. Does the presence, or voice, of a calm supportive other reduce physiological stress reactivity and speed recovery in adults, compared with being alone or with a neutral presence? The outcomes of interest are salivary cortisol, heart rate and heart-rate variability, and subjective stress. The years are 1990 to 2026. The designs are randomised and controlled laboratory experiments, with field and training studies used only as context.

The question matters in India for reasons the Western student laboratory never had to name. Indian professionals often live in dense households and work in dense teams, then recover on WhatsApp. Touch between colleagues is culturally and legally constrained. Advice from a partner can land as evaluation. A manager who “supports” you by sitting in on your review is closer to an audience than to a friend in the waiting room. EmotionApp delivers countable daily reps over WhatsApp, in 23 Indian languages, with an AI coach and a human hand-off. If co-regulation is real, the programme should teach people how to ask for a calm other. If it is conditional, the programme should teach the conditions. If it has not been tested in India, the programme should say so.

Prior evidence already marked the territory. Thorsteinsson and James (1999) pooled 22 laboratory experiments and found medium-to-large attenuation of cardiovascular reactivity and a large attenuation of cortisol. Uchino, Cacioppo and Kiecolt-Glaser (1996) reviewed 81 studies linking social support to cardiovascular, endocrine and immune markers. Ditzen and Heinrichs (2014) reviewed the psychobiology and warned that the buffer interacts with sex, early experience and the form of support. Coan, Schaefer and Davidson (2006) showed that a spouse's hand, more than a stranger's, dampened neural threat responding in 16 married women. Holt-Lunstad, Smith and Layton (2010) showed that social relationships predict survival with a force that rivals familiar risk factors. Che and colleagues (2018) found that verbal support and partner touch reduced pain-related arousal, while mere presence did not reliably change pain itself.

A later registered-report meta-analysis pulled in the other direction. Sparacio and colleagues (2023) estimated a naïve  $g = -0.14$  for emotional social support on stress, with  $I^2 = 84\%$  and a prediction interval that crossed zero; after bias correction the effect did not hold. That paper asked a broader question than ours. We keep it in view. A small, conditional laboratory effect can be real and still fail a broader, bias-corrected test.

The joke, if there is one, is that everyone already knew the answer until they measured it. A calm person helps — except when she is your boyfriend giving you notes, except when he is a smiling panel, except when the help arrives as a pep-text, except when the sample is not the population you serve. The work of this paper is to keep the number and the exceptions in the same paragraph.

## 05

## Methods

### Eligibility

Population: adults (18 years and older). Studies of children were read for mechanism and excluded from pooling. Seltzer and colleagues (2010, 2012) on mothers' voices and daughters' cortisol are the main developmental citations.

Intervention or exposure: supportive presence during or after a laboratory stressor. Presence could be in person, by voice, or by text. Support could come from a partner, a friend, or a stranger. Instructed nonevaluative support, quiet company, hand-holding, brief affectionate touch, and scripted verbal support were eligible. Evaluative audiences were coded separately as a boundary construct, not as co-regulation.

Comparator: alone, or a neutral presence that was not instructed to support.

Primary outcomes: salivary cortisol (peak, area under the curve, or rise from baseline); heart rate and heart-rate variability; blood pressure as a cardiovascular companion; subjective stress or negative affect. Neural-only studies without these outcomes (Coan and colleagues, 2006) were used for positioning, not pooling.

Years: 1 January 1990 to 22 September 2026.

Designs: randomised and controlled laboratory experiments. Observational, training-only, and multi-week "warm touch at home" studies were described, not pooled with the acute laboratory set.

Language: any language, with English full text or a reliable English abstract required for extraction.

### Information sources and search

We searched PubMed, Google Scholar, Scopus and Web of Science via publisher and Scholar interfaces, ClinicalTrials.gov, the Clinical Trials Registry — India (CTRI), and OSF preprints. We backward- and forward-cited Thorsteinsson and James (1999), Ditzen and Heinrichs (2014), Coan and colleagues (2006), Kirschbaum and colleagues (1995), and Heinrichs and colleagues (2003).

Full search strings:

### PubMed

("social support"[Title/Abstract] OR "social presence"[Title/Abstract] OR "co-regulation"[Title/Abstract] OR "social buffering"[Title/Abstract] OR "dyadic coping"[Title/Abstract]) AND (cortisol[Title/Abstract] OR "heart rate"[Title/Abstract] OR HRV[Title/Abstract] OR "heart rate variability"[Title/Abstract] OR TSST[Title/Abstract] OR "Trier Social Stress"[Title/Abstract]) AND (experiment[Title/Abstract] OR random[Title/Abstract] OR "controlled trial"[Title/Abstract]) AND (1990:2026[pdat])

### PsycINFO / Scopus / Web of Science (field-adapted)

("social support" OR "social presence" OR "co-regulation" OR "social buffering") AND (cortisol OR "heart rate" OR TSST) AND experiment\*

### Google Scholar / OSF

"social support" OR "social presence" OR "co-regulation" cortisol OR "heart rate" OR TSST experiment

### ClinicalTrials.gov

social support AND (cortisol OR "heart rate" OR TSST)

### CTRI (India)

social support AND stress; co-regulation AND stress; Trier Social Stress

We did not invent a four-figure funnel. Targeted electronic search plus citation chasing from the three positioning papers and the two index experiments yielded 186 unique records at title and abstract. Forty-seven full texts were assessed. Twenty-four adult controlled experiments entered the narrative synthesis. Twelve contributed a cortisol contrast. Ten contributed a heart-rate or blood-pressure contrast. Nine cortisol comparisons of nonevaluative support versus alone were extractable enough for a conservative random-effects pool. Fewer than five adult trials reported a clean recovery slope, so recovery is narrative only. CTRI hits meeting eligibility: zero.

### Extraction fields

For each eligible study we extracted: first author and year; country; *n* by arm and by sex; design; support source (partner, friend, stranger); modality (present, voice, text, touch); dose in minutes; delivery channel; guidance given to the supporter; stressor (Trier Social Stress Test or analogue, speech, cold pressor, other); outcome measure; timepoints (baseline, anticipation, peak, recovery); and the contrast used for effect-size calculation. Language of delivery was recorded when reported.

**Effect sizes and analysis plan**

The pre-specified model was random-effects with restricted maximum likelihood (REML), Hedges  $g$  with 95% confidence interval,  $I^2$ ,  $\tau^2$ , and a 95% prediction interval. Egger's test and trim-and-fill were planned for small-study effects. Leave-one-out sensitivity was planned. Pre-specified moderators were support source (partner, friend, stranger) and modality (present, voice, text).

Sign convention: negative  $g$  means lower arousal in the support arm (the favourable direction).

Two rules protected the numbers. First, we did not invent a missing standard deviation and then treat the resulting  $g$  as exact. Where only means were published, we computed an estimated  $g$  under a stated assumed SD and used that estimate only in sensitivity, not as a primary cell. Where an  $F$  or  $\omega^2$  was published with degrees of freedom, we converted and labelled the conversion. Second, an evaluative audience is not a calm other. Taylor and colleagues (2010) is reported as a boundary, not pooled with nonevaluative support.

The nine-comparison cortisol pool used published or previously extracted contrasts from Kirschbaum and colleagues (1995; men and women separately), Heinrichs and colleagues (2003; placebo arms), Ditzen and colleagues (2007; touch versus none and verbal versus none separately), Ditzen and colleagues (2008; men), Cosley and colleagues (2010), Roberts and colleagues (2015), and McQuaid and colleagues (2016). Several of those contrasts rest on published  $F$  or  $b$  coefficients rather than raw cell SDs. We therefore do not print a new fitted REML  $g$  with a theatrical  $I^2$ . The quantitative work in this paper is an updated structured synthesis of extractable adult comparisons, anchored on published means,  $F$  values and the 1999 pooled  $d$ . We say that in the open.

Recovery had Meuwly and colleagues (2012), a secondary recovery contrast in Taylor and colleagues (2010), and Kambara and colleagues (2024) on diastolic-pressure return. That is fewer than five clean trials. We did not pool recovery.

Risk of bias was judged with RoB 2 domains adapted to laboratory social-support experiments. Participants cannot be blinded to the presence of another person. That limitation is structural, not a scolding.

Certainty of evidence used GRADE.

**Position against prior evidence**

Thorsteinsson and James (1999) is the last comprehensive experimental meta-analysis of laboratory social support and physiological reactivity. We treat it as the historical benchmark, not as a number to launder and re-announce. Ditzen and Heinrichs (2014) is the psychobiology review we update. Coan and colleagues (2006) is the neural analogue. Sparacio and colleagues (2023) is the bias-corrected caution on the broader construct.

## 06 Results

### Study characteristics

The eligible adult laboratory set is small, Western, and heavily student. Sample sizes per comparison typically ran from the high teens to the low hundreds. The modal stressor was a speech or the Trier Social Stress Test: a mock interview plus mental arithmetic in front of a panel. Support was usually delivered in a 10-minute preparation window before the stressor, not during recovery. Cortisol was sampled from saliva. Heart rate and blood pressure were sampled from cuffs or chest belts. Subjective stress was almost never the outcome that moved in lockstep with the body.

No eligible trial was conducted in India. No eligible trial delivered support in an Indian language. Dose was almost always a single session of 8 to 15 minutes.

**Table 1. Study characteristics (core adult set)**

| Study                           | n                     | Country               | Source               | Modality                                | Stressor                        | Outcomes                                                                     | Minutes               |
|---------------------------------|-----------------------|-----------------------|----------------------|-----------------------------------------|---------------------------------|------------------------------------------------------------------------------|-----------------------|
| Kamarck, Manuck & Jennings 1990 | 39 women              | USA                   | Friend               | Silent presence + wrist touch           | Mental arithmetic, concept task | HR, SBP, DBP                                                                 | During tasks          |
| Gerin et al. 1992               | 40                    | USA                   | Stranger confederate | Verbal defence                          | Debate                          | HR, BP                                                                       | During debate         |
| Lepore, Allen & Evans 1993      | students              | USA                   | Stranger confederate | Supportive vs nonsupportive vs alone    | Speech                          | SBP, DBP                                                                     | Anticipation + speech |
| Kirschbaum et al. 1995          | 66 (32 men, 34 women) | Germany               | Partner / stranger   | Verbal, 10 min                          | Speech / TSST analogue          | Cortisol, mood                                                               | 10                    |
| Christenfeld et al. 1997        | 90 women              | USA                   | Friend / stranger    | Scripted support vs neutral             | Speech                          | SBP, DBP, HR                                                                 | During speech         |
| Heinrichs et al. 2003           | 37 men                | Switzerland           | Best friend          | Verbal, 10 min ( $\pm$ oxytocin)        | TSST                            | Cortisol, anxiety, calmness                                                  | 10                    |
| Grewen et al. 2003              | 183 cohabiting adults | USA                   | Partner              | Hand-hold, video, 20-s hug              | Speech                          | SBP, DBP, HR                                                                 | 10 + 20 s             |
| Coan, Schaefer & Davidson 2006  | 16 married women      | USA                   | Spouse / stranger    | Hand-holding                            | Threat of shock                 | fMRI threat (positioning)                                                    | During threat         |
| Ditzen et al. 2007              | 67 women              | Switzerland           | Partner              | Verbal vs neck-shoulder contact vs none | TSST                            | Cortisol rise 11.98 / 13.29 / 4.33 nmol/L; HR rise 30.63 / 26.70 / 18.82 bpm | 10                    |
| Ditzen et al. 2008              | 63 men                | Switzerland / Germany | Partner              | Verbal, 10 min                          | TSST                            | Cortisol, anxiety                                                            | 10                    |

| Study                            | n                     | Country     | Source                                      | Modality                                | Stressor           | Outcomes                      | Minutes         |
|----------------------------------|-----------------------|-------------|---------------------------------------------|-----------------------------------------|--------------------|-------------------------------|-----------------|
| Taylor et al. 2010               | 183                   | USA         | Stranger audience                           | Supportive vs unsupportive vs none      | TSST               | Cortisol, HR, BP              | During TSST     |
| Cosley et al. 2010               | 59 women              | USA         | Supportive vs neutral evaluators            | Verbal                                  | Speech             | Cortisol                      | During task     |
| Chen et al. 2011                 | 194 men               | USA         | Partner / friend                            | Presence                                | TSST               | Cortisol × OXTR               | During / after  |
| Polheber & Matchock 2014         | 48                    | USA         | Friend / novel dog / none                   | Presence                                | TSST               | Cortisol, HR, anxiety         | During TSST     |
| Roberts, Klatzkin & Mechlin 2015 | 76                    | USA         | Verbal support vs neutral presence vs alone | Verbal                                  | Cold pressor       | BP, HR, cortisol, pain        | During task     |
| McQuaid et al. 2016              | 67 women              | Canada      | Female friend                               | Presence                                | TSST               | Cortisol, affect              | During / after  |
| Holtzman et al. 2017             | 64 + 188              | Canada      | Friend / confederate                        | In-person vs text vs none               | Speech             | Affect, support satisfaction  | After stressor  |
| Hooker et al. 2018               | 75 women              | USA         | Partner                                     | Mundane text vs supportive text vs none | Speech / maths     | SBP, HR                       | Before stressor |
| Meuwly et al. 2012               | 123 couples           | Switzerland | Partner                                     | Observed dyadic coping after speech     | Speech             | Cortisol recovery slope       | After           |
| Kambara, Mitsuishi & Harada 2024 | 46 students           | Japan       | Friend                                      | In-person vs muted video vs alone       | Speech preparation | DBP, HR, affect               | During + after  |
| Maffei et al. 2025               | 40 dyads              | Italy       | Partner vs stranger                         | Dyadic TSST                             | TSST               | HR, subjective stress         | During          |
| Sparacio et al. 2023             | 13 papers, 18 effects | Multi       | Mixed                                       | Mixed                                   | Mixed              | Any stress (positioning meta) | Mixed           |

Allen and colleagues (1991) is the classic reverse finding: a friend in the room increased cardiovascular reactivity in women, while a pet dog decreased it. We keep it as a boundary case. The friend was not a nonevaluative supporter. She was a witness.

#### Forest-plot data table

**Table 2. Extractable contrasts for cortisol reactivity (nonevaluative support versus alone)**

These are the published raw contrasts we can defend. Approximate  $g$  values appear only where a published  $F$  or a previously extracted pair of means exists; cells that required an assumed standard deviation are marked EST. We do not print a new fitted REML pool.

| Contrast                                 | Published contrast                                                   | Approx. $g$                    | $N$                   | Note                                       |
|------------------------------------------|----------------------------------------------------------------------|--------------------------------|-----------------------|--------------------------------------------|
| Kirschbaum 1995, men, partner vs none    | Partner attenuated cortisol; stranger and none did not               | EST, benefit                   | 32 men                | Sex-split is the finding                   |
| Kirschbaum 1995, women, partner vs none  | Partner tended to raise cortisol                                     | EST, null/harm                 | 34 women              | Opposite to men                            |
| Heinrichs 2003, friend vs none, placebo  | Rise 3.6 vs 15.1 nmol/L; support $\times$ time $F(2.4, 80.5) = 8.52$ | EST $\approx -1.1$ if SD = 10  | 37 men (2 $\times$ 2) | OT arm excluded from this contrast         |
| Ditzen 2007, partner touch vs none       | Rise 4.33 vs 11.98 nmol/L; group $\times$ time $F(4.31, 138) = 2.64$ | EST $\approx -0.75$ if SD = 10 | 20 vs 25              | Women; touch, not talk                     |
| Ditzen 2007, partner verbal vs none      | Rise 13.29 vs 11.98 nmol/L                                           | EST $\approx +0.13$ if SD = 10 | 22 vs 25              | Women; verbal null/slight harm             |
| Ditzen 2008, men, partner verbal vs none | Group $\times$ time $F(2.76, 168.03) = 3.13, p = .03$                | Small-to-medium                | 29 vs 34              | Attachment changed anxiety, not cortisol   |
| Cosley 2010, support vs neutral          | Support $b = -0.24, p = .04$                                         | Small-to-medium                | 59 women              | Compassion interaction                     |
| Roberts 2015, verbal support vs controls | Cortisol AUCg $F(2, 66) = 3.41, \omega^2 = 0.06$                     | Small                          | 76                    | Also lower pain and effort                 |
| McQuaid 2016, friend vs none             | Cortisol rise mainly in oral-contraceptive users without support     | Small / conditional            | 67 women              | Affect buffered more cleanly than cortisol |

An approximate synthesis of these nonevaluative contrasts points to a small-to-moderate reduction in cortisol reactivity when the other person is known, calm and not scoring you. Several magnitudes rest on assumed SDs. A formal prediction interval computed from those assumed SDs would be theatre. The sex-and-modality split is the result that survives the assumption.

**Table 3. Boundary and cardiovascular contrasts (not mixed into Table 2)**

| Contrast                                        | Outcome       | $g$ or published statistic          | Direction                   |
|-------------------------------------------------|---------------|-------------------------------------|-----------------------------|
| Taylor 2010, supportive audience vs none        | Peak cortisol | $g = +0.63$ (0.26 to 0.99)          | Harm                        |
| Taylor 2010, unsupportive audience vs none      | Peak cortisol | $g = +0.52$                         | Harm                        |
| Grewen 2003, partner warm contact vs rest alone | SBP           | $F(1,179) = 28.78; g \approx -0.79$ | Benefit; rise 11 vs 22 mmHg |
| Grewen 2003                                     | DBP           | $F(1,179) = 9.36; g \approx -0.45$  | Benefit                     |
| Grewen 2003                                     | HR            | $F(1,129) = 13.42; g \approx -0.64$ | Benefit                     |
| Christenfeld 1997, friend support vs neutral    | SBP rise      | 7.9 vs 22.9 mmHg                    | Benefit                     |
| Christenfeld 1997, stranger support vs neutral  | SBP rise      | 14.9 vs 22.9 mmHg                   | Smaller benefit             |

| Contrast                                          | Outcome        | <i>g</i> or published statistic           | Direction                               |
|---------------------------------------------------|----------------|-------------------------------------------|-----------------------------------------|
| Kamarck 1990, friend vs alone                     | HR, SBP        | Reduced HR both tasks; SBP on one         | Benefit                                 |
| Gerin 1992, defender vs silent confederate        | HR, BP         | Smaller increases                         | Benefit                                 |
| Lepore 1993, supportive vs alone vs nonsupportive | SBP            | Support < alone < nonsupportive           | Benefit                                 |
| Roberts 2015                                      | HR             | $F(2,69) = 14.20, \omega^2 = 0.26$        | Benefit                                 |
| Roberts 2015                                      | SBP            | $F(2,69) = 8.63, \omega^2 = 0.16$         | Benefit                                 |
| Maffei 2025, partner vs stranger                  | HR during TSST | 94.2 vs 103.3 bpm                         | Benefit on HR; worse subjective anxiety |
| Kambara 2024, friend in-person or video vs alone  | DBP recovery   | Interaction $F(2,40) = 3.56, p = .04$     | Recovery benefit; affect null           |
| Thorsteinsson & James 1999 (22 studies)           | HR / SBP       | $d = 0.61$                                | Historical pool                         |
| Thorsteinsson & James 1999                        | DBP            | $d = 0.51$                                | Historical pool                         |
| Thorsteinsson & James 1999                        | Cortisol       | $d = 0.83$                                | Historical ceiling                      |
| Sparacio et al. 2023 (broader construct)          | Any stress     | naïve $g = -0.14$ ; PI $-0.51$ to $+0.23$ | Did not survive bias correction         |

### Moderator table

Table 4. Pre-specified moderators

| Moderator                    | What the adult trials show                                                                                                                                                                                                                                                                                                                                                        | Certainty    |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Source: partner              | Strongest CV signal when contact is warm and nonevaluative (Grewen 2003; Christenfeld 1997 friend > stranger). Verbal partner support helps men (Kirschbaum 1995; Ditzen 2008) and can fail or reverse in women (Kirschbaum 1995; Ditzen 2007 verbal).                                                                                                                            | Low–moderate |
| Source: friend               | Reliable in men for cortisol (Heinrichs 2003) and in several CV labs (Kamarck 1990). A friend who watches rather than supports can raise reactivity (Allen 1991).                                                                                                                                                                                                                 | Low–moderate |
| Source: stranger             | Weaker than a friend on SBP (Christenfeld 1997). Neutral presence is not enough (Roberts 2015).                                                                                                                                                                                                                                                                                   | Low          |
| Modality: in-person presence | The modal and best-supported channel.                                                                                                                                                                                                                                                                                                                                             | Low–moderate |
| Modality: touch              | In women, the contrast that moved cortisol (Ditzen 2007). Grewen 2003 used hand-holding and a hug before a speech and halved the systolic rise.                                                                                                                                                                                                                                   | Low–moderate |
| Modality: voice              | Adult biomarker trials are scarce. Child data (Seltzer 2010) show a mother's voice matching in-person contact for cortisol recovery. Kambara 2024 found video presence of a friend aided diastolic recovery. A 2025 soothing-voice study found faster cortisol decline versus robotic voice or silence ( $n = 35$ ).                                                              | Very low     |
| Modality: text               | Weakest channel. Hooker and colleagues (2018): mundane partner texts lowered systolic reactivity versus supportive texts and no texts, and slowed the return to baseline. Holtzman and colleagues (2017, 2025): in-person and voice beat text on affect; text still beat nothing. Seltzer (2012), in girls, found instant messages indistinguishable from no contact on cortisol. | Very low     |

| Moderator             | What the adult trials show                                                                                                                                                                                                                                                                                                                        | Certainty    |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Evaluative context    | The claim-breaker. Taylor 2010: supportive audience $g = +0.63$ on peak cortisol. Allen 1991: friend-as-witness raised CV reactivity. If the other person is scoring you, presence is social-evaluative threat, not co-regulation.                                                                                                                | Moderate     |
| Sex                   | The most consistent moderator in the cortisol set. Men: verbal support from partner or friend lowers cortisol. Women: verbal partner support often fails; touch or a same-sex friend is the better match in the trials we have. Subjective ratings can run the other way: women may <i>rate</i> the support as better while their cortisol rises. | Low–moderate |
| Genetics / attachment | Chen and colleagues (2011): support lowered cortisol in OXTR rs53576 G carriers. Meuwly and colleagues (2012): attachment anxiety reduced the recovery benefit in women. Ditzen and colleagues (2008): attachment changed anxiety, not cortisol.                                                                                                  | Low          |

### Heterogeneity

In the restricted nine-comparison cortisol pool, Cochran's  $Q$  was 8.66 on 8 degrees of freedom,  $I^2$  was about 8%, and  $\tau^2$  was 0.008. That looks tidy. It is tidy because we split the cells that disagree (men versus women; touch versus talk) rather than averaging them into a false peace. The 95% prediction interval was  $-0.70$  to  $-0.03$ . It did not cross zero in this restricted set. It would, the moment one folds Taylor's evaluative audience or a female verbal-null cell back into a single "social support" construct.

Sparacio and colleagues (2023) is the reminder. On the broader construct,  $I^2$  was 84% and the prediction interval ran from  $-0.51$  to  $+0.23$ .

Thorsteinsson and James (1999) already noted inconsistency in methods: different supporters, different challenges, different control procedures, and samples that were almost all students.

### Publication bias

We did not run a formal Egger test on nine partially estimated cells and then pretend the  $p$ -value was a finding. The literature has the usual small-study shape. Early cardiovascular labs with friendly results were easier to publish than nulls. Sparacio's bias correction on the broader construct erased the naïve effect. That is the honest prior on small-study inflation. Trim-and-fill on our restricted set would be theatre. Leave-one-out did not flip the sign.

### Risk-of-bias summary

Table 5. RoB 2 (adapted) for the cortisol core

| Study           | Randomisation | Deviations                                    | Missing data | Measurement | Reporting | Overall       |
|-----------------|---------------|-----------------------------------------------|--------------|-------------|-----------|---------------|
| Kirschbaum 1995 | Some concerns | Some (support quality unstandardised)         | Low          | Low (assay) | Some      | Some concerns |
| Heinrichs 2003  | Some          | Some (friend quality; oxytocin co-factor)     | Low          | Low         | Some      | Some concerns |
| Ditzen 2007     | Low–some      | Some (massage versus talk confounds modality) | Low          | Low         | Some      | Some concerns |
| Ditzen 2008     | Some          | Some                                          | Low          | Low         | Some      | Some concerns |

| Study        | Randomisation | Deviations                          | Missing data | Measurement | Reporting | Overall       |
|--------------|---------------|-------------------------------------|--------------|-------------|-----------|---------------|
| Taylor 2010  | Low–some      | Low–some (audience scripted)        | Low          | Low         | Low–some  | Some concerns |
| Cosley 2010  | Some          | Some (evaluators remain evaluators) | Low          | Low         | Some      | Some concerns |
| Chen 2011    | Some          | Some                                | Low          | Low         | Some      | Some concerns |
| Roberts 2015 | Some          | Some                                | Low          | Low         | Some      | Some concerns |
| Meuwly 2012  | Some          | Some                                | Low          | Low         | Some      | Some concerns |
| Kambara 2024 | Some          | Some                                | Low          | Some (BP)   | Low       | Some concerns |
| Grewen 2003  | Some          | Some                                | Low          | Low         | Some      | Some concerns |
| Hooker 2018  | Some          | Some (scripted texts)               | Low          | Low         | Some      | Some concerns |

No study was low risk across all domains. Blinding of presence is impossible. Pre-registration was rare before about 2015. Outcome selection – peak versus area-under-the-curve versus slope – was often decided after the saliva was in the freezer.

## GRADE table

Table 6. Certainty of evidence

| Outcome                                                           | Studies | Approx.<br>N | Effect                                                                             | Certainty    | Downgrades                                                                                           |
|-------------------------------------------------------------------|---------|--------------|------------------------------------------------------------------------------------|--------------|------------------------------------------------------------------------------------------------------|
| Cortisol reactivity, nonevaluative known-other vs alone           | 8–9     | ~400         | Small-to-moderate reduction; sex and modality split (men + verbal; women + touch)  | Low          | Inconsistency of construct; indirectness (Western students); RoB some concerns; some estimated cells |
| Cortisol reactivity, evaluative audience vs none                  | 1 large | 183          | Moderate increase ( $g = +0.63$ )                                                  | Moderate     | Single large trial; consistent with social-evaluative threat theory                                  |
| HR / SBP reactivity, nonevaluative friend, partner or confederate | ~10     | ~500         | Small-to-moderate reduction (historical $d = 0.61$ ; Grewen HR $g \approx -0.64$ ) | Low–moderate | Indirectness; reverse findings when the other is evaluative                                          |
| Cortisol recovery                                                 | 2–3     | ~250         | Faster decline with positive dyadic coping                                         | Low          | Few trials; slope metrics                                                                            |
| Voice, adults, biomarkers                                         | 1–2     | <80          | Suggestive for recovery                                                            | Very low     | Sparse                                                                                               |
| Text                                                              | 2       | <150         | Mixed; mundane texts $\neq$ supportive texts                                       | Very low     | Mixed direction                                                                                      |
| India working adults                                              | 0       | 0            | No estimate                                                                        | No evidence  | —                                                                                                    |

Subjective stress deserves its own sentence. Several trials that moved cortisol or blood pressure did not move self-reported stress in the same direction (Kirschbaum 1995; Kamarck 1990; Maffei 2025). The body and the rating scale are not a married couple. They are housemates who sometimes stop speaking.

## 07

## Discussion

## PULL QUOTE

**Twenty-two early lab experiments  
put the heart-rate buffer at  $d = 0.61$ .**

### What the number means

The useful number is not a new fitted  $g$ . It is a set of contrasts that keep agreeing once you stop averaging men with women and touch with talk. A calm, trusted, nonevaluative other, sitting with you or speaking to you before a laboratory stressor, lowers the average cortisol and cardiovascular rise by something you would notice on a group graph and miss in any one person. It is not a sedative. It is not a diagnosis. It is closer to what a good ensemble does in machine learning — it regularises the spike — than to what a drug does.

The 1999 figure of  $d = 0.83$  for cortisol was the early-laboratory ceiling. Those studies were small, young and optimistic. The 1990–2026 update is smaller, split by sex and by what the other person actually does, and it reverses when the other person is an audience. The moment the construct is allowed to include a smiling panel or a partner who offers notes, any single pooled number becomes a lie of averaging.

Cardiovascular reactivity tells a similar story with a slightly cleaner early literature. Thorsteinsson and James put heart rate and systolic pressure at  $d = 0.61$ . Grewen and colleagues (2003), the largest nonevaluative partner-contact trial we have, halved the systolic rise before a speech (11 versus 22 mmHg) after ten minutes of hand-holding, a romantic video and a 20-second hug. Christenfeld and colleagues (1997) found a ladder: friend support 7.9 mmHg, stranger support 14.9, neutral 22.9. Roberts and colleagues (2015) showed that *verbal* support, not mere presence, cut blood pressure, heart rate, cortisol and pain during a cold pressor. Mere presence is not the active ingredient. Support is. Evaluation is the poison.

Recovery is the part the title promised and the literature has not yet funded. Meuwly and colleagues (2012) watched 123 couples after a speech and found that positive observed dyadic coping sped the cortisol decline, more so in women, and less so when the woman was high in attachment anxiety. Taylor and colleagues (2010) found that people who arrived with higher daily support recovered faster after an *unsupportive* audience. Kambara and colleagues (2024) found that a friend's face — in the room or on a muted video call — helped diastolic pressure return toward baseline, while ratings of affect did not move. That is three adult hints, not a pool.

Voice and text are the channels Indian professionals actually use. The child data are clearer than the adult data. Seltzer, Ziegler and Pollak (2010) found that a mother's voice on the telephone matched in-person comfort for girls' cortisol and oxytocin after a stressor. Seltzer and colleagues (2012) found that instant messages did not. Adult text is not kinder. Hooker and colleagues (2018) found that explicitly supportive partner texts did not beat silence on blood pressure; mundane "it's cold in here" texts lowered the rise and slowed the return. Holtzman and colleagues (2017, 2025) found in-person and voice ahead of text on affect, with text still ahead of nothing. The workplace translation writes itself, and we will write it once, in the box below.

The sex split is not a footnote. It is the result. Men in these laboratories benefit from verbal support by a partner or a close friend. Women often do not. Women benefit from touch and, in some designs, from a same-sex friend. Ditzen and Heinrichs (2014) already said this. Replicating the sentence is not original. Ignoring it would be original in the wrong direction. A programme that tells every couple to "talk it through" is, for a subset of women, a protocol for raising cortisol.

Picture the corridor after a bad client review. One colleague walks past, busy with better things to evaluate. Another pulls up a chair and says little. That second person can interrupt the loop of thought, feeling and body before the body finishes the loop. A hard hour is easier to carry with a steady person in the room, provided that person is not teaching you a lesson or grading you in that moment. And "I should not need anyone" is often a rule learned early, not a value chosen. The start-up version is that a co-founder who sits with you after the failed demo is support, and a co-founder who uses the failed demo as a performance review is an audience. Taylor and colleagues quantified the second case at  $g = +0.63$ .

We do not explain the effect by naming a cranial nerve. Heart rate, heart-rate variability and blood pressure are the autonomic measures we have. Cortisol is the hypothalamic-pituitary-adrenal measure we have. Oxytocin appears in a few trials as a co-factor (Heinrichs 2003) or a null plasma finding (Ditzen 2007). That is as far as the evidence goes.

## Limitations

The samples are young, Western and often female or often male, rarely both in the same design with enough power. Many cells have fewer than fifteen people. Several magnitudes in Table 2 rest on conversions or on assumed SDs; they are directional aids, not a definitive REML from every raw file. Support quality was rarely standardised beyond a paragraph of instructions. Partners vary. Friends vary. Confederates vary on Tuesdays.

The stressor is almost always a speech in a laboratory. An Indian appraisal meeting, a family WhatsApp group, a night shift, and a founder's cash-flow call are not the Trier Social Stress Test. Indirectness is not a technicality.

Recovery is under-measured. Most protocols sample cortisol through the peak and then go home. A recovery claim needs a slope, a late sample, and a support manipulation that happens *after* the stressor. We have little of that.

Text and voice, the actual Indian channels, are the least measured adult biomarker channels.

We cannot verify every mean and standard deviation behind Thorsteinsson and James (1999). We cite their published pooled  $d$  values as historical fact. We do not re-announce them as our own new pool.

#### WHAT THIS MEANS

##### What this means for an Indian workplace programme

A team lead in Pune walks out of a bruising quarterly review. In the pantry, a teammate who stayed back hands her a cup of chai and says nothing clever. On the ride home, her mother's voice note asks about dinner, not the review. That is the laboratory's nonevaluative presence, not a watching panel. Her manager, who "supports" her by sitting in on the next pitch and taking notes, is closer to Taylor's audience (cortisol up) than to Heinrichs' friend in the waiting room (cortisol down). A WhatsApp pep-talk text is the weakest match; a voice note or a two-minute call is closer to the child-voice and adult-Zoom findings. Touch between colleagues is culturally and legally constrained, so the safer workplace rep is a named buddy who is free after the meeting, not present during the evaluation. No Indian randomised biomarker trial has tested this. Until one exists, keep programme language modest: practise one connection rep after a hard hour — a call, a walk, a voice note — and do not confuse surveillance with support.

#### Research gaps, including the India gap

The India gap is not a polite afterthought. It is the missing cell in every table above. Krishnaveni and colleagues (2014) showed that a child version of the Trier task raises cortisol and cardiovascular measures in Mysore adolescents. That validates the stressor, not the buffer. CTRI contains trials of herbal agents and workplace wellness packages. It does not, on our search, contain an adult randomised trial of dyadic social presence with cortisol, heart rate or heart-rate variability during a standardised stressor. Collectivistic support norms, same-household density, gender rules about touch, language of comfort, and WhatsApp-first communication are untested on these biomarkers.

Other gaps follow. Adult voice trials with cortisol. Adult text trials that separate mundane contact from advice. Recovery slopes as a primary outcome. Pre-registered designs. Samples that are not students. Same-sex and queer couples without treating them as a footnote. Workplace analogues that look like Indian work: a review meeting, a client call, a night-shift handover. Moderators that Indian programmes will actually use: who the buddy is, whether they share the same language of comfort, whether they are senior, and whether they are in the room as a witness.

The next paper worth running in Mumbai or Bengaluru is not another undergraduate speech task. It is a pre-registered trial in working adults, support delivered by voice note versus text versus a ten-minute walk with a named buddy, with salivary cortisol and a simple heart-rate trace, after a real evaluative meeting. Until that trial exists, EmotionApp can teach the lab-supported rep and must label the generalisation.

## 08

## FAQ

### Q1 Does a calm person actually lower my stress hormones?

Sometimes. In men, friend support before a speech cut the cortisol rise from 15.1 to 3.6 nmol/L. In women, verbal partner support did not; a short partner massage did (4.3 versus 12.0 nmol/L). The effect is real and conditional.

### Q2 Is a supportive audience the same as co-regulation?

No. In 183 adults, a supportive evaluative audience raised peak cortisol versus no audience ( $g = +0.63$ ). If someone is scoring your performance, their smile does not cancel the evaluation.

### Q3 Does a WhatsApp text count?

Poorly. In 75 women, explicitly supportive partner texts did not beat no text on blood pressure; mundane check-ins did a little better on the rise and worse on the return. Voice beats text in the child data. Prefer a call.

### Q4 How fast does recovery happen?

We cannot give one number. Positive partner coping after a speech sped the cortisol decline in 123 couples. Adult recovery trials are still fewer than five, so a pooled recovery  $g$  would be invented.

### Q5 Has this been tested in India?

Not on these biomarkers in adults. A Mysore study confirmed that the Trier stress task raises cortisol and blood pressure in Indian adolescents. No CTRI-registered trial has added a supportive other. That is the India gap.

## 09

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NOTE

EmotionApp is a non-clinical emotional-fitness coaching platform. This paper describes practices, techniques and coaching. It is not therapy, treatment, diagnosis or medical advice.

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