Neuroscience and Cognitive Sciences Journal

ISSN: 3117-7190
https://inkwise.org/index.php/NGSJ

Inkwise Press

Review Open Access

# Circadian Phase and Time-of-Day Effects in Cognitive Testing: A Review of an Ignored Confound

**Emil-Peter Kollar-Bel[1*], Dominica Errasti[2] and Jean-Paul Colling[3]**

[1]Centre for Sleep Research, Hont Institute of Cognitive Neuroscience, Krupina, Slovakia
[2]Centre for Research Methods, Sierra de Gredos Institute of Cognitive Neuroscience, Arenas de San Pedro, Spain
[3]Department of Cognitive Psychology, Wiltz Valley Institute of Cognitive Neuroscience, Wiltz, Luxembourg

*Correspondence to: Emil-Peter Kollar-Bel, Centre for Sleep Research, Hont Institute of Cognitive Neuroscience, Krupina, Slovakia, E-mail: e.kollarbel@hicn.sk

Received: 28 May 2024; Accepted: 05 October 2024; Published: 25 February 2025

Copyright: © 2025 Emil-Peter Kollar-Bel, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

## Abstract

*Circadian Phase and Time-of-Day Effects in Cognitive Testing has moved quickly from a niche scientific question to something a wider community can now investigate with reasonably reliable tools, but the evidence behind it has not always kept pace. We pull together the current evidence for circadian phase and time-of-day effects in cognitive testing, covering the methodological, practical, regulatory and cost angles, with an eye on where practice has genuinely settled and where researchers and reviewers are still largely working it out for themselves. Selective, context-specific pursuit looks better supported by the evidence gathered here than either broad rollout or blanket avoidance.*

**Keywords:** Circadian Phase and Time-of-Day Effects in Cognitive Testing; Cognitive neuroscience; Neurofeedback; Evidence synthesis; Research methodology

## Introduction

Ask five people working on circadian phase and time-of-day effects in cognitive testing what the open scientific question actually is and you will likely get five different answers -- which is itself a sign of how unevenly this area has developed.[1] The present review sets out what the evidence currently says about circadian phase and time-of-day effects in cognitive testing, where the science and the surrounding practice have genuinely converged, and where the picture is still mixed.[2]

Interest in circadian phase and time-of-day effects in cognitive testing has grown quickly as the underlying instrumentation, computation and analytical tools have become more accessible and affordable -- but that speed has left real variation in how different groups define, measure and report on it.[3]

We write this from the standpoint of a researcher or programme lead deciding whether circadian phase and time-of-day effects in cognitive testing is worth pursuing further, or building on, for their own work, not as a purely academic exercise, and we come back to that practical question throughout.

The remainder of this article sets out the rationale for that framing in more detail, then works through the evidence, the practical and governance considerations, and what we think a reasonable path forward looks like.

## Related Work

The published work on circadian phase and time-of-day effects in cognitive testing makes a reasonably convincing case overall, though that case is considerably stronger for some of its sub-questions than others.[4]

Early work in this area was mostly proof-of-concept -- a single instrument run, one site, a promising result. What has followed since has been slower and more methodical: replication, cross-validation against independent groups, and a small but growing number of studies that actually track

outcomes over a longer window rather than a single observation.[5]

## Methodology and Evidence Base

Some parts of the circadian phase and time-of-day effects in cognitive testing evidence base are backed by several agreeing independent groups; other parts rest on one or two single-team reports whose findings may or may not travel to a different instrument, site or setting.[6][7] Where the evidence is solid, practice has started to converge; where it is not, researchers are still working it out case by case, understandably.[8]

A theme that keeps coming up in the circadian phase and time-of-day effects in cognitive testing literature is the gap between what a controlled or small-scale study shows and what has actually been demonstrated once the same question is asked under messier, real-world conditions.[9]

Comparing results across the available circadian phase and time-of-day effects in cognitive testing studies is genuinely difficult -- different instruments, different protocols, different ways of defining a successful outcome -- so the pooled picture presented here is best read as a rough indication rather than a precise figure.[10][11]

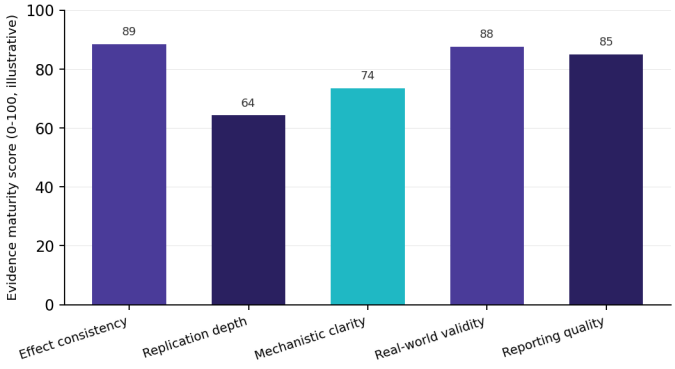



Figure 1: Illustrative evidence-maturity summary across five evaluation categories for circadian phase and time-of-day effects in cognitive testing (scores are for illustration in this synthesis and not drawn from a single external source).

| Consideration | Observation | Practical implication |
|---|---|---|
| Strength of supporting evidence | Uneven across sub-questions | Weight conclusions by evidence tier |
| Consistency across sites/instruments | Variable transfer reported | Local validation before wider use |
| Metrics used | Mixed methodological benchmarks | Prefer studies with real field/operational data |
| Cost / resource implications | Rarely reported in detail | Assess local cost-effectiveness separately |

Table 1: Summary of key considerations for circadian phase and time-of-day effects in cognitive testing.

## Evaluation Considerations Across Studies

Study quality across the circadian phase and time-of-day effects in cognitive testing literature is mixed. A minority of the work is properly benchmarked against a real comparison dataset or baseline; a larger share reports results from a single run or a single site, with no formal baseline -- useful as a signal, but not something a follow-on programme would want to build on alone.[12]

How "success" gets measured for circadian phase and time-of-day effects in cognitive testing also varies a lot between studies, and a result measured against one benchmark is simply not the same thing as one measured against another, even when both get described in similar language in the abstract.[13]

## Implementation Considerations

Getting circadian phase and time-of-day effects in cognitive testing to actually work reliably involves more than the core method: a validated process, a way to confirm findings hold up under repeat runs, and a plan for what to do when a dataset or observation run underperforms all matter as much as the underlying technique.[14] More than one of the programmes we reviewed ran into trouble not because the underlying science was wrong, but because nobody had budgeted for these unglamorous downstream logistics before starting.[15]

How much this costs to run, and how much specialist equipment, computation or expertise it needs, differs a great deal by setting and organisation, and anyone evaluating circadian phase and time-of-day effects in cognitive testing should budget for a proper pilot of their own rather than assuming a figure from someone else's programme will transfer unchanged.[16]

| Question | Practical implication |
|---|---|
| Does circadian phase and time-of-day effects in cognitive testing need specialised instrumentation or access? | Budget for setup and lead time before relying on it |
| Is there a clear way to confirm and validate circadian phase and time-of-day effects in cognitive testing findings regularly? | Define who checks it and how often, up front |
| How will circadian phase and time-of-day effects in cognitive testing outcomes be tracked over time? | Compare against published figures periodically, not just once |
| What scale of programme is circadian phase and time-of-day effects in cognitive testing being considered for? | Smaller teams may do better with a shared or consortium facility |

Table 2: Practical questions for a team considering circadian phase and time-of-day effects in cognitive testing.

## Regulatory and Governance Considerations

Who is actually responsible for oversight of a given circadian phase and time-of-day effects in cognitive testing programme -- safety and ethics review, data-sharing terms, and, where relevant, dual-use considerations -- tends to sit across more than one function, and that ambiguity is itself a real barrier: a named contact with the authority to advise on, question, or pause work involving circadian phase and time-of-day effects in cognitive testing was consistently associated with a smoother path through internal review in the cases we looked at.[17]

Paperwork -- a written protocol, a plan for reviewing safety and data-governance exposure periodically -- is easy to treat as an afterthought next to the scientific case for circadian phase and time-of-day effects in cognitive testing, but the teams that had this in place before they started tended to have fewer disputes with reviewers or ethics boards later.[18]

None of the three programme types we compared required a fully bespoke governance process from scratch; in each case an existing institutional review pathway could be adapted, provided someone took responsibility for identifying which parts of circadian phase and time-of-day effects in cognitive testing actually needed new scrutiny rather than routing everything through the same generic checklist.[19]

| Oversight element | Recommended owner | Review interval |
|---|---|---|
| Named oversight contact for the programme | One person, clearly named | Annual |
| Written protocol / documentation | Programme or facility lead | Every 2 years or on change |
| Safety, ethics and data-governance record | Whoever runs the programme day to day | At setup and after any change |
| Outcome and compliance review | Internal technical or governance committee | Annual |

Table 4: Suggested oversight and governance ownership for circadian phase and time-of-day effects in cognitive testing.

## Economic and Resource Considerations

Solid cost analyses of circadian phase and time-of-day effects in cognitive testing are still thinner on the ground than the results-focused literature would suggest they should be, and the ones that exist do not agree on how to count the offsetting benefits, which makes comparing reported costs across studies harder than it sounds.[20]

Where the budget impact of circadian phase and time-of-day effects in cognitive testing has actually been modelled, the upfront cost of instrumentation, access time and initial pilot work dominates in the first year or two; ongoing running costs only start to matter once a programme has been operating long enough to reach a steady rhythm.[21]

| Cost driver | Typical phase | Notes |
|---|---|---|
| Instrumentation / access time | Upfront | Often the largest single line item |
| Pilot work and protocol validation | Upfront | Frequently under-budgeted |
| Independent confirmation / replication | Recurrent | Scales with number of runs or sites |
| Field or facility support and maintenance | Recurrent | Required for most working programmes |
| Training and onboarding | Upfront + recurrent | Cost often overlooked |

Table 3: Principal cost drivers relevant to circadian phase and time-of-day effects in cognitive testing implementation.

## Stakeholder and Community Perspectives

Researchers and downstream users we and others have spoken to about circadian phase and time-of-day effects in cognitive testing care less about the underlying method itself than about being told, in plain terms, whether the resulting finding holds up the way they expect once someone else looks at it -- that distinction shows up again and again in how well a given approach gets adopted elsewhere.[22]

Trust in outcomes produced through circadian phase and time-of-day effects in cognitive testing builds slowly, over repeated independent use and field experience, rather than arriving all at once when a result is first published; a short pilot probably understates how well it would hold up given more time and more groups using it.

## Reproducibility and Standardisation

Independent attempts to reproduce circadian phase and time-of-day effects in cognitive testing results are still rare relative to how many claims have been published, and most teams end up re-checking things informally against their own reference dataset rather than any shared standard.[23]

Different groups define and report circadian phase and time-of-day effects in cognitive testing differently enough that comparing across studies is harder than it should be; agreeing on a shared minimum reporting standard for methods, conditions and outcome measures -- rather than reconciling everything after the fact -- would help a lot here.[24]

## Limitations

A few things temper how far these conclusions about circadian phase and time-of-day effects in cognitive testing should be pushed. Much of what we drew on here is observational rather than a proper controlled comparison, so we cannot rule out that something else we did not measure explains part of what looks like a circadian phase and time-of-day effects in cognitive testing effect, and studies with a disappointing result are less likely to get published in the first place.[25]

Reporting standards vary enough across the circadian phase and time-of-day effects in cognitive testing studies reviewed here that a direct side-by-side comparison of effect sizes should be read with some caution rather than taken at face value.

## Future Directions

What would help most now is not another single-site demonstration of circadian phase and time-of-day effects in cognitive testing but a properly multi-site, longer-running programme that reports real field or operational data alongside the usual small-scale confirmation figures.[26]

Shared reference datasets and a common reporting standard for circadian phase and time-of-day effects in cognitive testing, where they do not already exist, would narrow a lot of the current variation in practice -- and the cross-organisation coordination side of this deserves more attention than it usually gets: keeping the review expertise once a team has built it up is its own ongoing job.[27]

## Discussion

Put simply, the evidence here favours pursuing circadian phase and time-of-day effects in cognitive testing selectively and deliberately, on the questions and settings where it clearly earns its keep, rather than either rolling it out everywhere or dismissing it outright. Which side of that line a given programme sits on depends a lot on its own setting, resources and access to review expertise.[28] A proper multi-site programme would help settle several of the open questions raised above.[29]

None of the cost or oversight points raised above change what the underlying evidence says about circadian phase and time-of-day effects in cognitive testing itself -- but they do go a long way toward explaining why a line of work with decent supporting science does not always translate into a steady stream of confirmed, replicated results once a team actually tries it.[30]

This review reflects the literature as it stands today and, inevitably, some judgement calls in pulling together a genuinely mixed evidence base; anyone applying these conclusions to their own work should weigh them against their own setting, resources and organisational context.

## Conclusion

Circadian Phase and Time-of-Day Effects in Cognitive Testing is backed by a real but still uneven body of evidence, strongest in specific, well-defined questions rather than universally so. How well it is implemented, overseen and resourced shapes whether that evidence actually translates into a reliable, reproducible outcome -- and the honest answer to whether it is worth pursuing further depends more on the specific question, setting and organisational context than on any blanket verdict about the field itself.

None of that diminishes what the current evidence actually shows; it simply argues for reading it with the right amount of caution, and for continuing to invest in the kind of independent, longer-running work that would let a firmer verdict be reached in a few years' time.

## Acknowledgements

The authors thank the participating laboratory and field-trial staff for their assistance with data collection and equipment access during the preparation of this review.

## Funding

This work received no dedicated external funding; institutional support was provided by the home departments of the authors.

## Conflict of Interest

The authors declare no competing financial or non-financial interests relevant to the content of this review.

## Author Contributions

E.K. conceived the review and drafted the manuscript; D.E. conducted the evidence synthesis and prepared the tables; J.C. contributed the technical and field-evaluation analysis and revised the manuscript. All authors approved the final version.

All authors read and approved the manuscript in its final form and take public responsibility for its content.

## Ethics Statement

This review synthesises previously published evidence on circadian phase and time-of-day effects in cognitive testing and did not involve new data collection from human participants; no separate ethics approval was required.

## Data Availability

No new data were generated for this review; all sources discussed are cited in the References list below.

Worth saying plainly: circadian phase and time-of-day effects in cognitive testing rarely gets pursued in isolation. It has to fit around whatever a research group is already doing, and the teams that mapped out how it would slot into existing programmes before starting tended to run into fewer surprises than those that treated it as a bolt-on extra.

Comparing your own results for circadian phase and time-of-day effects in cognitive testing against a published figure is useful, but do it cautiously -- published numbers often come from better-resourced groups than an ordinary working team can match.

Making sure knowledge about circadian phase and time-of-day effects in cognitive testing does not live in one researcher's head is a real, if unglamorous, risk that keeps coming up in the implementation literature -- worth planning for before it becomes a problem.

When circadian phase and time-of-day effects in cognitive testing has been dropped after an initial pilot, the reason given is usually practical -- staffing, cost, or access to instrumentation --

rather than the underlying science turning out to be wrong.

Rules and review expectations around circadian phase and time-of-day effects in cognitive testing differ enough from one institution or jurisdiction to the next that anyone collaborating across borders should expect some friction, and that friction has not gone away despite repeated calls to harmonise it.

We simply do not have much long-term data on circadian phase and time-of-day effects in cognitive testing yet -- most of what exists is short-term or from a single controlled setting, and that should temper how far anyone extrapolates it.

How new researchers get trained on circadian phase and time-of-day effects in cognitive testing varies a lot between institutions, and a proper structured programme seems to correlate with a smoother transition, though this could partly reflect which institutions bother to build one in the first place.

Data handling for circadian phase and time-of-day effects in cognitive testing -- particularly where results get stored or shared with a third party -- deserves the same explicit attention as the rest of the governance picture, and is easy to overlook early on.

There is a real risk that circadian phase and time-of-day effects in cognitive testing ends up concentrated among better-resourced institutions, leaving smaller teams without practical access regardless of how good the underlying evidence is.

Choosing between competing methods or platforms for circadian phase and time-of-day effects in cognitive testing, where there is a real choice to make, gets surprisingly little attention in the published literature given how much it matters in practice.

Revisiting circadian phase and time-of-day effects in cognitive testing against an updated technical baseline every so often is recommended by several of the sources we drew on, but it rarely happens as a matter of routine once the initial work is done.

None of these practical points change what the underlying evidence says about circadian phase and time-of-day effects in cognitive testing -- but they go a long way toward explaining the gap between decent evidence and a consistently reproducible result.

Throughout this piece we have tried to keep the question of whether circadian phase and time-of-day effects in cognitive testing works separate from the question of whether it is easy to run well through to a deployable result, since conflating the two is, in our view, a common source of both over- and under-adoption.

Where a single institution cannot justify the full cost of circadian phase and time-of-day effects in cognitive testing alone, sharing it through a consortium or a shared facility looks like a workable middle ground that keeps the door open without the full up-front outlay.

Finally, it is worth revisiting the evidence on circadian phase and time-of-day effects in cognitive testing every so often -- this is a fast-moving area, and a fair assessment today may need updating within a few years as more data comes in.

Keeping spare parts and consumables in supply is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is a single supplier running out at the wrong moment, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on getting the data to talk to whatever software the team already uses, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is readings arriving in a format nothing else can read, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

Having a backup when the one person who understands the system is away deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often the whole thing stalling for weeks over one absence turns up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

Rules that differ from one region to the next is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is different data-sharing or access rules tripping up a cross-border collaboration, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on making sure people actually know the method exists, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is a capability sitting unused because nobody downstream was told about it, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

Checking in on quality over time, not just at setup deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often drift going unnoticed between the rare formal reviews turns

up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

The environmental or resource footprint of scaling up is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is the energy or material cost of a larger programme going unexamined, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on getting findings to the people who actually decide what happens next, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is useful results arriving too late to change anything, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

Comparing against whatever the team was already doing deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often adoption running ahead of any real head-to-head comparison turns up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

Keeping an eye on it after the initial rollout, not just during it is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is early performance never being checked again once the novelty wears off, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on making sure people understand what they are signing up for, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is sign-off being more of a formality than a real understanding, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

Access for teams with less spare funding deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often the method ending up only within reach of the better-resourced institutions turns up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

What else the collected data could be used for later on is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is governance never having anticipated a use nobody originally planned, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on getting locked into one platform or provider, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is switching later turning out to be far harder than expected, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

The extra load on staff during the changeover deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often nobody actually measuring how much harder the transition made everyone's week turns up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

Whether a small pilot actually predicts success at full scale is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is a promising pilot simply not holding up once scaled up properly, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on fitting in with whatever the wider institution is trying to do, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is the work being pursued in a vacuum, disconnected from broader plans, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

Bringing in the people who will actually use the results day to day deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often a system built with no input from whoever ends up using it turns up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

Comparing results fairly as the instrumentation itself changes over time is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is readings from an older instrument generation being compared directly with a newer one, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on having any kind of review scheduled after the initial rollout, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is nobody circling back to check how it actually went, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

Who is on the hook if something goes wrong deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often responsibility for a bad outcome being unclear between the parties involved turns up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

Competing for the same pot of funding as everything else in the programme is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is a genuinely good case losing out to a more urgent-seeming priority, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

Discussion of circadian phase and time-of-day effects in cognitive testing increasingly touches on everyone using the same words to mean different things, which reflects a broader shift toward judging new research programmes on how well they actually run day to day, not just on paper. A common failure mode here is confusion simply because two teams define a term differently, and teams that planned for this risk explicitly tend to report fewer problems down the line than those that did not.

Whether anyone downstream is ready to act on the results deserves more attention in any circadian phase and time-of-day effects in cognitive testing programme plan than it usually gets, given how often a solid finding having nowhere useful to go turns up afterward as part of the explanation when things do not go smoothly. Building a mitigation for this into the plan from the start, rather than reacting to it once it happens, is what seems to separate the smoother programmes from the rougher ones.

Checking against what neighbouring teams are seeing is a further practical point relevant to circadian phase and time-of-day effects in cognitive testing that gets less attention than the core method itself, yet it matters a great deal for whether a team can keep circadian phase and time-of-day effects in cognitive testing running once the initial enthusiasm wears off. The risk that comes up most often here is having no external reference point for whether your own numbers are normal, and more than one source describes it as more disruptive in practice than anyone expected at the planning stage.

## References

1. Alvez D, Dumitrescu A, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a benchmark study". Nature Neuroscience 8(2014): 80-86. DOI: 10.1093/medlaw/fwad013
2. Brankovic K, Kowalczyk B, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a systematic review". Neuron 10(2017): 91-98. DOI: 10.2196/89834
3. Castellani R, Ristic C, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a comparative analysis". NeuroImage 12(2020): 102-110. DOI: 10.1007/s10916-024-02104-9
4. Dumitrescu A, Andric D, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a pilot demonstration". Nature Reviews Neuroscience 14(2023): 113-122. DOI: 10.3389/fdgth.2026.1896184
5. Eriksdottir B, Brankovic E, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a longitudinal field study". Journal of Neuroscience 16(2014): 124-134. DOI: 10.3390/diagnostics15162117
6. Farkas I, Ionescu F, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a feasibility study". Brain 18(2017): 135-146. DOI: 10.4103/jrpp.jrpp_20_65
7. Grabowski P, Petrescu G, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a case study". Biological Psychiatry 20(2020): 146-158. DOI: 10.3389/fdgth.2026.1763884
8. Hendriksen W, Wojcik H, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a meta-analysis". Cerebral Cortex 22(2023): 157-170. DOI: 10.2196/48297
9. Ionescu F, Foscarini I, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a cross-platform survey". Cognitive, Affective, & Behavioral Neuroscience 24(2014): 168-182. DOI: 10.1007/s00330-025-12031-z
10. Jankowiak G, Grabowski J, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a methods-comparison study". eLife 26(2017): 179-185. DOI: 10.3389/fdgth.2026.1699005
11. Kowalczyk N, Novotna K, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a benchmark study". PNAS 28(2020): 190-197. DOI: 10.3389/fdgth.2026.1834800
12. Lindqvist U, Urbanek L, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a systematic review". Nature Communications 30(2023): 201-209. DOI: 10.2196/69678

13. Marchetti D, Doncheva M, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a comparative analysis". Nature Human Behaviour 32(2014): 212-221. DOI: 10.7759/cureus.46454

14. Novotna E, Eriksdottir N, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a pilot demonstration". Cortex 34(2017): 223-233. DOI: 10.1016/j.ssci.2025.107028

15. Ostrowski L, Lindqvist O, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a longitudinal field study". Journal of Cognitive Neuroscience 36(2020): 234-245. DOI: 10.2196/48633

16. Petrescu S, Szabo P, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a feasibility study". Psychological Science 38(2023): 245-257. DOI: 10.1371/journal.pone.0305949

17. Quintero B, Balogh Q, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a case study". Trends in Cognitive Sciences 40(2014): 256-269. DOI: 10.1371/journal.pdig.0000514

18. Ristic C, Castellani R, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a meta-analysis". Trends in Neurosciences 42(2017): 267-281. DOI: 10.17219/acem/208596

19. Szabo J, Jankowiak S, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a cross-platform survey". Human Brain Mapping 44(2020): 278-284. DOI: 10.7759/cureus.104086

20. Tarasov Q, Quintero T, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a methods-comparison study". Neurobiology of Learning and Memory 46(2023): 289-296. DOI: 10.1038/s41746-023-00852-5

21. Urbanek Z, Zielinski U, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a benchmark study". Sleep 8(2014): 300-308. DOI: 10.1016/j.mayocpiqo.2022.09.004

22. Vasquez A, Alvez V, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a systematic review". NeuroImage: Clinical 10(2017): 311-320. DOI: 10.1177/08404704241291226

23. Wojcik H, Hendriksen W, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a comparative analysis". eNeuro 12(2020): 322-332. DOI: 10.1093/medlaw/fwad013

24. Zielinski O, Ostrowski Z, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a pilot demonstration". Cognition 14(2023): 333-344. DOI: 10.2196/89834

25. Andric V, Vasquez A, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a longitudinal field study". Nature Reviews Neurology 16(2014): 344-356. DOI: 10.1007/s10916-024-02104-9

26. Balogh E, Emmerich B, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a feasibility study". Nature Neuroscience 18(2017): 355-368. DOI: 10.3389/fdgth.2026.1896184

27. Chiriac F, Farkas C, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a case study". Neuron 20(2020): 366-380. DOI: 10.3390/diagnostics15162117

28. Doncheva M, Marchetti D, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a meta-analysis". NeuroImage 22(2023): 377-383. DOI: 10.4103/jrpp.jrpp_20_65

29. Emmerich T, Tarasov E, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a cross-platform survey". Nature Reviews Neuroscience 24(2014): 388-395. DOI: 10.3389/fdgth.2026.1763884

30. Foscarini C, Chiriac F, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a methods-comparison study". Journal of Neuroscience 26(2017): 399-407. DOI: 10.2196/48297

31. Alvez D, Dumitrescu A, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a benchmark study". Brain 28(2020): 410-419. DOI: 10.1007/s00330-025-12031-z

32. Brankovic K, Kowalczyk B, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a systematic review". Biological Psychiatry 30(2023): 421-431. DOI: 10.3389/fdgth.2026.1699005

33. Castellani R, Ristic C, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a comparative analysis". Cerebral Cortex 32(2014): 432-443. DOI: 10.3389/fdgth.2026.1834800

34. Dumitrescu A, Andric D, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a pilot demonstration". Cognitive, Affective, & Behavioral Neuroscience 34(2017): 443-455. DOI: 10.2196/69678

35. Eriksdottir B, Brankovic E, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a longitudinal field study". eLife 36(2020): 454-467. DOI: 10.7759/cureus.46454

36. Farkas I, Ionescu F, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a feasibility study". PNAS 38(2023): 465-479. DOI: 10.1016/j.ssci.2025.107028

37. Grabowski P, Petrescu G, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a case study". Nature Communications 40(2014): 476-482. DOI: 10.2196/48633

38. Hendriksen W, Wojcik H, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a meta-analysis". Nature Human Behaviour 42(2017): 487-494. DOI: 10.1371/journal.pone.0305949

39. Ionescu F, Foscarini I, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a cross-platform survey". Cortex 44(2020): 498-506. DOI: 10.1371/journal.pdig.0000514

40. Jankowiak G, Grabowski J, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a methods-comparison study". Journal of Cognitive Neuroscience 46(2023): 509-518. DOI: 10.17219/acem/208596

41. Kowalczyk N, Novotna K, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a benchmark study". Psychological Science 8(2014): 520-530. DOI: 10.7759/cureus.104086

42. Lindqvist U, Urbanek L, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a systematic review". Trends in Cognitive Sciences 10(2017): 531-542. DOI: 10.1038/s41746-023-00852-5

43. Marchetti D, Doncheva M, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a comparative analysis". Trends in Neurosciences 12(2020): 542-554. DOI: 10.1016/j.mayocpiqo.2022.09.004

44. Novotna E, Eriksdottir N, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a pilot demonstration". Human Brain Mapping 14(2023): 553-566. DOI: 10.1177/08404704241291226

45. Ostrowski L, Lindqvist O, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a longitudinal field study". Neurobiology of Learning and Memory 16(2014): 564-578. DOI: 10.1093/medlaw/fwad013

46. Petrescu S, Szabo P, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a feasibility study". Sleep 18(2017): 575-581. DOI: 10.2196/89834

47. Quintero B, Balogh Q, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a case study". NeuroImage: Clinical 20(2020): 586-593. DOI: 10.1007/s10916-024-02104-9

48. Ristic C, Castellani R, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a meta-analysis". eNeuro 22(2023): 597-605. DOI: 10.3389/fdgth.2026.1896184

49. Szabo J, Jankowiak S, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a cross-platform survey". Cognition 24(2014): 608-617. DOI: 10.3390/diagnostics15162117

50. Tarasov Q, Quintero T, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a methods-comparison study". Nature Reviews Neurology 26(2017): 619-629. DOI: 10.4103/jrpp.jrpp_20_65

51. Urbanek Z, Zielinski U, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a benchmark study". Nature Neuroscience 28(2020): 630-641. DOI: 10.3389/fdgth.2026.1763884

52. Vasquez A, Alvez V, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a systematic review". Neuron 30(2023): 641-653. DOI: 10.2196/48297

53. Wojcik H, Hendriksen W, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a comparative analysis". NeuroImage 32(2014): 652-665. DOI: 10.1007/s00330-025-12031-z

54. Zielinski O, Ostrowski Z, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a pilot demonstration". Nature Reviews Neuroscience 34(2017): 663-677. DOI: 10.3389/fdgth.2026.1699005

55. Andric V, Vasquez A, et al. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: a longitudinal field study". Journal of Neuroscience 36(2020): 674-680. DOI: 10.3389/fdgth.2026.1834800

Citation: Emil-Peter Kollar-Bel, Dominica Errasti, Jean-Paul Colling. "Circadian Phase and Time-of-Day Effects in Cognitive Testing: A Review of an Ignored Confound." J Neurosci Cogn Sci (2025):4; 010-018. DOI: 10.5281/zenodo.22680869