Conversational AI agents for converting neurophysiology data to NWB and reanalyzing the DANDI Archive

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CATALYST NEURO

Try it out
github.com/catalystneuro/claude-skills

SKILL 1 · CONVERSION

Lowering the bar to NWB

Converting data to NWB remains an enduring challenge for neurophysiology labs with minimal software engineering expertise. At CatalystNeuro, we've approached it by building layered tools, each one making conversion easier by building on the one below. PyNWB made it possible to write NWB from Python. NeuroConv builds on PyNWB to read 64 acquisition formats. nwb-convert builds on NeuroConv and hands that work to an AI agent so a lab can convert its data through conversation.

`nwb-convert` skill

Phases lead the conversation from raw files to a published Dandiset. Knowledge files hold the reference material the agent reads when a phase calls for it. The skill is interactive by design: it tells the agent to ask the lab whenever the files leave something open, such as a quirk in the data or a detail the paper never reports.

PHASES

01 **Discover**
02 **Inspect data**
03 **Collect metadata**
04 **Synchronize**
05 **Generate code**
06 **Annotate ontologies**
07 **Test and validate**
08 **Local notebook**
09 **Upload to DANDI**
10 **Dandiset metadata**
11 **DANDI notebook**

KNOWLEDGE

- **NeuroConv interface catalog** — 85 interfaces and their arguments, across ecephys, ophys, behavior, icephys, images, events and text
- **Past CatalystNeuro conversions** — Conversion patterns and the canonical repo structure, drawn from real repos
- **NWB extensions** — Fiber photometry, optogenetics, pose, anatomical localization
- **PyNWB guides** — Behavior, ophys, icephys, images, advanced I/O
- **NWB best practices** — Conventions that NWB Inspector checks
- **Ontologies and external resources** — Looking up and writing identifiers for species, brain regions, people

In use at CatalystNeuro

We've used nwb-convert for 10 lab conversions so far, covering these modalities:

fiber photometry · video + pose · optogenetics · motion capture · tetrodes · behavioral tasks · Neuropixels · calorie imaging · EEG/EMG · IMU, audio

Evaluation

We re-ran a conversion we had already published, Seiler et al. (2022), and graded each run against our version on DANDI (000971).

1 · INPUTS

- **The lab's raw data** READ-ONLY — MED-PC behavior, TDT photometry, optogenetics, demographics sheet
- **The paper** READ-ONLY — Seiler et al. (2022), Current Biology
- **One opening prompt** — `/nwb-convert` "I'm a scientist from the Lerner Lab, please convert my data to NWB and upload it to the DANDI sandbox."

The skill command opens only the skill arms.

2 · CONVERSION

Sandbox: a fresh Docker container per run

No route to GitHub or the DANDI Archive. One run per arm.

	Vanilla arm	Skill arm
Opus 4.5	Claude Code alone	Claude Code + nwb-convert
Opus 5.5	Claude Code alone	Claude Code + nwb-convert

Simulated lab scientist

Claude Opus 5.5 with the lab's fact sheet; answers only what it's asked. From the Opus 5.5 skill run:

"The paper gives 20 Hz trains of 1 s but no pulse width. Do you know it … ?"
→ "The pulse width was 5 ms."

"Can I annotate both [DMS and DLS] with Caudoputamen … ?"
→ "Yes, use Caudoputamen for DMS and DLS …"

Unlocking the conversion task

One year ago (Opus 4.5, vanilla), using an AI agent to convert a whole dataset to NWB was barely feasible, and yielded a conversion littered with mistakes. Today, (Opus 5.5 with nwb-convert) an AI agent can convert a complex dataset with thousands of sessions, several data streams, and many edge cases, nearly perfectly, from a single prompt.

	Opus 4.5		Opus 5.5	
	Vanilla	Skill	Vanilla	Skill
Coverage				
Subjects (of 152)	55%	55%	99%	100%
Sessions (of 3,986)	19%	40%	99%	99%
Photometry stream (of 63 sessions)	83%	98%	97%	100%
Optogenetics stream (of 2,120 sessions)	0%	0%	99%	99%
Data fidelity				
Photometry samples identical to reference	100%	100%	100%	100%
Behavior event times match reference	88.3%	97.3%	99.5%	100%
Rewards at nosepoke times	88%	100%	100%	100%
Paired rewards at light onsets	53%	100%	100%	100%
Synchronization error, median	0 ms	0 ms	14 ms	13 ms
NWB Inspector				
Critical issues	0	0	0	0
Best-practice violations	4	1	0	0
Timestamps not ascending	3	0	0	0
Regular timestamps stored explicitly	1	1	0	0
Best-practice suggestions	0	3	2	7
Missing description	0	2	0	0
Single-row table	0	1	2	5
All-NaN column	0	0	0	1
Non-standard processing module name	0	0	0	1
Edge cases				
Should be converted				
No subject ID, MED-PC file in mouse folder	20/575	221/575	575/575	573/575
Photometry restarted mid-session	0/3	0/3	0/3	3/3
Should be skipped				
MED-PC run in the wrong mouse's file	3/3	0/3	3/3	3/3
Mice missing from the demographics sheet	5/15	12/15	15/15	15/15
Corrupted photometry	1/2	0/2	0/2	0/2

See the full results
github.com/catalystneuro/nwb-convert-benchmark-results

Staying up to date

The vanilla arm (Opus 5.5) converted the data correctly but missed recent additions to the NWB ecosystem. The skill arm, guided by nwb-convert's maintained instructions, yielded a state-of-the-art conversion with ontology identifiers, detailed Dandiset metadata, and preferred neurodata types.

	Opus 4.5		Opus 5.5	
	Vanilla	Skill	Vanilla	Skill
Neurodata types				
Photometry in FiberPhotometryResponseSeries	100%	100%	100%	100%
Behavior in EventsTable	0%	4%	100%	100%
Optogenetics in ndx-optogenetics tables	–	–	0%	100%
Photometry metadata in preferred types	100%	0%	100%	100%
Optogenetics metadata in preferred types	–	–	0%	100%
Ontology identifiers				
Terms with a correct identifier (of 11)	0%	0%	0%	91%
Species (NCBITaxon)	0/1	0/1	0/1	1/1
Strain (RRID)	0/1	0/1	0/1	1/1
Institution (ROR)	0/1	0/1	0/1	1/1
Experimenters (ORCID)	0/6	0/6	0/6	6/6
Brain regions (Allen atlas, UBERON)	0/2	0/2	0/2	1/2
Dandiset metadata				
Items matching our Dandiset (of 25)	12%	12%	24%	92%
Authors, in order, with ORCID and affiliation	0/8	0/8	1/8	8/8
Data collectors	0/4	0/4	0/4	4/4
Funders with award numbers	0/3	0/3	0/3	3/3
Anatomy and disorder terms	0/3	0/3	0/3	2/3
Related links, license and text fields	3/7	3/7	5/7	6/7
Example notebook				
Notebook written	no	no	no	yes

Asking the scientist

Prompted by the skill, the agent consulted the scientist on scope and metadata. The vanilla arm decided these on its own, leaving out supplementary data and key metadata unspecified by the paper.

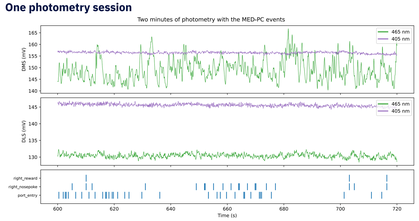
	Opus 4.5		Opus 5.5	
	Vanilla	Skill	Vanilla	Skill
Messages asking the scientist	0	3	2	7
Western blot images (of 16)	0%	100%	0%	100%
Metadata items (of 49)	48%	53%	92%	98%
Excitation wavelengths	0%	0%	97%	100%
Photodetector model	83%	0%	0%	100%
Stimulation pulse width (5 ms)	0%	0%	0%	100%

Example notebooks

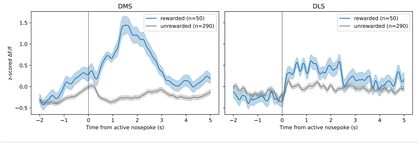
nwb-convert ends by writing two kinds of notebook. Review notebooks check each data stream against the lab's source files, and a demo notebook reads the published Dandiset back from DANDI and plots every stream, giving the lab a starting point for analysis.

219083_demo.ipynb

One photometry session



ΔF/F aligned to nosepokes



219083_demo.ipynb

Training history of the same mouse



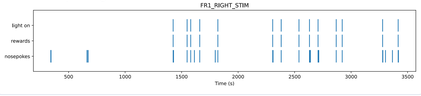
western_blot.ipynb

Check against the paper



optogenetics.ipynb

Check: reward-paired light follows rewards



SKILL 2 · REANALYSIS

Lowering the bar to reanalysis

Open archives like DANDI hold more and more NWB data, but reanalyzing it is still slow, one-off work. Starting from a scientific question, a researcher has to find a dandiset that might answer it, explore sample sessions, confirm the analysis fits, and start over when it doesn't. analyzing-dandi-datasets hands that search to an AI agent, so a scientist can bring just the question.

`analyzing-dandi-datasets` skill

STAGES

01 **Discover datasets**
02 **Prototype one session**
03 **Scale across sessions**
04 **Build the pipeline**
05 **Visualize and check**
06 **Deliver a notebook**

KNOWLEDGE AND TOOLS

- **neurosift MCP** — Searches the DANDI Archive
- **Pynapple** — Inspects NWB files and runs the analysis
- **NWB data access patterns** — Streaming with LINDI and remfile, loading many sessions
- **Common analysis patterns** — Tuning, place cells, PSTHs, population dynamics

RULES

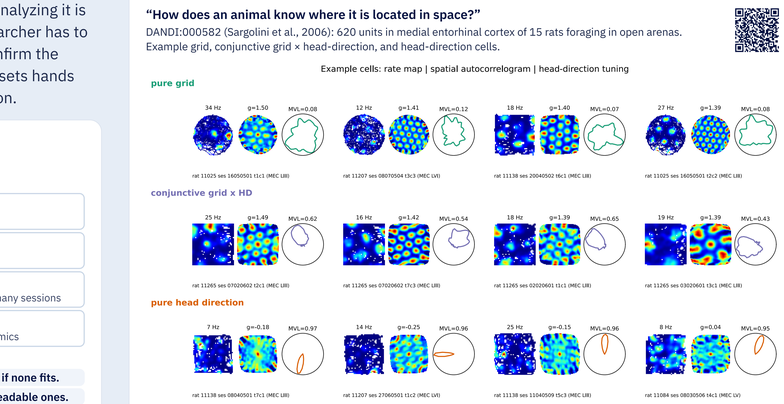
- Never simulates data; tells the scientist if none fits.
- Reads every plot it makes and fixes unreadable ones.

Example reanalyses

Runs of analyzing-dandi-datasets in Claude Code (Claude Opus 5.5), each from a single prompt. Each panel shows one of the figures the agent generated.

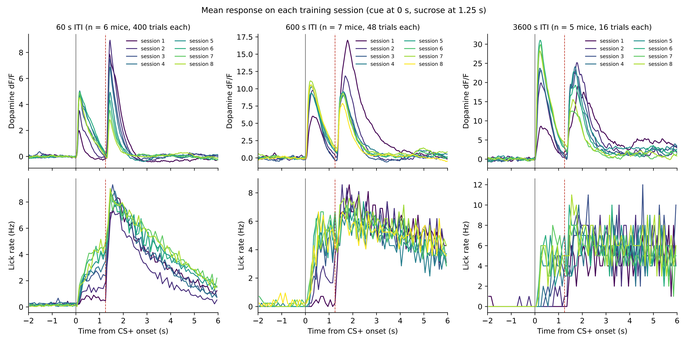
"How does an animal know where it is located in space?"

DANDI:000582 (Sargolini et al., 2006): 620 units in medial entorhinal cortex of 15 rats foraging in open arenas. Example grid, conjunctive grid × head-direction, and head-direction cells.



"How does an animal learn what comes before a reward?"

DANDI:001632 (Burke et al., 2026): dopamine photometry in nucleus accumbens of 18 mice learning that a tone predicts sucrose. Mean dopamine and licking on each training session.



"How does an animal's brain turn light into a picture of the world?"

DANDI:000021 (Siegle et al., 2021): Neuropixels recordings from visual thalamus and cortex of 13 mice viewing drifting gratings. Orientation tuning of single neurons, and orientation selectivity in LGN and V1.

