The Complete FPV Freestyle Training Program: Indoor Whoop to Outdoor Confidence in 6 Months

You can absolutely go from hitting a skill wall on indoor whoops to flying confidently in front of others by July 2026. Your current frustration—failing power loops and split-S maneuvers in 9-foot ceilings—is a technique gap, not a physics impossibility. Whoop pilots routinely execute power loops, split-S reversals, matty flips, and far more in standard residential rooms. The compressed vertical space demands precise blip timing and specific hardware setup (prop choice, rates, throttle scaling), but the maneuvers are well within reach. The real progression accelerator is evidence-based practice structure: **20-minute focused sessions before bed, 5-6 days per week**, leveraging sleep-dependent motor memory consolidation that research shows produces a 30% enhancement in skill retention. One critical planning note for your Denver trip: **drones are prohibited in all Denver park facilities** except specifically designated areas—you'll need to scout alternative locations.

Phase 0: Your practice engine and simulator bridge

Before any stick time matters, your practice infrastructure needs to be optimized. The research on motor skill acquisition is unambiguous: distributed practice (shorter sessions across more days) dramatically outperforms massed practice. A UC Berkeley study found that training close to bedtime, followed by sleep, produces a **30% memory enhancement** compared to training earlier in the day. NREM Stage 2 sleep spindles physically reactivate and strengthen motor memory traces overnight.

Your optimal daily schedule: A 20-25 minute focused evening session (sim or real flight), stopping *before fatigue sets in*. After roughly 30-40 minutes of intense practice, pilots start encoding sloppy inputs as muscle memory—and flight log data consistently shows that performance degrades noticeably after pack 6-8 in a single session. Structure each session as 5 minutes warm-up free flight, 10 minutes deliberate drill practice on one specific skill (blocked practice), then 5 minutes mixing 3-4 skills together (interleaved practice). The research on contextual interference is clear: **blocked practice builds a new skill fastest, but interleaved practice locks it into long-term memory**. Start blocked, transition to interleaved once you can execute a trick reliably.

Your sim-to-real ratio should shift over the six months: **50/50 sim-to-real in February-March** (sim for practicing tricks at safe altitude and building inversion comfort; real flight for

transferring that to your actual space and hardware), **40/60 in April-May** (more real flight as you transition outdoors), and **20-30/70-80 from June onward** (sim only for new tricks and bad-weather days). Since you're already comfortable in acro indoors, the sim's primary value isn't teaching you to fly—it's giving you unlimited altitude and zero-consequence reps on specific maneuvers (inverted hang, power loop timing, split-S exit planes) that are high-consequence in a 9-foot room.

Simulator setup with your TX16S: Connect via the top USB-C port, select "USB Joystick (HID)" on the radio prompt, and create a dedicated sim model profile with both internal and external RF modules disabled. Use EdgeTX over OpenTX for lower USB joystick latency. Your primary simulator should be **VelociDrone** ($20)—it integrates Betaflight directly, so you can copy your real whoop's rates and PIDs for near-1:1 matching. Select the Micro Quads category and use the TinyHawk 2 profile as your starting point. Set prop wash to ~28%, camera angle to 15-20° for indoor practice, and throttle limit to 80-90% to match real indoor behavior. Your secondary sim should be **Liftoff: Micro Drones** ($6 on Steam), purpose-built for whoop-class physics with indoor environments. For 5-inch practice starting in April, **TRYP FPV** ($15) offers the best freestyle-specific environments with photorealistic scanned locations.

Hardened simulator configuration for 5-inch training (Phase 2+): When you shift to practicing 5-inch maneuvers in sim, the default "accessible" physics settings become actively harmful to your progression. Standard sim settings undermodel the momentum and weight that makes 5-inch flying feel like controlling a drifting rally car versus a hummingbird. For your 5-inch sim profile specifically, set gravity to 115-120% (compensates for the lack of vestibular feedback—you can't feel g-forces in a chair, so slightly exaggerated gravity forces your visual processing and throttle responses to react faster), drag to 90-95% (simulates the "slide" of a heavy quad, training you to initiate turns and stops earlier), camera angle to 25-30° (standard freestyle tilt), FOV to 115-120° (matches DJI digital systems), and throttle scale to 75-85% (removes the "infinite power" crutch and forces momentum conservation). This is separate from your whoop-matching sim profile—keep both and use the appropriate one for each training phase.

The honest truth about sim-to-real transfer for whoops: sims tend to make whoops feel slightly heavier with more momentum than real ultralight 65mm builds. Real whoops also have significant ground effect, wall turbulence, and 1S battery sag that sims undermodel. However, stick coordination, spatial awareness, throttle management, and trick timing transfer very well. One experienced pilot noted: "flips and rolls are a bit more disorientating in real life than in sim, and proximity feels easier in the sim." Accept this gap—sim builds the neural pathways, real flight calibrates them.

Phase 1: Indoor acro tricks (February through mid-March, 6 weeks)

Where you actually are: You fly acro indoors. You can hover reasonably well. You're starting to feel flips and rolls but they're inconsistent—specifically, you lose spatial awareness at the apex of rotations (the "inversion disconnect"), your exit planes drift unpredictably, and you haven't cracked the timing for power loops or split-S in your 9-foot ceiling rooms. That's your starting line, and it's a solid one. The fundamentals that take most pilots weeks to build—comfort in acro, basic throttle authority, spatial awareness in forward flight—are already in place. Phase 1 is about converting that acro fluency into actual indoor freestyle tricks.

Indoor whoop acro in standard rooms is a well-established discipline. Pilots routinely power loop, split-S, matty flip, and chain multi-trick lines in rooms with 8-9 foot ceilings. Your space (two 10×20-foot rooms with 9-foot ceilings connected by doorways) is typical for indoor whoop freestyle. The vertical compression is real—it demands precise throttle blip timing, appropriate prop and rate choices, and practiced muscle memory—but it's a technique problem with known solutions, not a physical limitation to work around.

Your best indoor acro whoop is the BetaFPV Air65 Freestyle Edition (23000KV). At **17.3g**, it's the lightest option in your fleet with the best FC/gyro combination (G473 processor + ICM42688P gyro, superior to the BMI270 in the Mobula6). The wider canopy plastic is more crash-resistant, and the dual ball-bearing 0702SE II motors handle aggressive inputs well. The Freestyle version's lower KV provides smoother, more controllable power delivery for learning while maintaining a 5.26:1 thrust-to-weight ratio. Once the FC replacement arrives, prioritize getting this airborne. In the meantime, the Mobula6 Race HD 2024 is your #2 option—swap its fragile HappyModel frame for a BetaFPV Meteor65 frame for better durability.

Critical Betaflight settings for indoor acro: Scale throttle to 80-90% (this gives you more resolution in the throttle range you actually use, which is critical for blip timing on power loops). Set VBAT Sag Compensation to 100%, Motor Idle to 8-10%, enable Crash Recovery, set camera angle to 15-20°. For rates, 500-700 deg/s for acro. Upgrade from PH2.0 to BT2.0 connectors if you haven't—the voltage sag reduction is dramatic and gives more consistent power delivery throughout a pack. Consider bi-blade props (Gemfan 1210-2 or HQ 31mm 2-blade)—they carry more momentum through throttle cuts, which directly opens up power loops and stalls by giving the quad more "coast" at the apex.

Addressing your three specific failure modes

Before the weekly breakdown, these are the root causes behind your current wall, and each has a targeted fix.

The "Inversion Disconnect" (losing spatial awareness at the apex of rotations): This happens because your brain hasn't yet built the mental model for what "inverted" looks like through the camera. The fix is dedicated inversion exposure. In sim, practice inverted hover at high altitude until you can hold 10+ seconds reliably—this teaches your brain what the world looks like upside down without the stress of a ceiling 3 feet away. On your real whoop, start with slow half-rolls to inverted at 4-5 feet, hold for 1-2 seconds, then roll back. Gradually extend the hold time. The key insight: during any rotation, consciously track where the horizon line is moving in your goggles. It sweeps through the frame in a predictable arc. Once your brain learns to read that arc, the disconnect resolves.

Exit Drift (inconsistent exit plane, variable rotation speed): This is almost always caused by contaminated stick inputs—you're adding unintended roll, pitch, or yaw during the rotation because your thumbs tense up mid-trick. The fix is isolating each axis. Practice rolls with your left thumb completely off the stick (just let the quad drift laterally—that's fine, you're training rotation purity). Same for flips. Once each axis is clean in isolation, the combined inputs become cleaner. In sim, use the stick overlay display to watch for the telltale signs: if your roll stick drifts forward during a roll, that's pitch contamination causing the exit plane to shift. The second cause is inconsistent rotation speed from variable stick pressure—practice snapping the stick to full deflection and releasing at exactly 360°, rather than modulating pressure mid-rotation.

Indoor Verticality (power loop timing in 9-foot ceilings): The technique for low-ceiling power loops is fundamentally different from outdoor loops. Outdoors, you sustain throttle through a wide arc. Indoors, you use a **sharp throttle blip** (80-90% for ~0.3 seconds) simultaneous with full pitch-back. The blip provides just enough upward energy to carry through a very tight 3-4 foot diameter loop without hitting the ceiling. Starting altitude matters enormously: begin at 3-4 feet, giving you roughly 5 feet above and 3 feet below. The throttle blip and pitch-back must happen at the exact same instant—throttle first and you hit the ceiling, pitch first and you nose-dive. Recovery is a quick throttle catch at 50-60% as you come around the bottom. Bi-blade props help significantly here because they carry more off-throttle momentum through the apex.

Week-by-week indoor breakdown

Weeks 1-2: Clean up rotations and build inversion comfort. Your flips and rolls are inconsistent—this is the week to make them reliable. Drill pure-axis rolls (10 in a row, each direction, checking for exit drift). Drill pure-axis flips. Practice at 4-5 feet altitude to give yourself margin. Track success rate: you want to go from "sometimes clean" to 70%+ clean exits. Simultaneously, start building inverted hang time: half-roll to inverted at center room, hold 2 seconds, roll back. Extend to 5 seconds by end of week 2. In sim, practice inverted hover at altitude with the inversion disconnect protocol—perform flips at dramatically reduced rates (300-400 deg/s) and consciously track the horizon through the entire

rotation. Practice the **Ceiling Scrape**: hover less than 6 inches from the ceiling for 10+ seconds. The Bernoulli effect pulls the drone upward as airflow between props and ceiling creates low pressure—if you get stuck, **disarm immediately** rather than fighting with throttle. This drill builds the fine throttle resolution that translates directly to power loop apex control.

Weeks 3-4: Split-S and power loop technique. With clean rotations and some inverted comfort, you're ready for your two target tricks. **Split-S first** (it's more forgiving indoors): fly forward at 5-6 feet, quick roll to inverted, cut throttle to 0-10%, pull pitch back to arc under into the direction change, gradually increase throttle as you level out. The indoor adaptation uses a 60-70% throttle blip for ~0.2 seconds just before rolling inverted—this gives upward momentum without ceiling contact. Starting at 5 feet gives 2.5 feet above and 4 feet below, which is sufficient. Common failure: rolling too slowly causes excessive descent before inversion completes. Speed up the roll. **Power loops**: start in sim until you can land 5 in a row, then transfer to real flight. Begin at 3-4 feet altitude, sharp throttle blip (80-90%, ~0.3 seconds) simultaneous with full pitch-back, throttle catch at 50-60% on the exit. Your first real attempts will be ugly—that's expected. Focus on completing the rotation rather than making it round. Roundness comes with repetition.

Weeks 5-6: Consistency, matty flip introduction, and 5-inch build. Power loops and split-S should be moving from "sometimes land it" toward 50%+ success rate. Start linking them: split-S into forward cruise, then power loop around a doorway. Introduce matty flip foundations—fly forward, push pitch forward to initiate a front flip, cut throttle during the flip. Start with just the initial flick without completing the full rotation (high altitude in sim, then at 5+ feet indoors). Practice the punch-out-and-catch drill as a matty flip prerequisite: quick throttle burst to 6 feet, cut throttle, arrest descent before dropping below 3 feet. Complete your 5-inch build during evening bench sessions—have it ready for maiden flight when weather permits.

Go/no-go gates for Phase 1 → Phase 2

You advance when you can check every box: execute clean rolls and flips in both directions with 70%+ consistent exit planes. Hold inverted hover for 5+ seconds with less than 1 foot drift. **Land a split-S indoors 3 out of 5 attempts. Land a power loop indoors 3 out of 5 attempts** (it doesn't need to be round yet—completing the rotation and recovering cleanly counts). Measure time for 10 consecutive figure-8 laps through your doorways—a variance of less than 2 seconds indicates consistent control inputs. Thread gaps smaller than 3 feet wide at moderate speed consistently. Hold a ceiling scrape for 10 seconds without surface contact. Accumulate 15+ hours combined sim and real acro time during this phase.

Phase 2: The outdoor transition (April through May, 8 weeks)

The shift from indoor to outdoor flying produces a well-documented phenomenon called **"lost in space" syndrome**—indoor pilots suddenly have unlimited space and lose all spatial reference points. The fix is simple: start by flying close to a single object (tree, bench, pole) to anchor your spatial awareness. Your first outdoor sessions should use the **75mm Meteor75 Pro** in dead-calm conditions (early morning is typically calmest). Even 5 mph of wind is challenging for sub-75mm whoops.

Throttle management changes fundamentally outdoors. Indoors, you use 30-60% throttle. A well-built 5-inch freestyle quad hovers at **20-30% throttle**, leaving 70-80% of the range above hover. This means enormously more resolution for tricks but also enormously more consequence for over-throttling. When you maiden the 5-inch, set Betaflight's throttle limit to 70% initially.

A critical note on your DJI Avata: Multiple expert sources strongly advise against using it for freestyle training. Its poor center of gravity and battery placement cause tumbling during acro maneuvers, and its duct guards create instability. Use the Avata exclusively for outdoor cruising in Normal/Sport mode to build comfort with outdoor visual perspectives and for location scouting. It is not a stepping stone to freestyle.

Wind limits by platform: 65-75mm whoops should only fly in dead calm. 3-inch quads handle 5-10 mph. 5-inch quads are comfortable up to 10-15 mph; experienced pilots manage 20+. Pay more attention to gust speed than average speed—sudden gusts cause crashes. Use the UAV Forecast app before every session.

The size transition feels like this

Quad size	Hover throttle	Key characteristic
65mm whoop (1S)	40-60%	Stops instantly, negligible momentum, direction changes are immediate
75mm whoop (1-2S)	35-55%	Slightly more inertia, better wind resistance
3-inch (2-4S)	30-45%	Noticeable momentum carry, "slides" through turns
5-inch (4-6S)	20-30%	Significant momentum, requires planning *ahead* of the drone's position

A flip on a whoop takes under 0.5 seconds with almost no altitude loss. The same flip on a

5-inch takes longer and loses significant altitude. Add **20+ feet to whatever altitude felt safe on a whoop** when you start 5-inch tricks. The fundamental difference is that a whoop is a hummingbird—it stops where you tell it to. A 5-inch quad at speed is a drifting rally car—you must plan your inputs ahead of the drone's position, not react to where it is now.

Rate settings across sizes: Keep rates consistent within similar-sized quads but expect different rates between platforms. Indoor whoops in Acro: 500-700 deg/s. 5-inch freestyle: 700-850 deg/s. Camera angle progression: 15-20° outdoors on whoop, 15-25° on 5-inch while learning, working up to 25-35° as confidence grows.

Outdoor week-by-week

Weeks 7-8 (early April): First outdoor flights with 75mm whoop in calm conditions. Large open field, no obstacles. Fly at 10-20 feet. Focus on forward flight, banking turns, figure-8s around a single object. Bring 8-10 batteries minimum. **Weeks 9-10 (mid-late April):** Introduce the 3-inch (Rekon3 Nano). Notice the increased inertia and momentum carry. Practice rolls and flips at 50+ feet altitude. Begin gentle wind days (5-8 mph). **Weeks 11-12 (early-mid May):** Maiden the 5-inch. Test hover throttle position first. Start with 15-20° camera angle. Practice split-S and wide, high power loops in open air. **Weeks 13-14 (late May):** Fly all three sizes to reinforce cross-platform skills. Begin proximity flying near structures. Practice in wind up to 10-12 mph on 5-inch. Start basic trick sequences.

Go/no-go gates for Phase 2 → Phase 3

Complete 5+ outdoor packs on 5-inch without uncontrolled crashes. Perform clean rolls, flips, and split-S at safe altitude. Maintain orientation after tricks (no post-trick "lost in space"). Fly in 8-10 mph wind with confidence. Comfortably fly within 10 feet of a large object. Land smoothly and consistently. Complete at least one power loop (even wide and high).

Phase 3: Flow and lines (June, 4 weeks)

Flow is not about doing more tricks—it's about **eliminating the pauses between them**. The FPVFrenzy "Lessons in Flow" article (a must-read resource) distills it: beginners do a trick, then fly straight to recover and align, then do another trick. Flow pilots stitch moves together so the exit of one trick is the entry of the next. The signature technique is **throttle-controlled hang time**: throttle up hard, flip inverted, cut throttle at the apex—momentum carries the quad upward while inverted, creating a graceful pause before gravity takes over. This requires exquisite throttle timing that comes from hundreds of repetitions.

How to develop lines at a location: Walk the spot first without goggles. Identify "anchor

objects" (trees, poles, structures) that serve as trick points. Map natural corridors between obstacles for cruising segments. Your first pack at any new location should be slow, exploratory reconnaissance. Then build lines: start by linking just two tricks (power loop around a tree → forward cruise → split-S at the next tree). Gradually extend to 3-4 trick sequences. The Rotor Riot Tricktionary identifies three fundamental building blocks from which all freestyle derives: **rolls, flips/loops, and yaw spins**. Everything else is a combination or variation.

Common flow patterns to practice: power loop → forward dive → split-S (classic approach-and-return). Split-S → matty flip → forward cruise (direction reversal combo). Speed run → flip → throttle-cut pause → recovery dive (momentum play). Vary tempo deliberately—alternating fast runs with slow, deliberate movements creates rhythm and drama.

The "IGOW Line" pressure drill: Adapted from the International Game of Whoop competition format, plan a continuous line of 4 specific tricks (for example: orbit → power loop → matty flip → dive). The constraint: if you miss any element, the line is a failure—land and restart. This simulates the pressure of a one-take video or competition run and builds the mental fortitude required for public flying. Start with 3-trick lines and extend to 4-5 as consistency improves.

Go/no-go gates for Phase 3 → Phase 4

Execute a 3-trick combo with smooth transitions and no obvious pause/correction between them. Adapt flight lines to a new location within 2-3 packs. Maintain a personal repertoire of 5+ tricks executed reliably. Review DVR after every session and articulate specific improvements. Fly comfortably in 10-15 mph wind on 5-inch. Fly at minimum 3 different locations.

Phase 4: Confidence building for Denver (July, 2 weeks)

Denver parks prohibit drones in all park facilities except areas specifically designated by the Department of Parks and Recreation Executive Director. This is strictly enforced. Colorado State Parks also prohibit drones except in designated areas. Your practical options: **Chatfield State Park model airfield** (south of Denver) is one of the few legal flying areas near the metro. Scout locations outside Denver city park jurisdiction—private property with owner permission or open land outside city limits. For hotel flying, a sub-250g whoop requires no FAA registration and can be flown indoors freely. Always carry proof of your TRUST test completion and FAA registration for anything over 250g. Use the B4UFLY app to verify airspace restrictions at every GPS coordinate you plan to fly. Denver International Airport creates Class B airspace over much of the metro area requiring LAANC authorization, and **Centennial Airport (APA) south of Denver creates additional Class D**

airspace—verify both before flying anywhere in the metro area.

The mental game for public flying: Fly 1-2 warm-up packs before attempting anything impressive. Focus on repeating practiced combos, not trying new tricks under pressure. The best advice from the FliteTest community: "THE best thing you can do as a freestyler is to relax and enjoy what you're doing. Get the Flow! If you feel hell-bent on trying one thing, everything else will look shabby." Brief curious spectators about what you're doing—letting kids try the goggles builds goodwill. Have a spotter (FAA-required for FPV with goggles outdoors) who can also manage spectator interactions.

Noise discipline for public flying: 5-inch quads are loud. Fly 2 packs, then take a break before flying more. Persistent high-pitched motor noise generates complaints and ill will faster than almost anything else. This is especially important in residential-adjacent areas or places where you're trying to build goodwill for the hobby. A spotter who engages curious onlookers while you fly helps enormously.

For RF-noisy hotel/urban environments: ExpressLRS at 2.4GHz is resilient but test link quality before arming in new locations. DJI O4 handles interference better than analog. Power up, check RSSI, and verify clean video before committing to acro.

The "Final Exam" line: To graduate the program, perform a continuous 45-second line containing one flow element (orbit or smooth gap), one vertical element (power loop or dive), one technical element (matty flip or split-S), and one recovery element (rewind or controlled landing). Success metric: no ground touches, no video breakup, smooth throttle management (no audible throttle "pumping"). This isn't about perfection—it's about demonstrating the connected, intentional flying that makes freestyle look deliberate rather than lucky.

Week-by-week drill timeline

This is the master schedule. Each week lists the primary drills, target volume, the go/no-go checkpoint for that week, and reference links for technique. "Sessions" means dedicated 20-25 minute practice blocks (real or sim). The sim column indicates what to practice in VelociDrone/Liftoff that session if you're doing sim instead of or in addition to real flight.

Phase 1: Indoor acro tricks (Weeks 1-6)

Week	Primary drills	Target	Sim focus	Go/no-go checkpoint	References
	Pure-axis rolls		Rolls and	50%+ clean	

1	(L and R), pure-axis flips (fwd and back), figure-8 flow drill, ceiling scrape	5-6 sessions, 3 packs each	flips at altitude with stick overlay on. Inverted hover attempts.	roll exits both directions. 10-lap figure-8 time recorded as baseline.	Headmazta: Rolls · Ceiling scrape drill
2	Pure-axis rolls/flips (consistency push), inverted hang (2→5 sec), orbit drill, gap threading	5-6 sessions, 3 packs each	Inverted hover hold target: 10 sec. Slow-rate flips (300-400°/s) tracking horizon consciously.	**70%+ clean roll/flip exits.** Inverted hang 3+ sec real, 10+ sec sim. 5 clean orbits each direction.	Headmazta: Inverted · Orbit drill
3	Split-S technique (start at 5 ft), punch-out-and-catch, inverted hang (extend to 5+ sec)	5-6 sessions, 3 packs each	Split-S at safe altitude—land 5 in a row before attempting real. Inverted yaw turns.	First real split-S attempts. Punch-out catch within 1 ft of target. Inverted hang 5 sec real.	Infinity Loops: Split-S Whooptorial · Pro Whooper: Split-S
4	Split-S (consistency), power loop technique (start in sim, transfer to real), ceiling scrape refinement	5-6 sessions, 3 packs each	Power loops—sim until you land 5 consecutive. Focus on simultaneous blip + pitch-back timing.	**Split-S 2/5 success rate real.** First real power loop attempts. Ceiling scrape 10 sec hold.	Infinity Loops: Power Loop · Headmazta: Power Loop
5	Power loop (consistency push), split-S + cruise combos, matty flip intro (initial flick only), punch-out-and-catch	5-6 sessions, 3 packs each	Full matty flips at altitude. Power loops around sim objects. 2-trick lines: split-S → cruise → power loop.	**Split-S 3/5.** Power loop 2/5. Matty flip: can execute initial flick and recover.	Astrorocketz: Matty Flip progression · Pro Whooper: Matty Flip

6	Power loop + split-S consistency, matty flip full attempts, 2-trick linking, wall proximity	5-6 sessions, 3 packs each	Matty flips around objects. 3-trick sim lines. Rewind introduction.	⬛ **PHASE 1 GATE: Split-S 3/5. Power loop 3/5. Inverted hang 5 sec. Figure-8 variance <2s. Rolls/flips 70%+ clean.**	Pro Whooper: Freestyle Boot Camp · FPVFrenzy: Lessons in Flow

Phase 2: Outdoor transition (Weeks 7-14)

Week	Primary drills	Target	Sim focus	Go/no-go checkpoint	References
7	First outdoor flights: 75mm whoop, open field, no obstacles. Forward flight, banking turns, figure-8s around single object.	4-5 sessions, 6-8 packs each (more batteries outdoors)	5-inch sim profile: hover practice, forward flight, gentle turns. Get comfortable with momentum.	Completed 3+ outdoor sessions. Can maintain orientation at 10-20 ft altitude. No panicked disarms.	Joshua Bardwell: First outdoor flights
8	Outdoor whoop: rolls/flips at 30+ ft altitude, split-S in open air, begin orbiting objects. Continue indoor whoop sessions for trick	5-6 sessions mixed indoor/outdoor	5-inch sim: rolls and flips at altitude. Split-S with forward exit momentum.	Outdoor rolls/flips 50%+ clean. Outdoor split-S attempted. Indoor tricks maintained (no regression).	Headmazta: Outdoor transition

	maintenance.				
9	Introduce 3-inch (Rekon3 Nano): hover, forward flight, banking. Note inertia difference. Outdoor whoop: power loops at 40+ ft.	5-6 sessions, split between whoop and 3-inch	5-inch sim: power loops at altitude. Matty flips. Propwash recovery (fly forward through descents).	3-inch: comfortable hover and forward flight. Outdoor whoop power loop attempted.	Oscar Liang: Propwash
10	3-inch: rolls, flips, split-S at 50+ ft. Begin gentle wind days (5-8 mph). Outdoor whoop: matty flip attempts at safe altitude.	5-6 sessions	5-inch sim: wind enabled. Practice maintaining lines in turbulence. Trippy spin introduction.	3-inch: rolls and flips 50%+ clean. Flown in 5+ mph wind.	Headmazta: Trippy Spin · Pro Whooper: Trippy Spin
11	**Maiden 5-inch build.** Hover test, throttle limit 70%. Gentle forward flight. Rolls at 80+ ft altitude. Continue 3-inch for trick practice.	4-5 sessions, prioritize 5-inch maiden + 3-inch	5-inch sim: match your real build's rates/PIDs. Practice the exact maneuvers you'll attempt real.	5-inch: successful maiden. Comfortable hover. Forward flight with banking turns.	Joshua Bardwell: Maiden flight checklist
	5-inch: rolls, flips, split-S at 60+ ft. Start 15-20° camera	5-6 sessions,	Trippy spin practice.	5-inch: clean rolls/flips. Split-	

12	angle. 3-inch: power loops around objects, proximity introduction.	split 5-inch and 3-inch	Rewind technique. 5-inch flow lines in sim.	S attempted. 3-inch: power loop around an object.	TRYP FPV sim
13	5-inch: power loops (wide, high), proximity within 10-20 ft of objects. Fly all three sizes in one session to build cross-platform sense. Wind up to 10-12 mph on 5-inch.	5-6 sessions	Matty flip and rewind combos. 2-3 trick lines around sim objects.	5-inch: power loop attempted. Comfortable in 8-10 mph wind. Flies all three sizes.	Mr. Steele: Proximity philosophy
14	5-inch: split-S, power loops, basic proximity. Begin 2-trick sequences. 3-inch: matty flip, trippy spin attempts.	5-6 sessions	3-4 trick flow lines. Inverted yaw spin. Juicy flick.	**⬛ PHASE 2 GATE: 5-inch 5+ packs no uncontrolled crashes. Clean rolls/flips/split-S at altitude. Power loop landed. 8-10 mph wind. Proximity within 10 ft.**	Skitzo: Flow

Phase 3: Flow and lines (Weeks 15-18)

Week	Primary drills	Target	Sim focus	Go/no-go checkpoint	References
	5-inch: 2-trick combos (power		4-5 trick flow		

15	loop → split-S, split-S → matty flip). Fly a new location. Focus on eliminating pauses between tricks.	5-6 sessions, minimum 2 locations	lines. Practice "exit of trick A = entry of trick B" transitions.	2-trick combos with smooth transitions. Flown at 2+ locations.	GAPiT FPV: Pauses and backtracking · FPVFrenzy: Lessons in Flow
16	3-trick lines. Throttle-controlled hang time practice. Trippy spin on 3-inch/5-inch. Rewinds as flow recovery. Explore a third location.	5-6 sessions, minimum 3 locations total	5-trick lines. Rubik's cube. Inverted yaw spin.	3-trick combo landed on video. Trippy spin 30%+ success.	Le Drib: Freestyle lines · Pro Whooper: Rewind
17	Extend to 4-trick lines. Vary tempo (fast → slow → fast). IGOW line drill: plan 4 tricks, restart if you miss one. Fly in 10-15 mph wind.	5-6 sessions	Long flow lines (60+ seconds). Practice "reading" new sim environments quickly.	4-trick line on video. IGOW line completed 2/5 attempts. Comfortable 10-15 mph.	IGOW competition format
18	Polish and consolidate. DVR review every session. Film "best line" attempts. Build a go-to 3-trick combo you can land 80%+ of the time. Fly 4th location.	5-6 sessions, 4+ total locations	Refine weakest trick. Practice pressure: "one take" lines with restart penalty.	**⬛ PHASE 3 GATE: 3-trick combo smooth 3/5 attempts. 5+ trick repertoire at 70%+. DVR reviewed every session. 3+ locations flown. 10-15 mph wind comfortable.**	Pro Whooper: Freestyle Boot Camp

Phase 4: Denver confidence (Weeks 19-20)

Week	Primary drills	Target	Sim focus	Go/no-go checkpoint	References
19	Polish go-to combos. Practice "warm-up → show" cycle: 1-2 easy packs then attempt your best line. Film everything. Pressure drill: fly for an audience (friend, family, anyone). Indoor whoop session to stay sharp.	5-6 sessions	"Final exam" line practice: flow → vertical → technical → recovery, 45 sec continuous.	Go-to combo lands 4/5 attempts. Flown for at least one spectator.	GetFPV: Psychology at events
20	Scout Denver locations (Chatfield State Park, private property). Test ELRS link in urban RF environments. Hotel whoop sessions. Pack spares. Final "exam" line attempts.	Travel-dependent	Final polish. Visualize Denver lines.	**⬛ PHASE 4 GATE: 45-sec continuous line with flow + vertical + technical + recovery element. No ground touches, smooth throttle. Locations scouted. Spares packed.**	B4UFLY app · AirMap

Reading this chart

Bold items in the go/no-go column are hard gates—don't advance until they're met. Non-bold items are targets to aim for. The ⬛ **PHASE GATE** rows are the formal advancement

checkpoints from the phase descriptions above.

If you're ahead of schedule, don't skip weeks—use the extra time to push success rates higher or add tricks from the next level. Consistency at 90% is worth more than attempting the next trick at 30%.

If you're behind schedule, that's fine. The weeks are targets, not deadlines. The go/no-go gates matter more than the calendar. Better to spend 8 weeks on Phase 1 and nail your indoor tricks than to rush outdoors with shaky fundamentals. The only hard deadline is Denver in July—and even that's "fly confidently," not "perform at competition level."

Reference links: The YouTube channels link to the channel level because specific video URLs change frequently—search each channel for the specific trick name. Pro Whooper's tricktionary and Freestyle Boot Camp are behind their site navigation but searchable by trick name.

The trick database: what to learn and when

All freestyle tricks build from three fundamentals: roll (rotation on roll axis), flip/loop (pitch rotation around objects), and yaw spin. The progression below is synthesized from Pro Whooper's tricktionary, the Rotor Riot Freestyle Tricktionary, community consensus on IntoFPV, and multiple tutorial sources.

Level 1 tricks (Month 1): the foundation

Clean 360° Roll: Right stick full deflection left or right, then return to center at exactly 360°. Practice until you can execute 10 consecutive rolls with less than 5° deviation from your original attitude. **Clean Flip:** Right stick full forward or back for a 360° pitch rotation. Same mastery standard. **Yaw Spin:** Left stick full yaw while maintaining altitude and position. Complete 360° ending within 10° of original heading. **Gap Threading:** Fly through doorways and openings at controlled speed, progressing to knife-edge (90° roll) through narrow gaps. **Coordinated Turn:** Turning the aircraft using roll, pitch, and yaw simultaneously to maintain altitude and forward velocity without "drifting" sideways—Mode 2 inputs are roll plus yaw in the same direction with slight pitch back to maintain altitude. The go/no-go metric: 10 laps of your double-door figure-8 track without touching walls or floor.

Level 2 tricks (Months 2-3): building the acro vocabulary

Split-S (your first direction reversal): Fly forward at 5-6 feet altitude, roll inverted with a quick right-stick flick, cut throttle to 0-10%, pull pitch back to dive into direction change, gradually increase throttle as you arc under and forward. For 9-foot ceilings, use the throttle

blip method: a 60-70% blip for ~0.2 seconds just before rolling inverted gives upward momentum without ceiling contact. Keep the maneuver flat—use forward momentum and a fast roll rather than punching up. Starting at 5 feet gives you 2.5 feet above and 4 feet below, which is comfortable for a whoop split-S. Common failure: rolling too slowly, which causes excessive descent before inversion completes. The fix is a faster, more committed roll input.

Power Loop (indoor technique for 9-foot ceilings): The loop diameter compresses to approximately 3-4 feet in standard rooms, which demands a different technique than the sustained-throttle outdoor version. Start at 3-4 feet altitude. Give a sharp throttle blip (80-90% for ~0.3 seconds) while *simultaneously* pulling full pitch back. The blip provides the upward energy to carry through the top of a tight loop. The throttle blip and pitch-back must happen at the exact same instant—throttle first hits the ceiling, pitch first nose-dives. Recovery: as you come around the bottom, a quick throttle catch at 50-60% stops the descent. Bi-blade props like the Gemfan 1210-2 carry more off-throttle momentum, which opens up this trick significantly by giving the quad more coast through the apex. Higher KV motors (28000-30000KV) provide the instantaneous punch needed. Go/no-go metric for outdoor progression: the loop must be round, not egg-shaped, and you should be able to loop a specific object (soccer goal, tree) without bailing out.

Matty Flip: Fly forward over an object, push pitch forward (right stick up) to initiate a front flip, cut throttle during the flip, and as you go inverted with the camera pointing backward, hold pitch forward to continue the arc downward. Gradually increase throttle to arrest descent, ease off pitch to level out flying backward under the object. The drill progression from Astrorocketz: practice just the initial flick without completing rotation → high-altitude full attempts → both directions → around specific objects → gradually lower altitude. A critical sim-to-real note: in the simulator, pilots often unconsciously "pause" gravity during the stall moment. In reality, you must pulse the throttle before the drone stalls to push it backward—if the throttle pulse is too late, the drone simply falls; if too early, it climbs. The timing window is milliseconds.

Immelmann Turn: The opposite of a split-S—half loop upward followed by a 180° roll at the top to level out. This gains altitude while reversing direction, maintaining forward speed throughout. Mode 2 inputs: pitch back to initiate the half-loop, blip throttle through the climb, then roll 180° at the apex to return to upright and level flight. The go/no-go metric: must exit level with maintained forward speed, not stall at the top.

Level 3 tricks (Months 4-5): multi-axis coordination

Trippy Spin: Simultaneous pitch-back and roll input (right stick to bottom-left or bottom-right corner) while modulating throttle between 30-70% to maintain altitude. The corkscrew-like path looks hypnotic. Prerequisites: clean rolls and clean flips. Start at high

altitude with 50% pitch-back and 50% roll input for one rotation. Multiple sources note this is easier to learn on a 3-inch quad due to lower rotational inertia. **Inverted Yaw Spin:** Roll inverted, full yaw input while managing inverted throttle, roll back upright. Community consensus: "not as easy as it sounds—it's a combination of yaw and roll to get a spin on a line without wobbling." **Rubik's Cube:** Pitch forward 180° → full roll 360° → pitch forward 180°, creating a cube-like tumbling pattern—a combination of a roll and a flip that looks like the drone is tumbling over itself box-style. **Juicy Flick:** Fast pitch forward to flip inverted → brief inverted hang (camera looks backward) → continue flip back upright. Similar to Matty Flip but faster and snappier.

Level 2-3 trick (anytime): the rewind

Rewinds are the **"undo button" of freestyle**—enter a motion and immediately reverse it. The stall flip rewind (beginner level): punch up, half-flip to inverted, stall, then reverse the flip to return upright. The side rewind (intermediate): roll left at full deflection for ~180°, snap to full right roll, add opposite yaw during the reversal, and blip throttle to maintain altitude. The stall rewind with yaw variation: fly up, stall, execute a 360° yaw spin at the apex (zero throttle), then fall back down through the entry path. Rewinds are invaluable for flow correction when a trick goes off-line, and they create dramatic visual "pause and reverse" moments.

Level 4 tricks (Month 5-6): technical freestyle

Stall Rewind (advanced): Fly under an object, punch up, 180° spin, fall back through the gap. Requires precise throttle timing to stall at exactly the right height. **Powerloop-Dive Combo:** Powerloop around an object, then immediately dive through a gap below it without a pause between the two elements. This is where flow and tricks merge.

Level 5 tricks (aspirational—IGOW competition standard)

These represent the frontier of freestyle and are included for reference and long-term goal-setting, not for your 6-month timeline: **Hamhook** (½ front flip to inverted → 180° inverted yaw spin → pitch back to sweep under an obstacle), **Rodeo 7** (backflip + 360° yaw spin blended together for 720° total rotation, typically performed off a "jump" or over an object), **McTwist** (a corked rotation combining diagonal flip and yaw), **Sbang sequences** (multiple wall-taps chained together), and **Kururi** (a complex multi-axis spin). These require "blind" flying—trusting momentum and muscle memory over visual confirmation.

The drill library for your specific spaces

Each drill below has been verified as executable in your 10×20-foot rooms with 9-foot

ceilings using a 65mm whoop.

The Double-Door Figure-8 Flow Drill: Two reference objects 8 feet apart, or better yet, use your standard door and double door as natural gates to create a repeatable test loop. Fly figure-8s at 3-4 feet height in both directions with height variations at 2, 4, and 6 feet for altitude consistency practice. **Measure time for 10 consecutive laps: a variance of less than 2 seconds across laps indicates emerging flow state and consistent control inputs.** This is your primary indoor progress metric—it's objective, repeatable, and directly measures the throttle/pitch/roll coordination that underpins everything else. Builds toward orbits, proximity, and flow connections. Outdoor scale: trees or poles 20-50 meters apart with progressive speed increases.

Orbit Drill: Object in room center, orbit at 4-5 foot radius at 3-foot height. Mode 2 inputs: simultaneous roll + opposite yaw + forward pitch. Master 5 clean orbits each direction with the object staying center-frame, then progress to inverted orbits. Builds toward pole dancing tricks and smooth flow.

Punch-Out and Catch: From 2 feet, punch to ~6 feet (within ceiling margin), cut throttle, catch before dropping below 3 feet. Mastery: consistent catch within 1 foot of target altitude with no oscillation on recovery. This drill is the foundation of power loops, stalls, and matty flips—all require the punch → cut → catch sequence.

Ceiling Scrape: Maintain a controlled hover less than 6 inches from the ceiling for 10+ seconds. This tests fine throttle control and inverted ground effect management. Whoops require high throttle (60-80%) to hover at this height, and the Bernoulli suction effect actively fights your control authority. Mastery: hold position for 10 seconds without touching the ceiling. This directly builds the throttle precision needed for power loop apexes and matty flip stall points.

Inverted Hang Practice: Center of room, flip inverted at 5-6 feet, hold with reduced throttle. Progress from 2 seconds to 5 to 10. Mastery: 10-second inverted hover with less than 1 foot drift in any direction. Builds toward split-S, matty flip, and inverted yaw spin.

Doorway Gap Threading: Your doorways are natural training gates. Practice entering and exiting at different angles and speeds, progressing to knife-edge passes. Mastery: 20 consecutive passes without touching the frame. Outdoor equivalent: trees, poles, and natural gaps with progressive speed.

Wall Proximity Flying: Fly along the 20-foot wall at 3 feet height, starting at 3-foot distance. Decrease to 2 feet, 1 foot, 6 inches. Both directions along all four walls. **Be aware of the Bernoulli wall-suction effect—the same physics that pulls you into the ceiling also pulls you toward nearby walls.** If the drone gets sucked to a wall, disarm immediately rather than trying to throttle out. Builds toward wall taps, wall rides, and proximity freestyle.

Practice session tracking and review system

Your analytical mindset is a genuine advantage here. The system below has three layers: a per-session log you fill out during/immediately after flying, a post-session review protocol, and a weekly progress review.

Per-session log template

Copy this template for each session. Fill in during breaks between packs and immediately after the session while your memory is fresh.

```
=== SESSION LOG ===
Date:           ____-__-__
Time:           __:__ to __:__
Location:       [home-room-A | home-room-B | library | outdoor-field | outdoor-pa
Platform:       [Air65 | Mobula6 | Meteor75 | Rekon3 | 5-inch | sim-whoop | sim-5
Weather:        [indoor | calm | 5-8mph | 8-12mph | 12-15mph | 15+mph]
Session type:   [blocked-drill | interleaved | free-flow | DVR-review | sim]

--- PACKS ---
Pack 1: Vstart __.__V  Vend __.__V  Focus: _____________  Crashes: __  Notes: ____
Pack 2: Vstart __.__V  Vend __.__V  Focus: _____________  Crashes: __  Notes: ____
Pack 3: Vstart __.__V  Vend __.__V  Focus: _____________  Crashes: __  Notes: ____
Pack 4: Vstart __.__V  Vend __.__V  Focus: _____________  Crashes: __  Notes: ____
(add more as needed)

--- TRICK SCORECARD ---
Trick               Attempts  Landed  Rate   Notes
_________________     ____      ____    ___%   ____________________
_________________     ____      ____    ___%   ____________________
_________________     ____      ____    ___%   ____________________
_________________     ____      ____    ___%   ____________________

--- CRASH LOG ---
Pack#  Trick          Failure type              Root cause        Action item
____   _____________   [orient|throttle|timing    [pilot|tune|      _______________
                        |spatial|propwash|muscle   mech|signal|
                        |signal|environ]           environ]

--- EQUIPMENT ---
Props replaced?  [y/n]  Damage noted: _______________
Frame condition: [good | cracked | replaced]
Motors:          [good | hot-after-flight | bearing-noise]
```

```
--- DVR ---
Notable timestamps: _____________________
Blackbox recorded?  [y/n]
```

Post-session review (fill out before walking away)

This takes 2-3 minutes and is the single highest-leverage habit you can build. Do it every time.

```
=== POST-SESSION REVIEW ===
3 things I did well:
1. ____________________________________________________
2. ____________________________________________________
3. ____________________________________________________

3 things to improve:
1. ____________________________________________________
2. ____________________________________________________
3. ____________________________________________________

Fatigue level by end:       [fresh | good | tired | sloppy]
Frustration level:          [none | mild | moderate | high]
Did I stop before encoding bad habits?  [y/n]

Tomorrow's focus drill:     ____________________________________________________
Sim drill for tonight:      ____________________________________________________
```

Weekly progress review (Sunday evening, 10 minutes)

Review the week's session logs and update your trick mastery tracker.

```
=== WEEKLY REVIEW — Week __ of 20 ===
Date range: ____-__-__ to ____-__-__
Phase: [1-indoor | 2-outdoor | 3-flow | 4-denver]

Sessions this week:  __ real  __ sim  __ DVR review
Total packs flown:   __
Total sim minutes:   __

--- TRICK MASTERY TRACKER ---
Trick              Last week %   This week %   Trend    Status
Clean roll L         ___%          ___%         [↑↓→]   [learning|reliable|maste
Clean roll R         ___%          ___%         [↑↓→]   [learning|reliable|maste
Clean flip fwd       ___%          ___%         [↑↓→]   [learning|reliable|maste
Clean flip back      ___%          ___%         [↑↓→]   [learning|reliable|maste
```

```
Inverted hang (sec)   __s          __s          [↑↓→]   [learning|reliable|maste
Split-S               ___%         ___%         [↑↓→]   [learning|reliable|maste
Power loop            ___%         ___%         [↑↓→]   [learning|reliable|maste
Matty flip            ___%         ___%         [↑↓→]   [learning|reliable|maste
Yaw spin              ___%         ___%         [↑↓→]   [learning|reliable|maste
Orbit (clean laps)    __/5         __/5         [↑↓→]   [learning|reliable|maste
Figure-8 variance     __s          __s          [↑↓→]   [target: <2s]
(add tricks as you progress)

--- GO/NO-GO CHECK ---
Current phase gate items:          Met?
_____________________________      [y/n]
_____________________________      [y/n]
_____________________________      [y/n]
_____________________________      [y/n]
_____________________________      [y/n]

Ready to advance to next phase?    [y/n]
If no, what's the blocker?         _____________________________

--- EQUIPMENT STATUS ---
Frames in stock:    __
Props in stock:     __
Batteries healthy:  __/__
Any pending repairs: _____________________________

--- NOTES ---
Biggest insight this week: _____________________________
Pattern I noticed:         _____________________________
Next week's priority:      _____________________________
```

Mastery thresholds

Track success rate per trick across sessions (not just within one session—one good session doesn't mean mastery).

Status	Success rate	What it means
Learning	<50%	Still building the motor pattern. Blocked practice only.
Reliable	70-89%	Can execute on demand most of the time. Start interleaving with other tricks.
Mastered	90%+	Consistent across locations and conditions. Ready to use in flow lines.

The definitive mastery test: performing the trick on demand at an unfamiliar location, not just once in ideal conditions at your home spot. The competition standard (Pro Whooper IGOW) requires tricks performed in unedited single-take clips.

Failure taxonomy for categorizing crashes

Use these codes in your crash log for consistent categorization: **orient** (orientation loss—didn't know which way the quad was facing), **throttle** (too much or too little at the critical moment), **timing** (started the trick too early or late relative to the object), **spatial** (misjudged distance to obstacle), **propwash** (aerodynamic instability on recovery—this is a tuning issue, not a skill issue), **muscle** (wrong stick input under pressure), **signal** (VTX freeze, failsafe, desync), **environ** (wind gust, sun blinding camera).

When you see the same failure type appearing 3+ times across sessions, that's a systematic problem worth dedicated drill time—not just "I need more practice" but "I need to specifically isolate and fix this input pattern."

DVR review protocol

After every session, watch your footage at reduced speed. Oscar Liang has published a tutorial on overlaying Betaflight Blackbox stick position data onto FPV footage—this lets you see exactly what your thumbs did during every moment of flight. Use Blackbox Explorer (web-based, free) for quick log viewing and PIDtoolbox (free, requires MATLAB Runtime) for deep analysis including spectral noise analysis and step response evaluation. In VelociDrone, enable "Display Control Sticks" for real-time stick overlay during sim practice.

Step response analysis for the engineering-minded: The Blackbox step response is the PID equivalent of a unit test. Perform a "snap roll" (0 to full stick deflection instantly) and analyze the Blackbox log. You're looking at the Gyro trace (what actually happened) overlaying the Setpoint trace (what you commanded). **Rise time** measures how fast the gyro catches the setpoint (controlled by P-gain and FeedForward). **Overshoot** is whether the gyro crosses the setpoint (P too high or D too low). **Settling time** is how long until the trace becomes flat (overall system efficiency). This gives you objective data on whether your tune is actually the problem or whether you're chasing phantom issues with PID changes.

Hardware triage: when it's you versus the tune

Before blaming yourself or your PIDs, run through this diagnostic ladder. **The single most important principle:** PID oscillations happen regardless of pilot input—they persist even

hands-off. Pilot-induced oscillations (PIO) only happen during active control input and grow worse as you fight them. If you let go of the sticks and the quad stabilizes, the problem is you. If oscillation persists hands-off, it's hardware or tune.

Mechanical issues that masquerade as skill problems (check these first): Bent props are the #1 cause of vibration and erratic flight—replace after any hard crash. Bad motor bearings cause noise on one axis; spin each motor individually in Betaflight's Motors tab (props off!) and watch gyro traces. A loose FC causes noisy gyro data that no PID tuning will fix. Worn motor bearings create a degradation cycle: more vibration → hotter motors → further degradation → "I'm getting worse" feeling that's actually hardware failure.

Specific diagnostic scenarios

Scenario: "Bounce-back" after a snap roll. You snap the stick to stop a roll and the drone stops, then "bounces" back slightly in the opposite direction before stabilizing. This has three possible causes and a clean test protocol. Hypothesis 1 (pilot): you released the stick too quickly, allowing gimbal spring tension to oscillate the stick (and thus the command) around center. Hypothesis 2 (tune): D-gain is too low, meaning the PID loop sees the P-term error reduce to zero but lacks the braking force to stop the drone's mass instantly. Hypothesis 3 (tune): P-gain is too high, causing the drone to overshoot the setpoint. **Test:** Increase D-gain by 5 points. If the bounce reduces, it was a tuning issue. If motors become hot (check temperature after a 30-second hover), return to previous D-gain and practice "soft stops" with stick fingers instead.

Scenario: Mid-throttle vibration ("jello" in the FPV feed). The video feed oscillates during steady forward flight. Hypothesis 1 (mechanical): a bent propeller, loose arm screw, or damaged motor bearing is creating high-frequency vibration. Hypothesis 2 (firmware): excessive filtering (lowpass filters set too low) is causing phase delay, where the flight controller's reaction lags behind the actual event, creating a feedback loop. **Test: mechanical first.** Change all props. Tighten all frame screws. If the issue persists, switch to the "Limp Mode" PID profile (see below). If the drone flies smoothly in Limp Mode, the issue is confirmed as mechanical noise that the standard tune cannot filter out.

Scenario: Throttle-correlated issues. If the problem only appears at specific throttle ranges, the cause narrows significantly. Low throttle (descent): propwash—increase D-term or fly forward through descents rather than dropping straight down through your own wash. Mid throttle: mechanical resonance—adjust gyro filters or soft-mount the FC. High throttle: TPA (Throttle PID Attenuation)—increase the TPA breakpoint to maintain more PID authority at high throttle.

The "Limp Mode" PID profile

Software engineers build "Safe Mode" into operating systems; FPV pilots need an

equivalent. Create a dedicated Betaflight Profile 3 called Limp Mode with D-gains set near zero (prevents D-term from amplifying noise), P-gains reduced by 30% (softens the control loop), and filtering maxed out (set Gyro Lowpass 1 and 2 to static low frequencies around 90Hz). The drone will feel mushy and sluggish but will fly safely. **Primary use case:** if a prop tip breaks mid-flight, the resulting vibration will cause the D-term to overheat the motors within seconds. Switching to Limp Mode via the OSD allows you to fly home safely with a mushy but cool drone. **Secondary use case:** the Limp Mode test—if a drone that flies badly on your normal tune flies smoothly on Limp Mode, you've confirmed the issue is mechanical noise, not PID tuning.

General PID diagnostics

High-frequency buzzing/vibration = P-gain too high. Slow wobble = could be PIO (you overcorrecting) or I-gain too high. Bounceback after flips = D-gain too low or I-term windup. Propwash oscillation on descents = D and I need tuning, but fly forward through descents rather than dropping through your own wash. Mushy/sluggish feel = D too high or excessive filtering.

Whoop-specific tune recommendations: Whoops have poor yaw authority due to ducts—set Yaw P and I to 100. For Bluejay ESC firmware, use 48kHz PWM for acro/freestyle (balances responsiveness and efficiency). Enable Anti-Gravity boost to prevent nose dips during rapid throttle changes. Consider bi-blade props (Gemfan 1210-2 or HQ 31mm 2-blade) for better off-throttle momentum enabling power loops and stalls.

Your DJI O4 narrow FOV problem on the Meteor75 Pro: The O4 Lite camera has only ~117° diagonal FOV versus ~~155° for analog or HDZero cameras. The **Flywoo O4 Wide Camera lens upgrade** ~~($40-60) increases FOV to approximately 155°, nearly matching the O4 Pro. It adds 5-7.5g and may show slight lens edge visibility in 4:3 Wide mode. The alternative workarounds: set aspect ratio to 16:9 for maximum horizontal FOV, fly lower camera angles indoors, learn to use peripheral motor sound cues for spatial awareness, and develop a "scanning" habit of yawing to look into turns rather than relying on peripheral vision. In VelociDrone, set your FOV to 115° on your whoop sim profile to match the hardware so muscle memory transfers accurately.

Durability strategy for maximum training uptime

The most common indoor whoop breakage points in order: frame duct/arm cracking (especially HappyModel frames), canopy breaking, motor wire solder joint failure, camera dislodgment, and prop damage. Keep these spares in stock: 4-8 frames, 2-4 canopies, 20+ props (mixed 2 and 3-blade), 2 spare motors, motor screws (PEEK for weight savings), silicone dampers, BT2.0 pigtails, 6-10 batteries (1S 300mAh LiHV BT2.0), and a spare

camera. Apply CA glue to motor solder joints as strain relief, Loctite on motor mounting screws, and hot glue to secure the camera in the canopy. Pre-solder motor leads with extra length for quick re-soldering after breaks.

Three preventive mods that dramatically reduce downtime deserve special attention. First, **USB port strain relief**: on AIO flight controllers, the USB-C port is held by surface-mount solder alone and is the most common single point of catastrophic failure—one crash shears it off and the FC becomes unconfigurable. Apply a small bead of E6000 adhesive or UV-cure resin around the base of the USB port (avoiding the internal pins) to mechanically bond it to the PCB, converting shear force into tensile force distributed across the board. Second, **connector maintenance cycles**: BT2.0 and PH2.0 connectors degrade through mechanical wear and electrical arcing. If flight time drops by more than 30 seconds or the quad sags on punch-outs, check the connector temperature immediately after flight—warmth indicates high resistance. Replace the pigtail connector on the drone every 100-150 flights or upon detecting resistance heat. Third, **camera angle locking**: whoop camera mounts rely on friction and shift during crashes. A shifting camera angle silently destroys your muscle memory because your brain calibrates throttle-to-pitch relationships against a consistent visual perspective. Once you've set your angle (15-20° for indoor acro, 25-30° for freestyle), lock it with a dab of E6000 or hot glue.

The mental game: managing frustration and building public confidence

Plateaus are neurologically normal. The emotional cycle of skill progression—excitement → rapid improvement → plateau → frustration → breakthrough—repeats at every skill level. Your current wall with power loops is textbook Phase 3 (plateau) approaching Phase 4 (frustration). Knowing this cycle exists is genuinely protective: **frustration means breakthrough is close, not that you've hit your ceiling.**

Practical strategies from sports psychology applied to FPV: Set **process goals** ("I will practice 4 packs today") not outcome goals ("I will land this power loop"). Track three things you did well and three things to improve after every session—this shifts the mental frame from defeat to development. If you're failing the same trick for 10+ consecutive minutes, you're encoding failure. Stop, sleep on it, try tomorrow. The research is emphatic: **the skill will be better after sleep even without additional practice.**

Visualization is not woo—mental imagery activates the same motor pathways as physical practice. Before each flight, mentally fly your intended line. Before attempting a new trick, visualize the full rotation including what you'll see at the apex. Watch pro pilot DVR at reduced speed and mentally replicate their inputs.

Managing "the shakes": FPV induces a significant adrenal response, and shaking hands are a physiological reality for new pilots, particularly when flying expensive 5-inch rigs or in front of spectators. The most effective countermeasure is exposure therapy (flying frequently in progressively higher-stakes contexts) combined with **box breathing** before arming: inhale 4 seconds, hold 4 seconds, exhale 4 seconds, hold 4 seconds, repeat 3-4 times. The adrenaline response diminishes with familiarity, which is why the Phase 4 pressure drills (IGOW lines with restart penalties) exist—they create controlled stress exposure before the real thing.

The Goldilocks Zone for motivation: If a trick is too hard, anxiety spikes and you stop enjoying the process. If too easy, boredom sets in. The training program's level system is designed to keep you in this zone—each level should feel challenging but not impossible. If you find yourself dreading a drill, it's either too hard (drop back one level) or you've been doing it too long without variety (switch to a different drill at the same difficulty).

For public flying confidence: your analytical nature is an asset. Pre-plan your routine of 2-3 reliable combos. Warm up with 1-2 private packs. Accept that you'll fly at 70% of your capability under social pressure—this is normal across all performance domains. The "fear of crashing expensive equipment" resolves by factoring repair costs into the hobby budget and by building your own quads (understanding the build reduces anxiety because you know you can fix anything).

Essential resources and where to learn each skill

For trick tutorials with stick overlays (your highest-priority resource): Headmazta on YouTube produces "No Talking Trick Tutorials" (NTTT) covering basic through advanced tricks with clear stick input visualization. The IntoFPV community universally recommends this channel for learning specific tricks. Headmazta also offers 1-on-1 monthly coaching sessions via Patreon using Liftoff sim. **Infinity Loops on YouTube** produces "Whooptorial Wednesday" covering trippy spins, juicy flicks, split-S, inverted yaw spins, power loops, and wall taps using VelociDrone with stick overlays.

For whoop-specific freestyle progression: Pro Whooper (prowhooper.com) by Tyrantt is the definitive resource. The site hosts a 90+ trick tricktionary with animated GIFs and difficulty classifications, a 10-week Freestyle Boot Camp structured course, and the IGOW (International Game of Whoop) competitive framework that drives structured progression. This is your single most valuable resource for the indoor-to-freestyle pipeline.

For freestyle philosophy and theory: Mr. Steele for consistency philosophy and proximity flying principles. Skitzo for understanding flow at the highest level. GAPiT FPV for dramatic pauses and backtracking technique. Le Drib / Alex Vanover for creative freestyle and

competition-style flow. The FPVFrenzy article “Lessons in Flow” is a must-read single resource on flow theory.

For technical education: Joshua Bardwell for Betaflight configuration, build tutorials, troubleshooting, and rate tuning. Oscar Liang (oscarliang.com) for the most comprehensive written reference on PID tuning, Blackbox analysis, stick overlay tutorials, and whoop-specific settings. Chris Rosser for deep PID and filter analysis.

For structured learning: FPV Mastery (fpvmastery.com) by Lexie offers 10+ hours of step-by-step video from basics to advanced with a “mindful training” approach and live coaching calls. FPV Unlocked (fpvunlocked.com) offers a 30-day structured curriculum. GetFPV Learn provides excellent free articles covering the full progression.

Communities for ongoing support: IntoFPV Forum (intofpv.com) for active trick discussions and DVR review threads. Reddit’s r/fpv and r/TinyWhoop for community feedback. MultiGP for finding local racing/freestyle groups and events near Denver. VelociDrone community Discord for sim practice partners and events. FlowState sim Discord for another active community.

Conclusion: the path from here to Denver

Your skill wall is real and it’s a technique gap—which is good news, because technique gaps close with deliberate practice. The indoor phase is about cracking the specific timing and stick coordination for power loops and split-S in compressed vertical space, while simultaneously building the inversion comfort and throttle precision that make every outdoor trick possible.

The evidence-based practice structure—**20-minute evening sessions, 5-6 days per week, blocked practice on new skills transitioning to interleaved practice for retention**—will compound dramatically over 6 months. At 3 packs per day plus 20 minutes of sim, you’ll accumulate roughly 100-150 hours of total stick time by July. Community consensus places “confident freestyle with varied trick repertoire” at 100-200 hours for pilots who practice with deliberate intent.

Three things that will matter most: First, **your Air65 with proper Betaflight settings is your primary training platform through March**—get the FC replaced and optimize it immediately. Second, **Pro Whooper’s Freestyle Boot Camp and Headmazta’s stick overlay tutorials are your curriculum**—don’t scatter attention across dozens of YouTube channels. Third, **scout Denver flying locations before you travel**—the park prohibition is a hard constraint, and Chatfield State Park’s model airfield or private property with permission are your best options. You have the analytical mindset, the equipment, and now the

structured path. The only variable is consistent reps.