Phase 1 – Part 2: Emotion Factors & Streaks

Extends the Phase 1 normalized-quality model with realistic *reductions* and *streak sensitivity* so that Satisfaction (S) and Frustration (F) reflect a player's *current mood*, not just cumulative history.

Recap of Phase 1 Baseline (Foundation):

We compute a per-pull **normalized quality** in [0,1]:

$$quality01 = \frac{rawScore - minScore(pack)}{maxScore(pack) - minScore(pack)}$$

Then we calculate emotion deltas:

$$Satisfaction = quality01 \times S\_max$$

$$Frustration = (1 - quality01) \times F\_max$$

> This additional factor keeps the above as the *input* and layers dynamics that can both **increase** and **decrease** emotions to feel more lifelike over continuous pulls.

Why Add Reductions & Streaks

Problem: The baseline always *adds* to S/F. Over many pulls, values drift upward and stop representing how the player feels *now*.

Goals:

- Emotions should **feel realistic**: rise on spikes, fall on calm or counter-events.
- Recent experience (last 5–10 pulls) should noticeably sway the mood.
- Numbers should remain stable under continuous testing (no unbounded drift).

Factors:

1. **Oppositional Dampening** – a strong rise in one emotion trims the other.
2. **Quality-Driven Reduction** – great pulls actively cool frustration; bad pulls cool satisfaction.
3. **Neutral-Band Recovery** – mid pulls reduce both emotions slightly (calming effect).
4. **Rolling Streak Window** – last N qualities tilt deltas up/down (temporal memory).

Update Order (Per Pull)

At pull *t*, compute in this order:

1. **Base deltas** from Phase 1 part 1.
2. **Quality-driven reduction** (dynamic reset).
3. **Neutral-band recovery** (if quality in middle band).
4. **Oppositional dampening** (cross-trim).
5. **Streak multiplier** (using rolling average of last N).
6. **Apply to state** and **Clamp** to ranges.

Calculations

1. Emotion Deltas (unchanged from the part 1)

   Quality Normalization: $quality01 = \frac{rawScore - minScore(pack)}{maxScore(pack) - minScore(pack)}$

   Then calculating emotions

   $Satisfaction = quality01 \times S\_max$

   $Frustration = (1 - quality01) \times F\_max$

   Let it be S_base and F_base

2. Immediately cool the *opposite* emotion based on how good/bad the pull was:

Intuition:

- High quality → subtracts more from F (feels like relief).
- Low quality → subtracts more from S (feels like disappointment).

New Tunable parameters:

1. Satisfaction reduction constant - R_S (e.g., 2.0–3.0)
2. Frustration reduction constant - R_F (e.g., 2.0–3.0)

FORMULA

- If `quality01 > good_threshold`: reduce frustration proportionally to the quality
  - $F\_red = quality01 \times R\_F$

    $F = F\_base - F\_red$
- If `quality01 < bad_threshold`: reduce satisfaction proportionally to the badness
  - $S\_red = (1 - quality01) \times R\_S$

    $S = S\_base - S\_red$
- Otherwise leave deltas unchanged for this step:
  - $S = S\_base$
  - $F = F\_base$

Running Example (Step 1)

Pack: Silver (min=6, max=12)
Pulled: Uncommon(2) + Rare(3) + Epic(4) → `raw = 9`
Normalize: `quality01 = (9 - 6)/(12 - 6) = 0.50`
Base:

`S_base = 0.50 × 3 = 1.50`

`F_base = (1 − 0.50) × 3 = 1.50`
Thresholds: 0.50 is between 0.40 and 0.60 → **no dynamic reset**
After Step 1: `S = 1.50, F = 1.50`

(Branch example: if `quality01=0.85`*, then*
`F_red = 0.85 × 2 = 1.70`*;*
`F = (0.15 × 3) − 1.70 = 0.45 − 1.70 = −1.25` → *an immediate* ***cool-down*** *of frustration.)*

3. Neutral-Band Recovery (Both Emotions Ease on Average Pulls)

Intuition: Average pulls calm both emotions a bit rather than nudging emotions upward forever.

New Tunable parameters:

1. Band around the midpoint
   a. $neutral_{min} = 0.45$
   b. $neutral_{max} = 0.55$
2. Recovery amount applied to both emotions when in the *neutral band* - N_R (e.g., 0.8)

RULE:
If `neutral_min ≤ quality01 ≤ neutral_max`,
skip adding the base gains and instead **reduce both**:

- $S = -N\_R$
- $F = -N\_R$

(this overwrites Step 1's result for this case).

Running Example (Step 2 on same pull)

`quality01 = 0.50` is inside `[0.45,0.55]` → **neutral recovery applies**.
So we **replace** emotion deltas: `S = −0.8, F = −0.8.`

(Branch example: if `quality01 = 0.85`*, neutral band does not apply; keep Step-1 result.)*

4. Oppositional Dampening (Emotions Push Against Each Other)

Intuition: A strong rise in one emotion should trim the other automatically - this creates a balanced, realistic system

New Tunable parameters: Cross Reduction factor - k (e.g., 0.25)

FORMULA

- $S\_opp = S - (F \times k)$
- $F\_opp = F - (S \times k)$

Apply this to the current emotion deltas after Step 1/2.

Running Example (Step 3 on same pull)

From Step 2 we had
`S = -0.8, F = -0.8.`
`S_opp = -0.8 - (-0.8 × 0.25) = -0.8 + 0.2 = -0.6`
`F_opp = -0.8 - (-0.8 × 0.25) = -0.6`

After Step 3: `S_opp = -0.6, F_opp = -0.6`

(Branch example: if a different pull gave
`S = +2.4, F = +0.3,` *then*
`S_opp = 2.4 -(0.3 × 0.25) = 2.325,`
`F_opp = 0.3 -(2.4 × 0.25) = -0.3` → *a nice automatic frustration trim.)*

5. Streak Sensitivity via Rolling Window (N=5...10)

Intuition: A strong rise in one emotion should trim the other automatically - this creates a balanced, realistic system

- Good streak (streak > 0) → boosts S changes and *dampens* F changes.
- Bad streak (streak < 0) → boosts F changes and *dampens* S changes.

New Tunable parameters:

1. $streak\_window$ = N (e.g., 5) → number of previous pulls to average
2. α and β - streak multiplier (e.g., 1.0)
3. $streak\_threshold$ - (optional display threshold, e.g., 0.10) for labeling **hot/cold** streak in UI

Definitions:

- Keep a queue of the last **N quality01 values** (not including the current pull yet).
- `quality_avg = mean(last N qualities)`
- `streak = quality_avg - 0.5` (positive → hot; negative → cold)

FORMULA

- $S\_final = S\_opp \times (1 + \alpha \times streak)$
- $F\_final = F\_opp \times (1 - \beta \times streak)$

(Hot streak amplifies satisfaction movement and dampens frustration movement; cold does the opposite.)

Running Example (Step 4 on same pull)

Assume the **previous 5 qualities** were: `[0.20, 0.30, 0.65, 0.70, 0.40]`
`quality_avg = (0.20 + 0.30 + 0.65 + 0.70 + 0.40)/ 5 = 0.45`
`streak = 0.45 - 0.5 = -0.05` (slightly **cold**)

With `α = β = 1.0` **and** `S_opp = -0.6, F_opp = -0.6`:

$$S\_final = -0.6 \times (1 + 1.0 \times -0.05) = -0.6 \times 0.95 = -0.57$$
$$F\_final = -0.6 \times (1 - 1.0 \times -0.05) = -0.6 \times 1.05 = -0.63$$

After Step 4: `S_final=-0.57, F_final=-0.63`

6. State Update & Clamping

Intuition: Keep values stable and meaningful over long sequences of pulls.

New Tunable parameters: S_cap, F_cap = e.g., 20

FORMULA

- $S\_t = clamp(S\_\{t-1\} + S\_final, 0, S\_cap)$
- $F\_t = clamp(F\_\{t-1\} + F\_final, 0, F\_cap)$

Running Example (Step 5 on same pull)

Assume prior state `S_{t-1} = 6.0, F_{t-1} = 7.0`.

$S\_t = clamp(6.0 + (-0.57), 0, 20) = 5.43$

$F\_t = clamp(7.0 + (-0.63), 0, 20) = 6.37$

Result after this pull: both emotions cooled slightly due to a neutral result, with the cold streak keeping frustration a touch higher than satisfaction.

Full Worked Summary (same pull)

1. Normalize → `quality01 = 0.50`
2. Base → `S_base = 1.50, F_base = 1.50`
3. Neutral band overrides → `S = -0.8, F = -0.8`
4. Oppositional dampening → `S_opp=-0.6, F_opp=-0.6`
5. Streak scaling (slightly cold) →

   `S_final = -0.57, F_final = -0.63`

6. Update & clamp from `(6.0, 7.0)` → `(5.43, 6.37)`

Branch Mini-Examples (to check extremes)

A) Strong Good Pull (quality01 = 0.85)

- Base: `S_base = 2.55, F_base = 0.45`
- Dynamic reset on F: `F = 0.45 − (0.85 × 2) = −1.25`
- Oppositional:
  - `S_opp ≈ 2.55 − (−1.25 × 0.25)= 2.86,`
  - `F_opp ≈ −1.25 − (2.55 × 0.25)= −1.89`
- Hot streak (say `streak = +0.20`):
  - `S_final = 2.86 × 1.20 = 3.43,`
  - `F_final = −1.89 × 0.80 = −1.51`

Interpretation: Big satisfaction spike and a drop in frustration - feels like an immediate rebound.

B) Strong Bad Pull (quality01 = 0.20)

- Base: `S_base = 0.60, F_base = 2.40`
- Dynamic reset on S: `S = 0.60 − (0.80 × 2) = −1.0`
- Oppositional:
  - `S_opp = −1.0 − (2.4 × 0.25) = −1.6,`
  - `F_opp = 2.4 − (−1.0 × 0.25) = 2.65`
- Cold streak (say `streak = −0.20`):
  - `S_final = −1.6 × 0.80 = −1.28,`
  - `F_final = 2.65 × 1.20 = 3.18`

Interpretation: Frustration meaningfully rises, satisfaction drops - but not unbounded.