

# Driving Emotionally Expressive NPC Animations and Behaviors with a Designer-friendly Pipeline

Gautier Boeda  
AI Engineer – SQUARE ENIX CO., LTD

# TEAM



Gautier Boeda



Shinpei Sakata



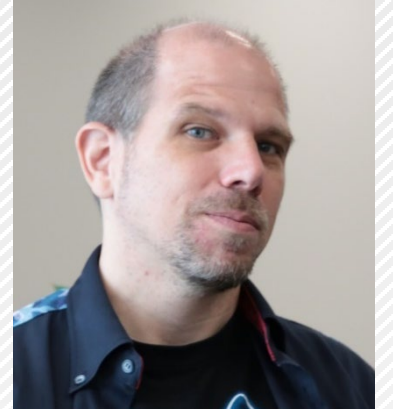
Remi Driancourt



Youichiro Miyake



Gustavo Martins



Juan Vilato



Perry Leijten



Xintong Lyu



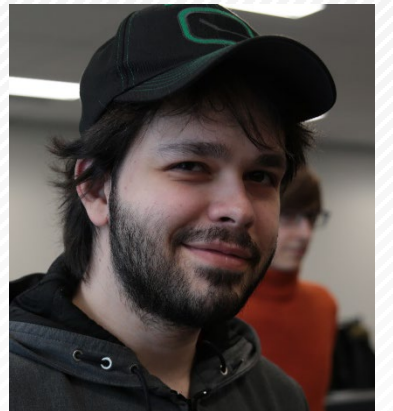
Sietske Wielsma



Justin (Wai Keat)  
Wong



Adelle Bueno



Eduardo Mosena



# HISTORY



<https://www.gdcvault.com/play/1026254/NPCs-Have-Feelings-Too-Verbal>



# HISTORY

**Learning**  
Operant Conditioning

**Pathfinding**  
Navigation Mesh

**Perception**  
Smart Object

**Style Transfer**  
Deep Learning

**Photograph**  
Genetic Algorithm

**Drawing**  
Neural Network

**Memory**  
Associative Tagging

**Personality & Emotion**  
Emotional Component

**Decision Making**  
Utility System

**Problem Resolution**  
GOAP

**Inheritance Action**  
Affordance Comparison

**Animation Blending**  
Finite State Machine

**Buddy Communication**  
Multi Agent Language

**AI Technologies**  
G D C 2 0 2 1

*“Gods do not play dice.”*



# WHAT?

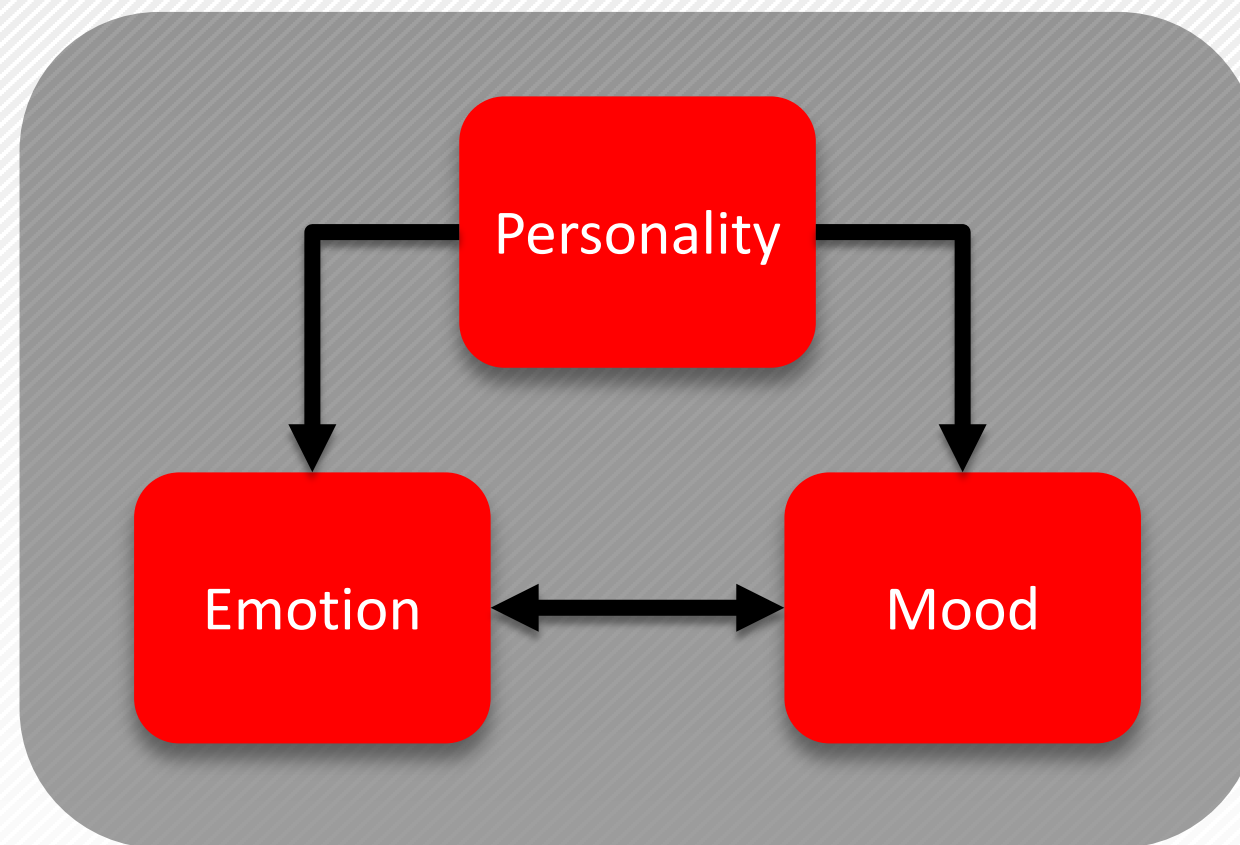
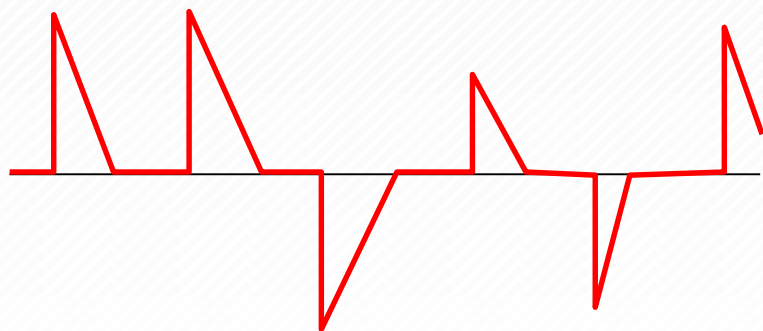
## WHAT ARE EMOTIONS, MOODS, PERSONALITIES?



# EMOTION MOOD PERSONALITY

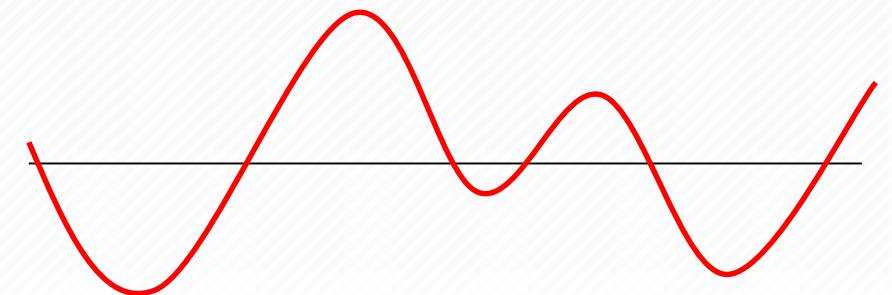
## EXPLANATION

Short term feeling  
Evolve quickly over time  
Joy, Distress, Fear, ...



Defines the agent  
Fixed or evolve very slowly over time  
Curiosity, Shyness, Laziness, ...

Long term feeling  
Evolve slowly over time  
Exuberant, Depressed, Afraid, ...



# WHY?

WHY WOULD YOU WANT THEM IN YOUR GAME? WHAT DO THEY BRING?





# WHY?

WHY WOULD YOU WANT THEM IN YOUR GAME? WHAT DO THEY BRING?

[Watch video \(click\)](#)

[Watch video \(click\)](#)



without Emotional Component



with Emotional Component



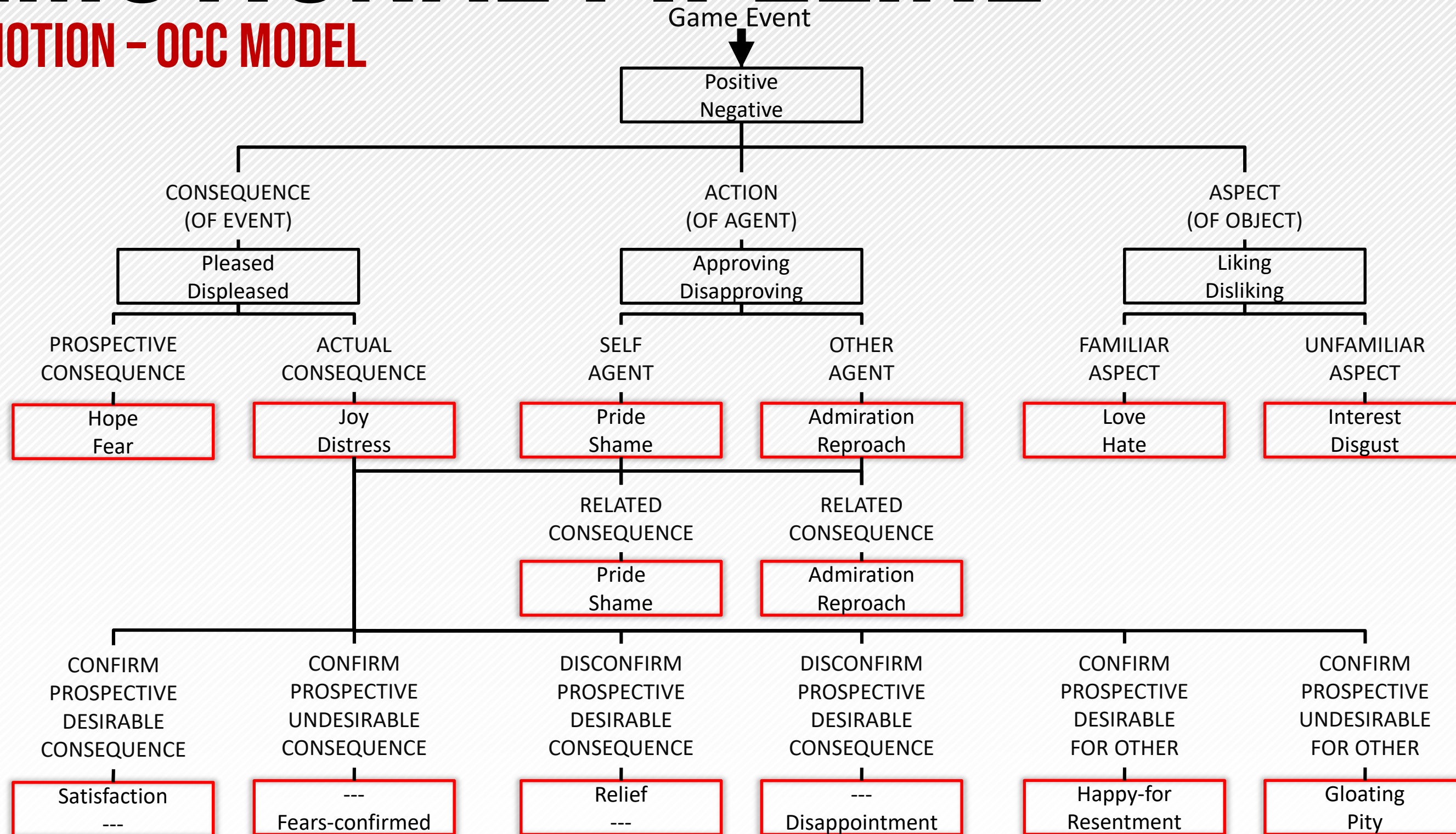
# EMOTIONAL PIPELINE

EMOTION, MOOD, PERSONALITY



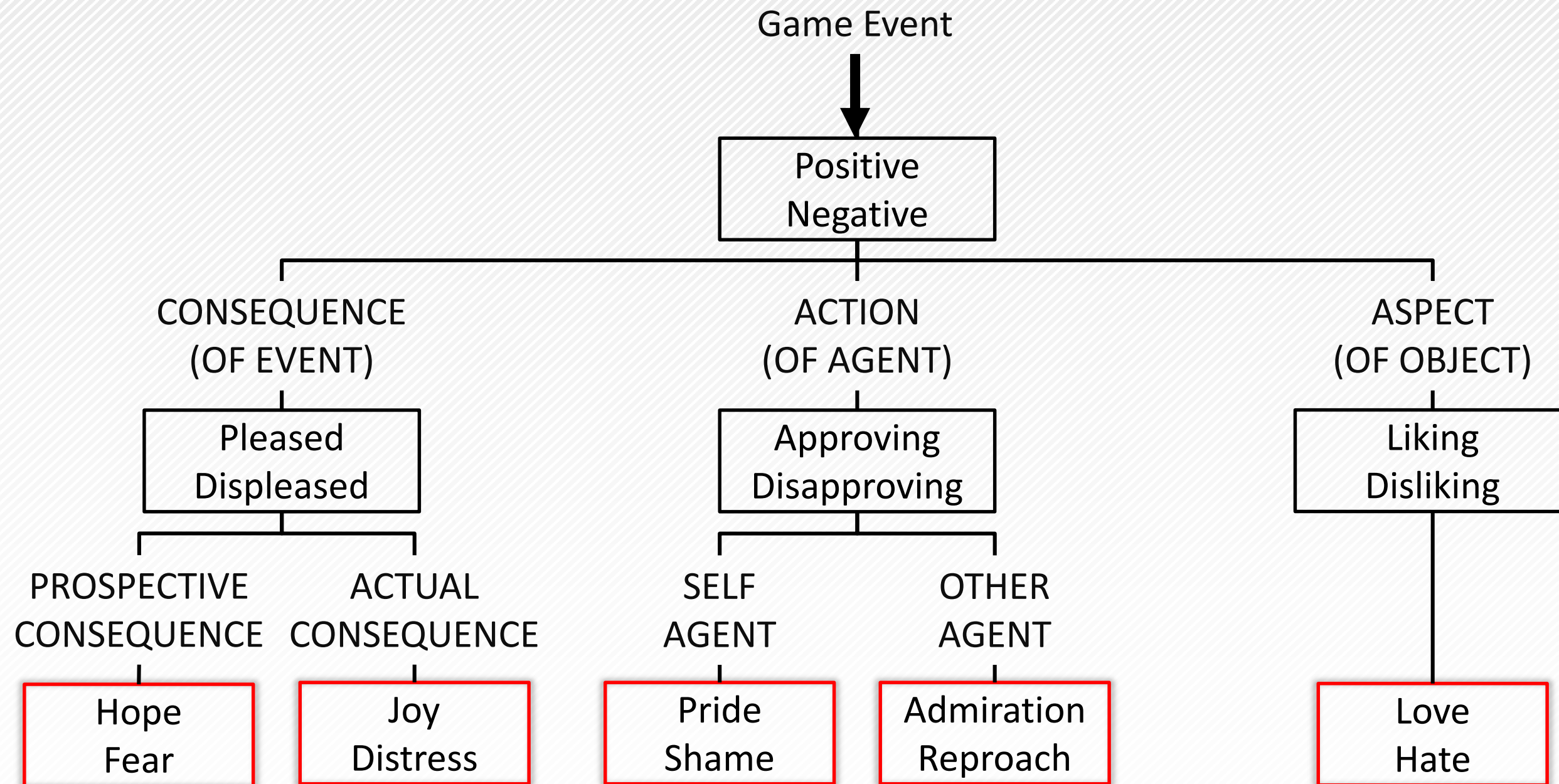
# EMOTIONAL PIPELINE

## EMOTION - OCC MODEL



# EMOTIONAL PIPELINE

## EMOTION - INSPIRED OCC MODEL - WONDER EXAMPLE

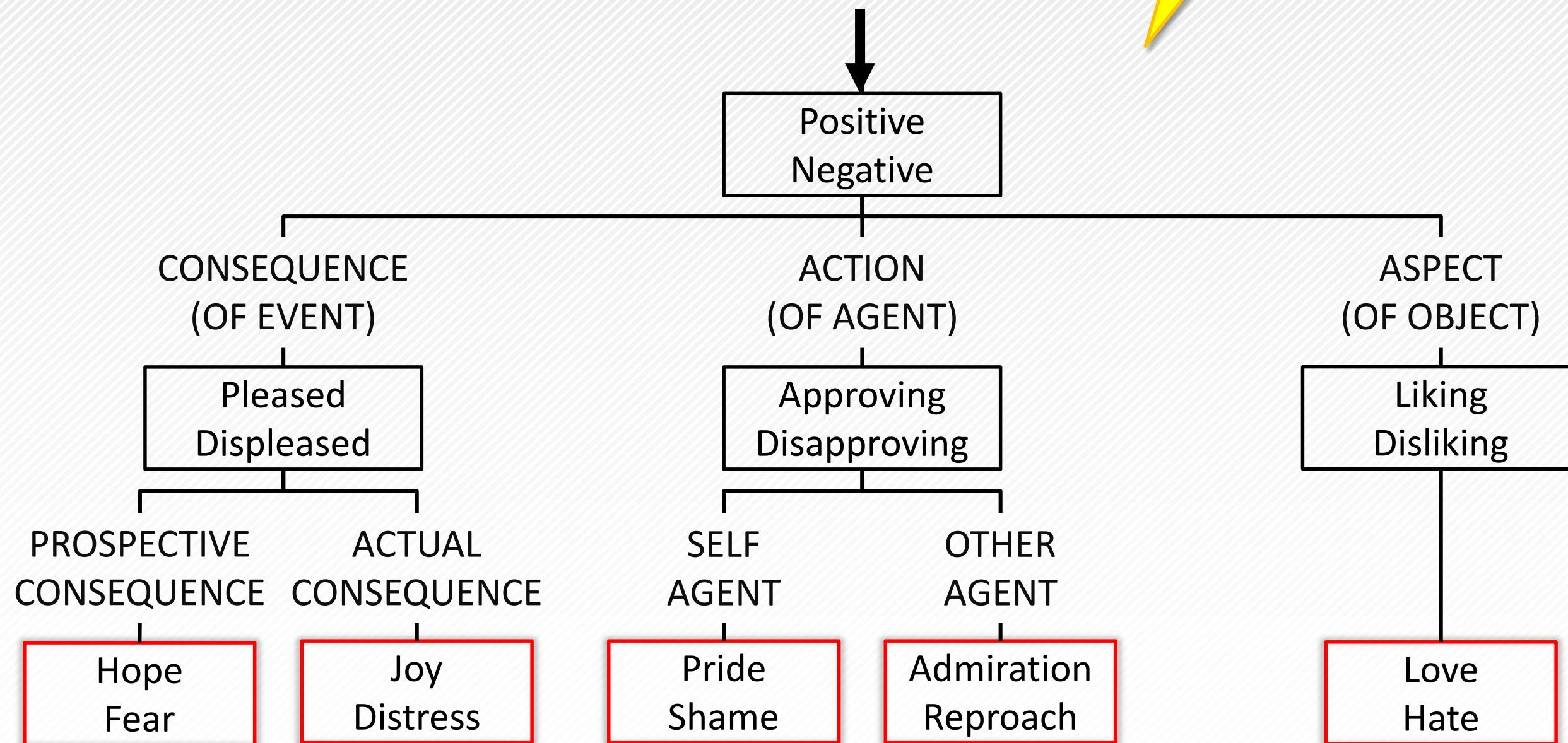




# EMOTIONAL PIPELINE

## EMOTION - INSPIRED OCC MODEL - WONDER EXAMPLE

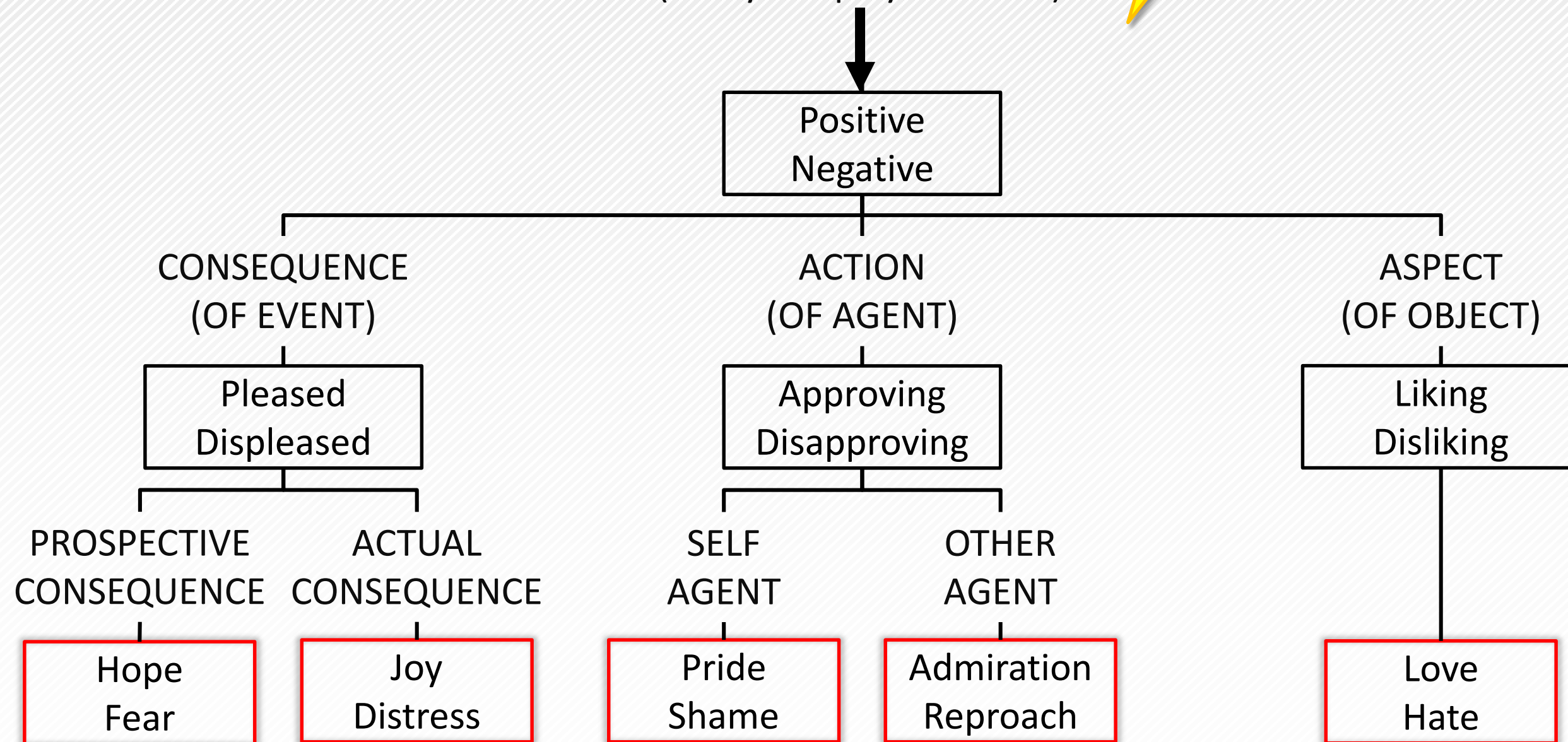
Player hit the ball with the bat



# EMOTIONAL PIPELINE

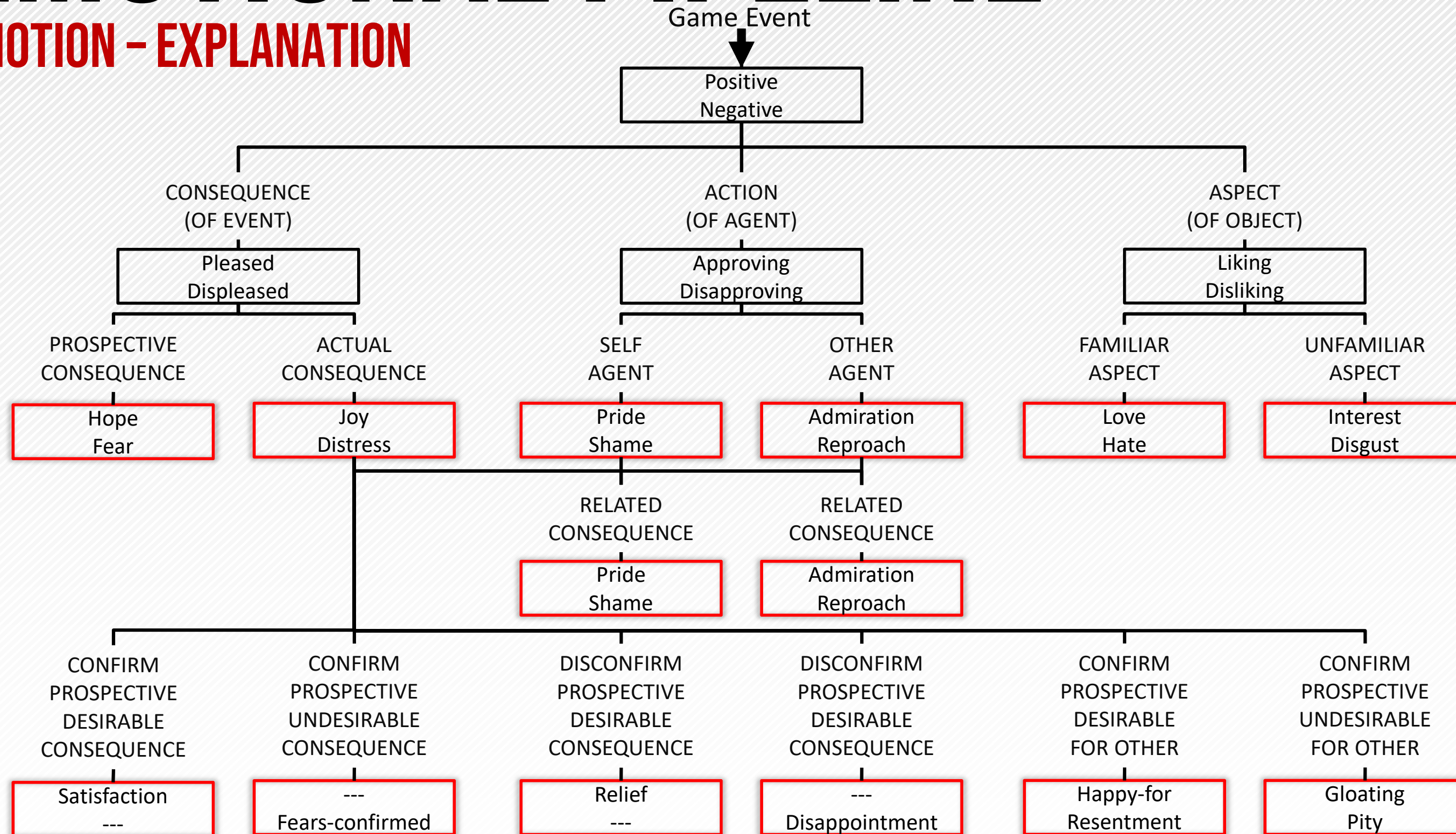
## EMOTION – INSPIRED OCC MODEL – WONDER EXAMPLE

Window broke due to the ball  
(hit by the player earlier)



# EMOTIONAL PIPELINE

## EMOTION - EXPLANATION





# EMOTIONAL PIPELINE

## EMOTIONS EXPRESSION

- Voice sound
- Facial blend
- Special animations
- Specific speech

[Watch video \(click\)](#)

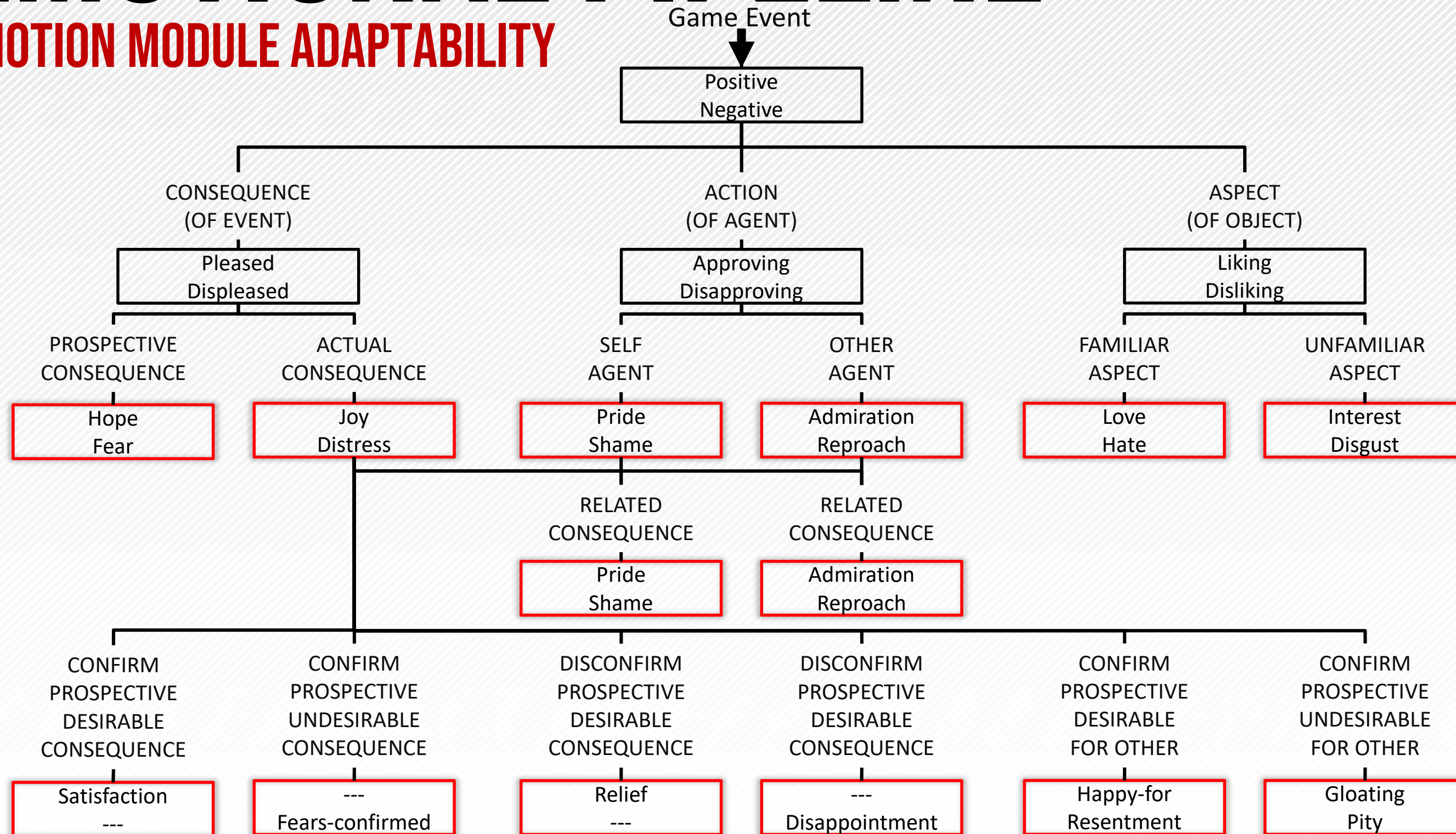
Blended on top of personality  
and mood animations.

Fear	Hope
Distress	Joy
Shame	Pride
Anger	Admiration
Hate	Love
None	



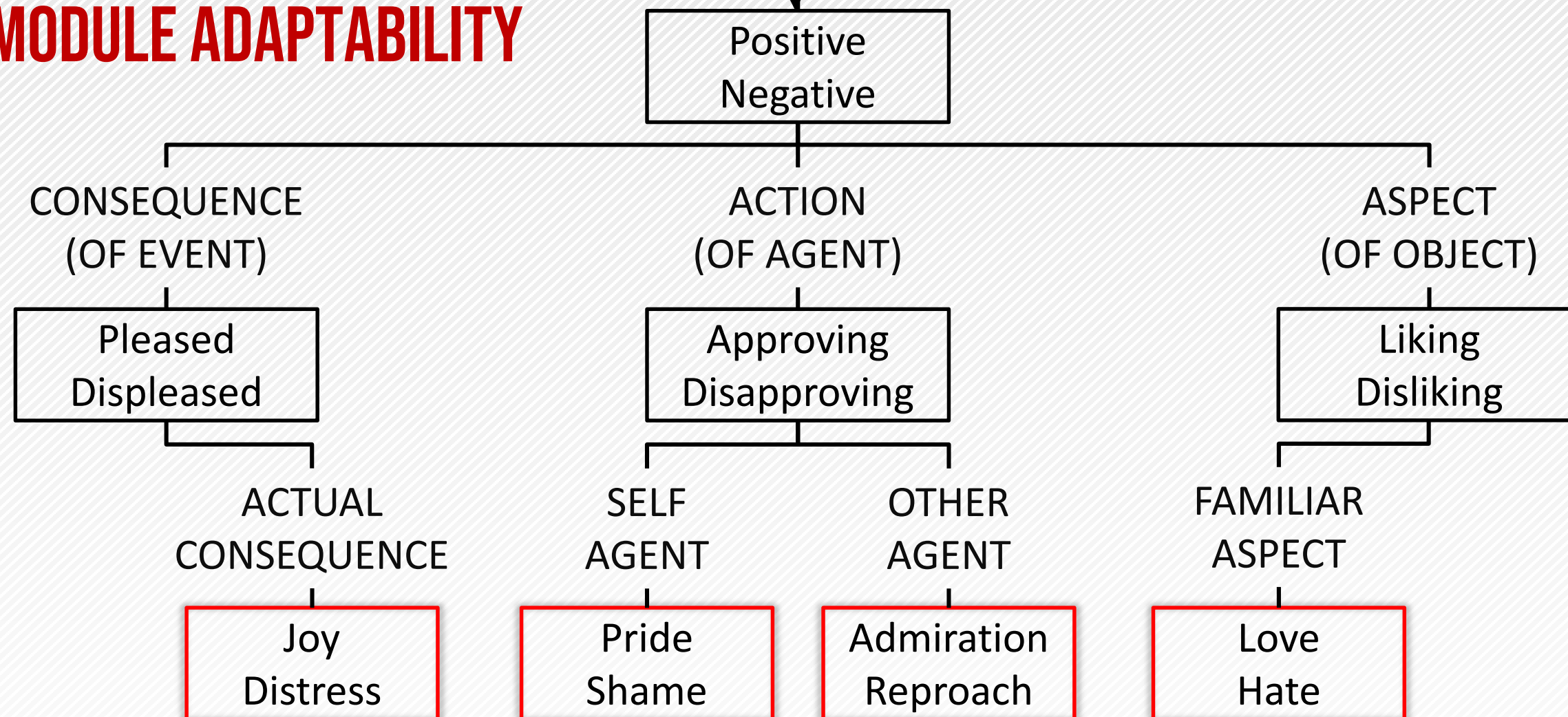
# EMOTIONAL PIPELINE

## EMOTION MODULE ADAPTABILITY



# EMOTIONAL PIPELINE

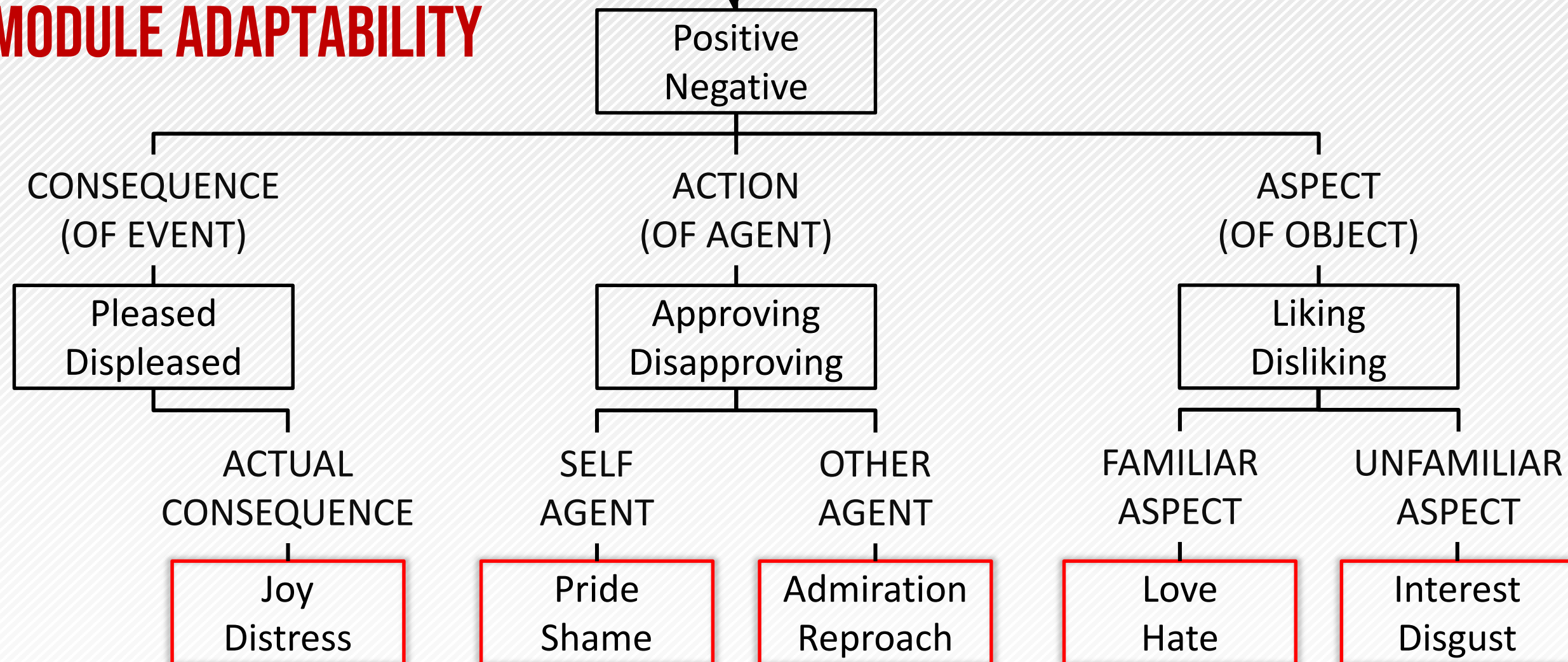
## EMOTION MODULE ADAPTABILITY





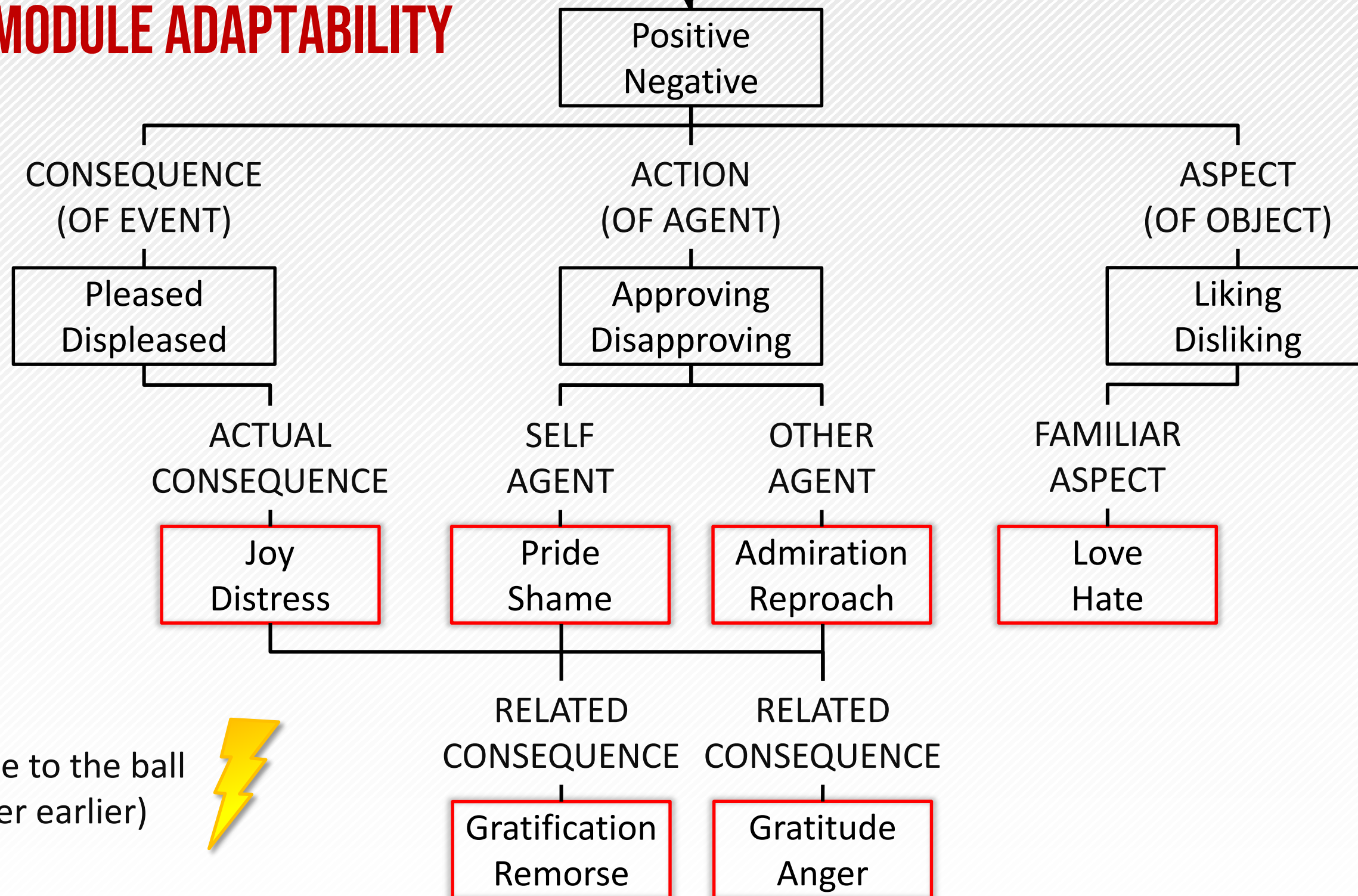
# EMOTIONAL PIPELINE

## EMOTION MODULE ADAPTABILITY



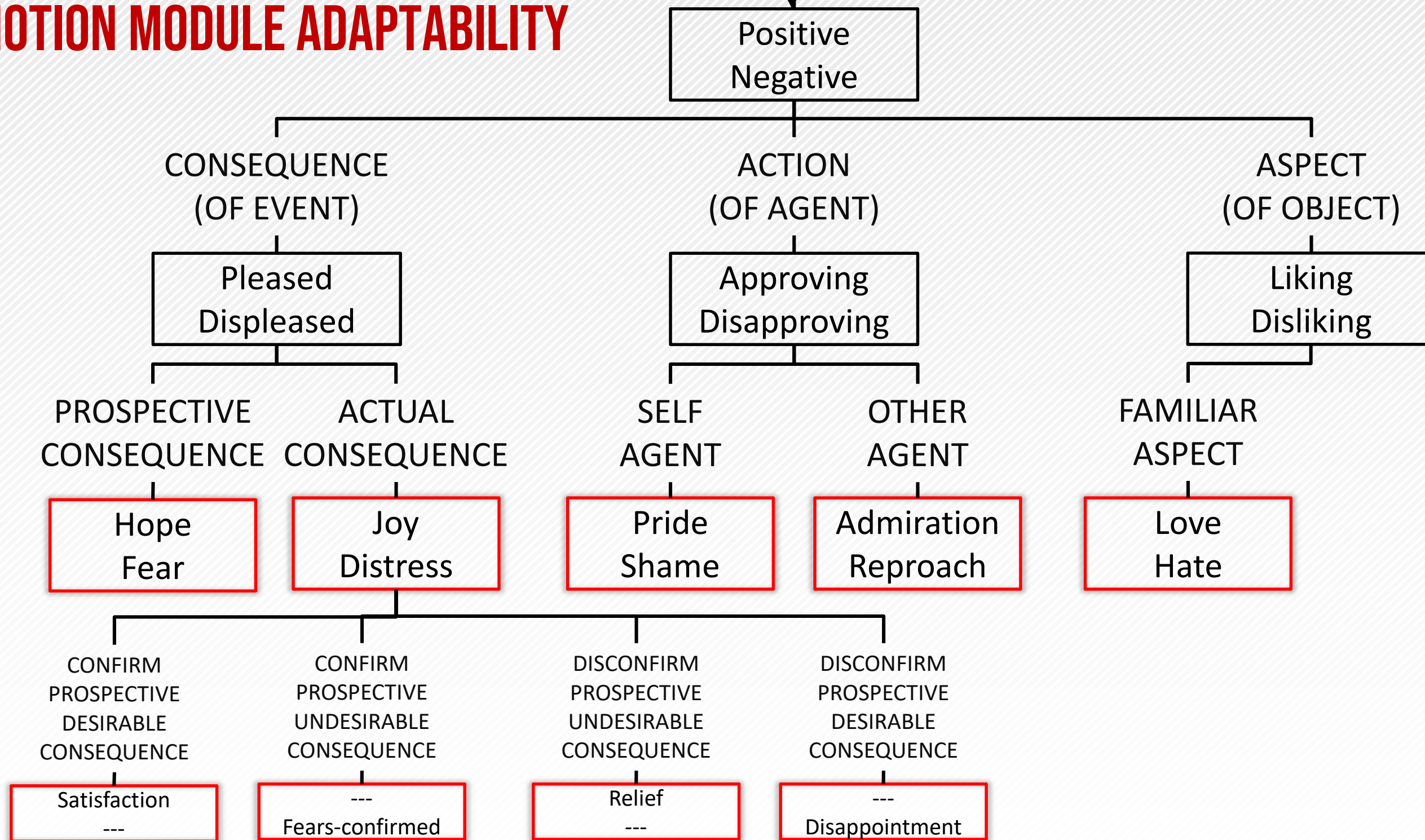
# EMOTIONAL PIPELINE

## EMOTION MODULE ADAPTABILITY



# EMOTIONAL PIPELINE

## EMOTION MODULE ADAPTABILITY





# EMOTIONAL PIPELINE

## EMOTION MODULE ADAPTABILITY

Emotion

- Type
- Duration
- Intensity

Event	Category	Intensity [-1, 1]	MinDuration	MaxDuration	DurationRatio [0, 1]
EAT_FOOD	ACTION_OF_AGENT	= memory.liking(event.item)	4	4	1
HIT_BY_OBJECT	CONSEQUENCE_OF_EVENT	= - event.hit.speed * event.item.weight	4	20	= power(intensity, 2)
OBJECT_VISIBLE	ASPECT_OF_OBJECT	= memory.liking(event.item)	4	4	1

Positive/Negative evaluation is done based on the Intensity result

# EMOTIONAL PIPELINE

LIKE DISLIKE

CONSEQUENCE  
(OF EVENT)



ACTUAL  
CONSEQUENCE



Agent electrified by a fence.



1. Generate a Distress emotion
  - Intensity computed based on the severity of the shock
2. Add a negative affect to
  - “fence” object

An affect has:

- intensity
- memorable duration

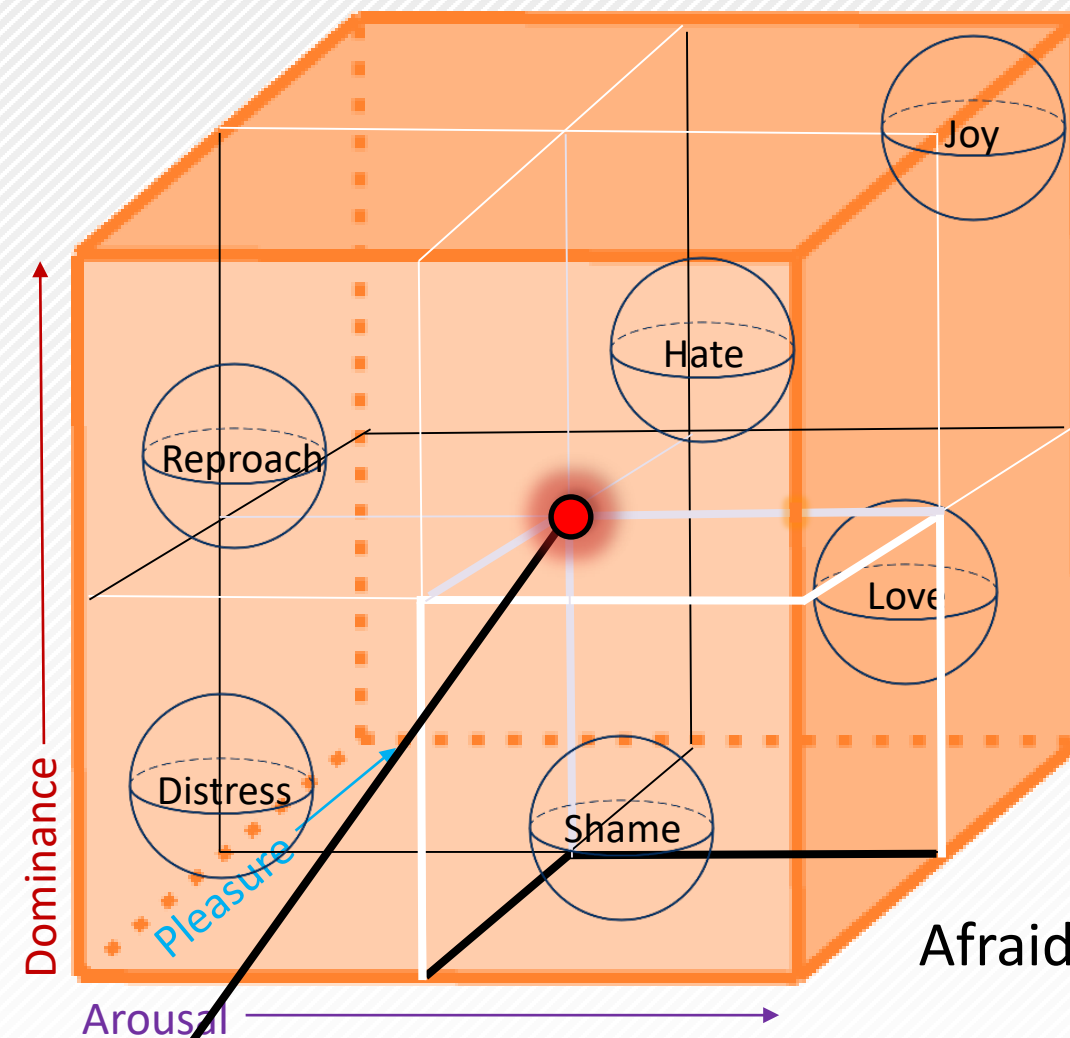


In Wonder, we do not have time-based affect. We only increment/decrement the liking of the item.

# EMOTIONAL PIPELINE

## MOOD MODULE - PAD

MOOD OCTANT	P	A	D
Exuberant	+	+	+
Dependent	+	+	-
Relaxed	+	-	+
Docile	+	-	-
Afraid	-	+	-
Hostile	-	+	+
Disdainful	-	-	+
Depressed	-	-	-



Default Mood (P=0, A=0, D=0)

**P** Pleasure Displeasure

How pleasant is an emotion.

Joy ↔ Fear

**A** Arousal Nonarousal

How intense is an emotion.

Rage ↔ Boredom

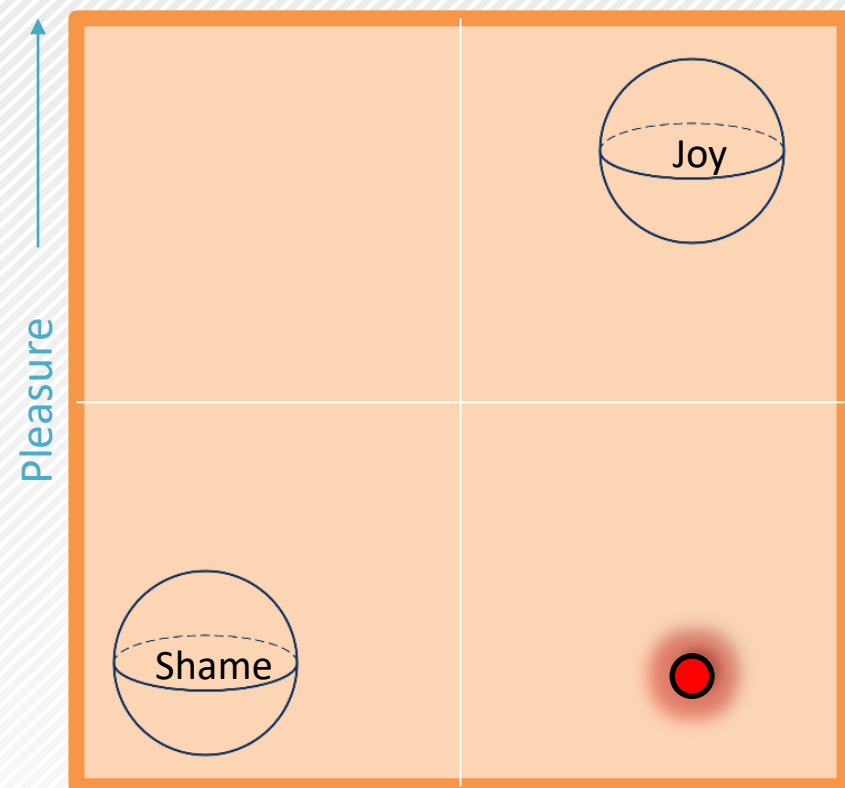
**D** Dominance Submissiveness

How much control and influence the agent has over situations

Anger ↔ Distress

# EMOTIONAL PIPELINE

## MOOD MODULE - PAD



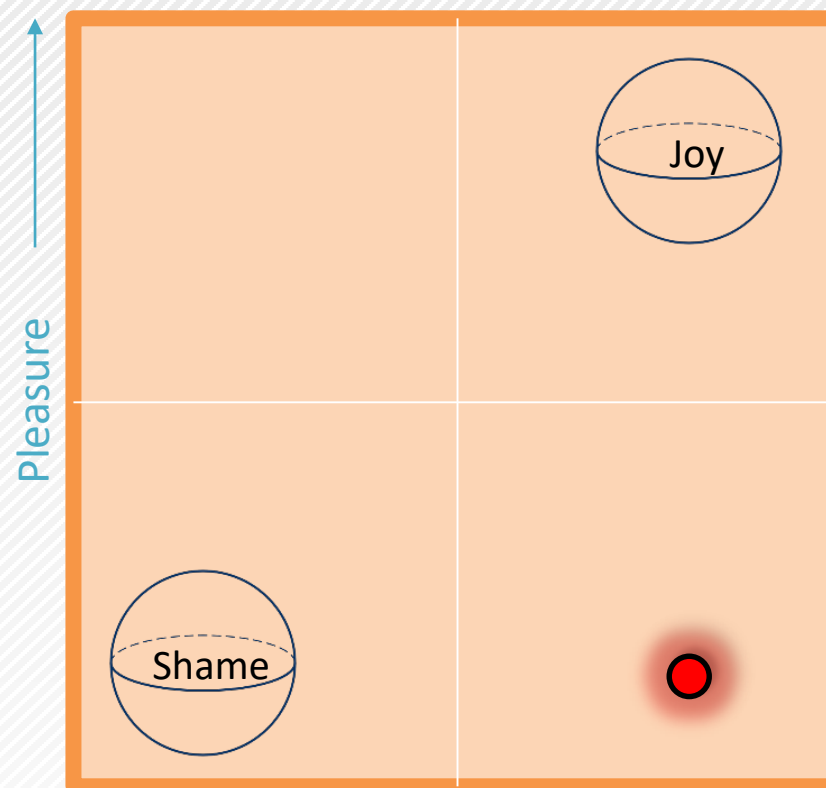
Dominance →

Emotions Intensity Time

Joy

0.5

5s



Dominance →

Emotions Intensity Time

Joy

1.0

5s

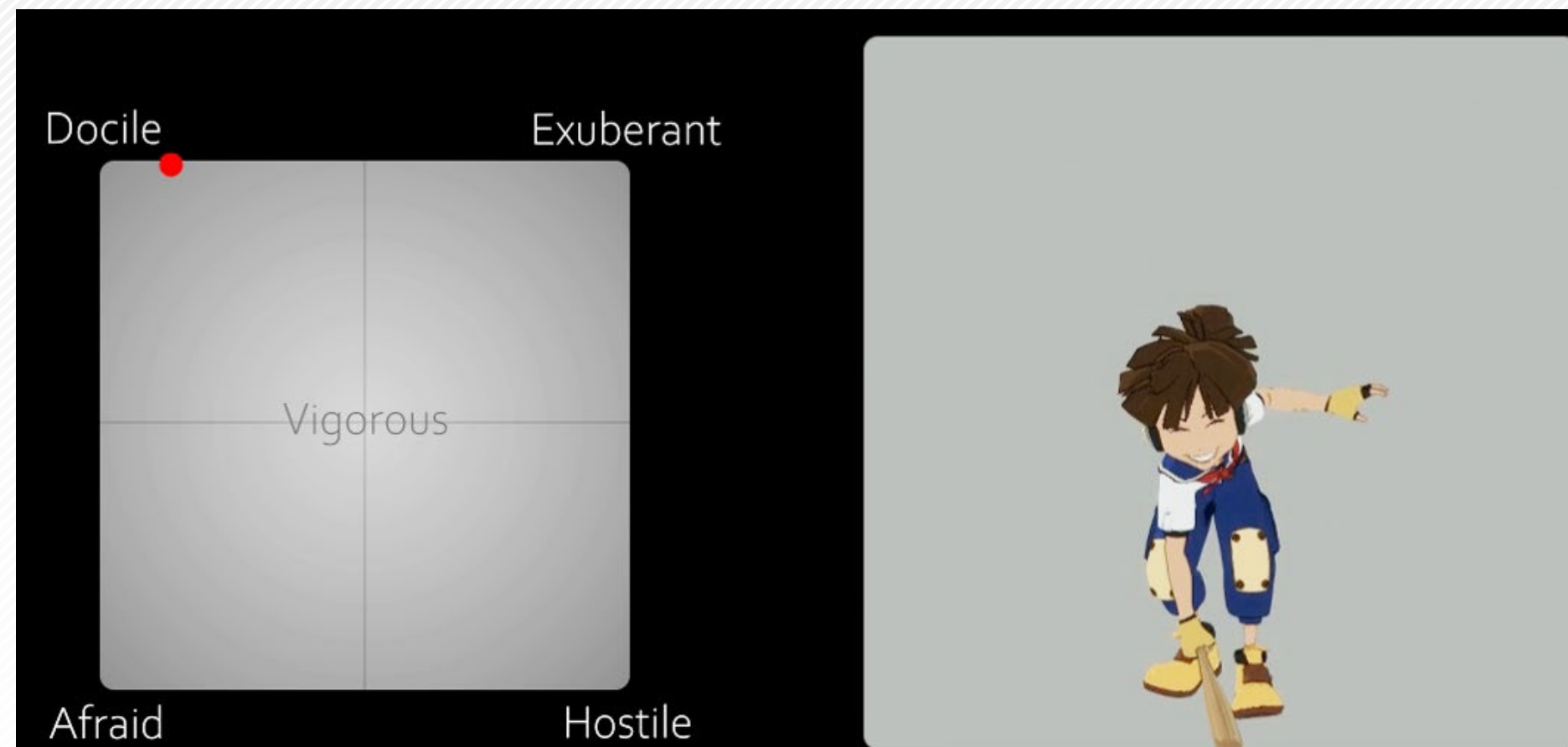


# EMOTIONAL PIPELINE

## MOOD MODULE - EXPRESSION

- Decision Making (Goal selection, planning, learning, etc)
- Voice tone (Wonder)
- Variation of the base body animation, and can be blended together (Not changing the way of doing the action of the base body animation) (Wonder)

[Watch video \(click\)](#)



# EMOTIONAL PIPELINE

## PAD MODEL ADAPTABILITY

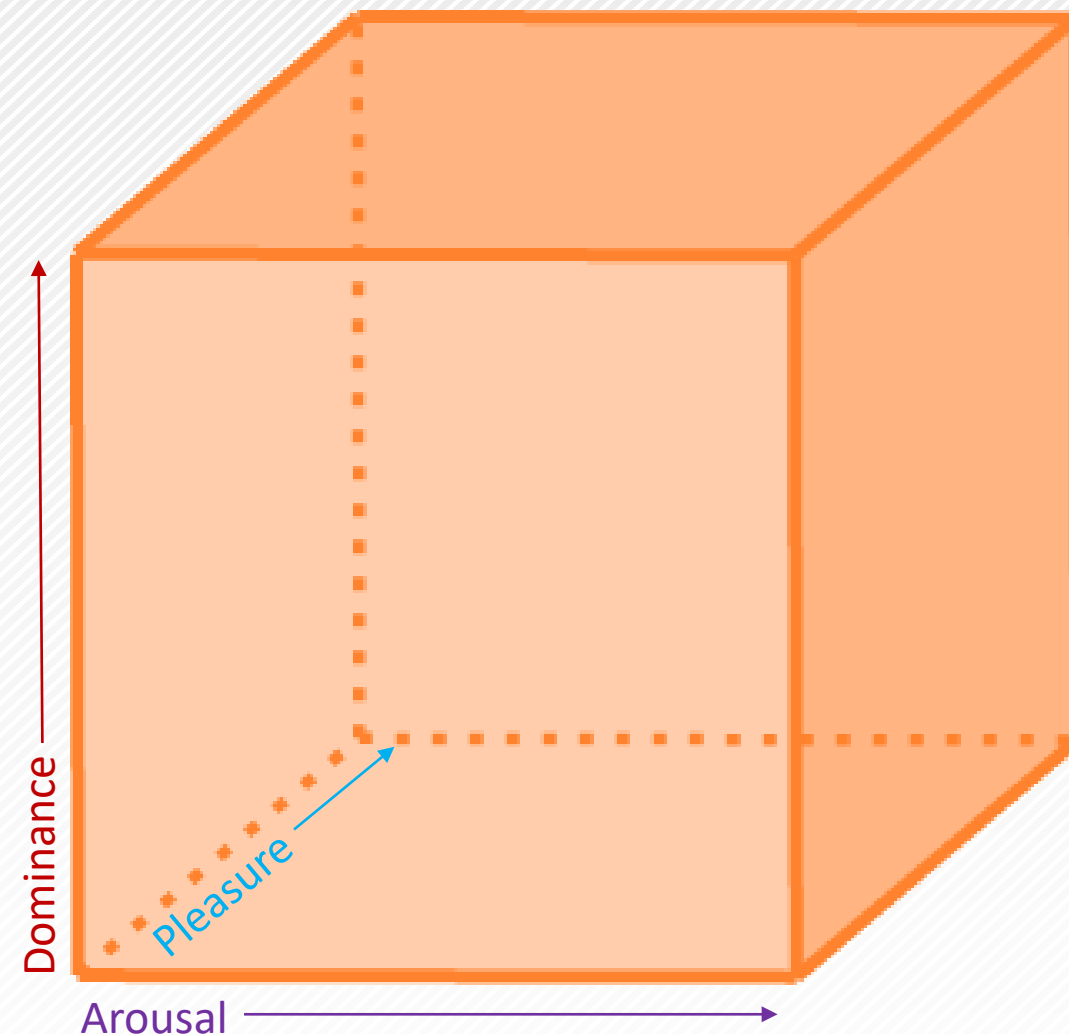
### 3D mood space:

#### Pros:

- Vast variations of expressions

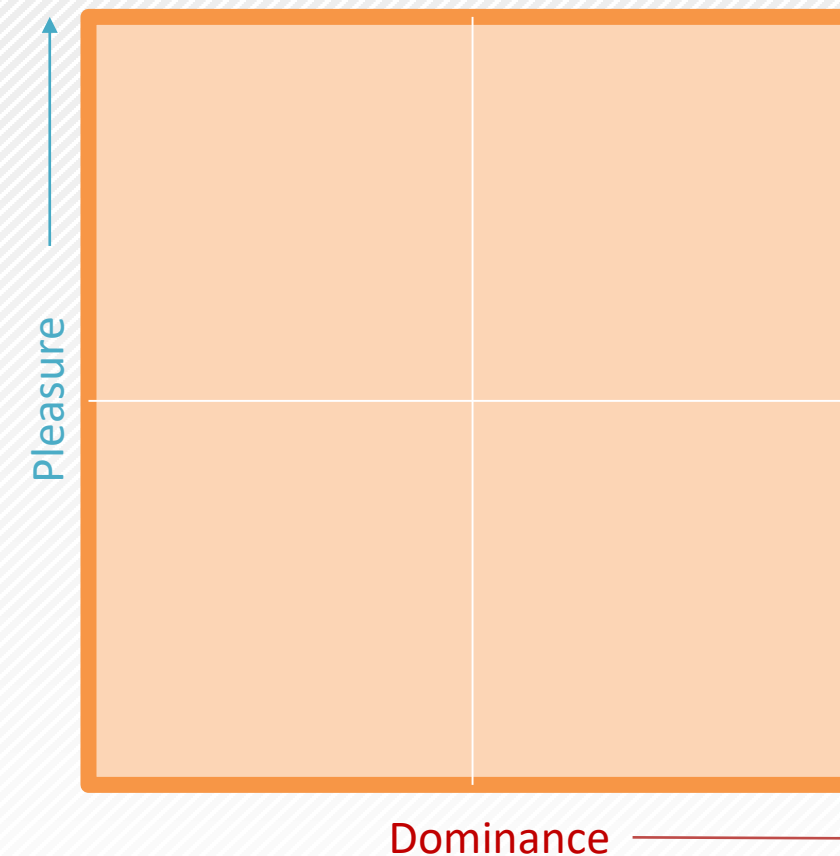
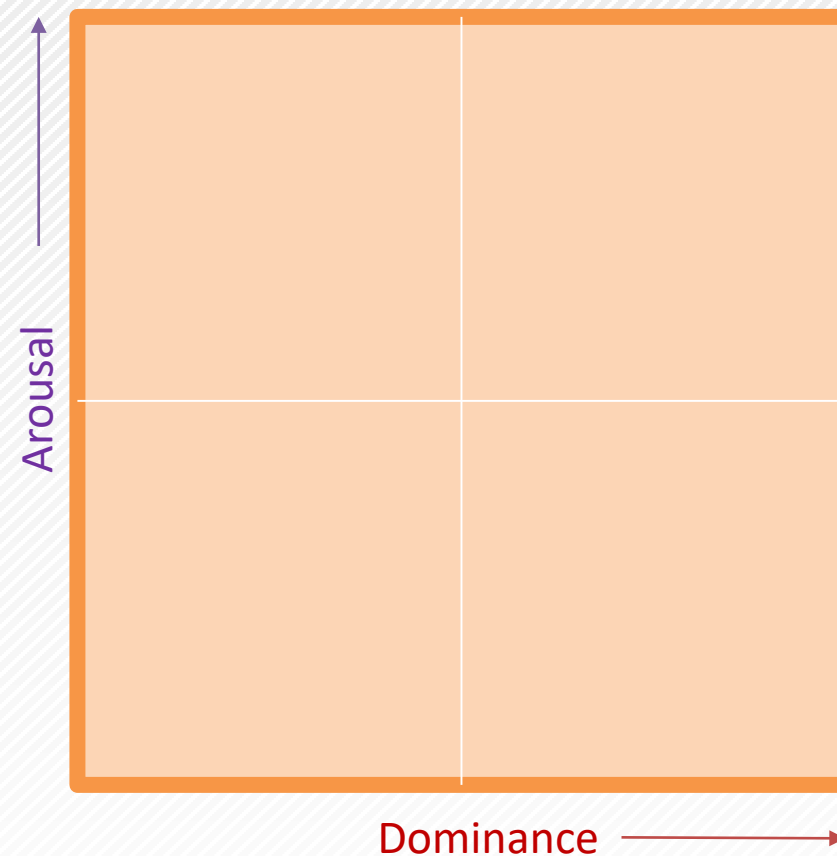
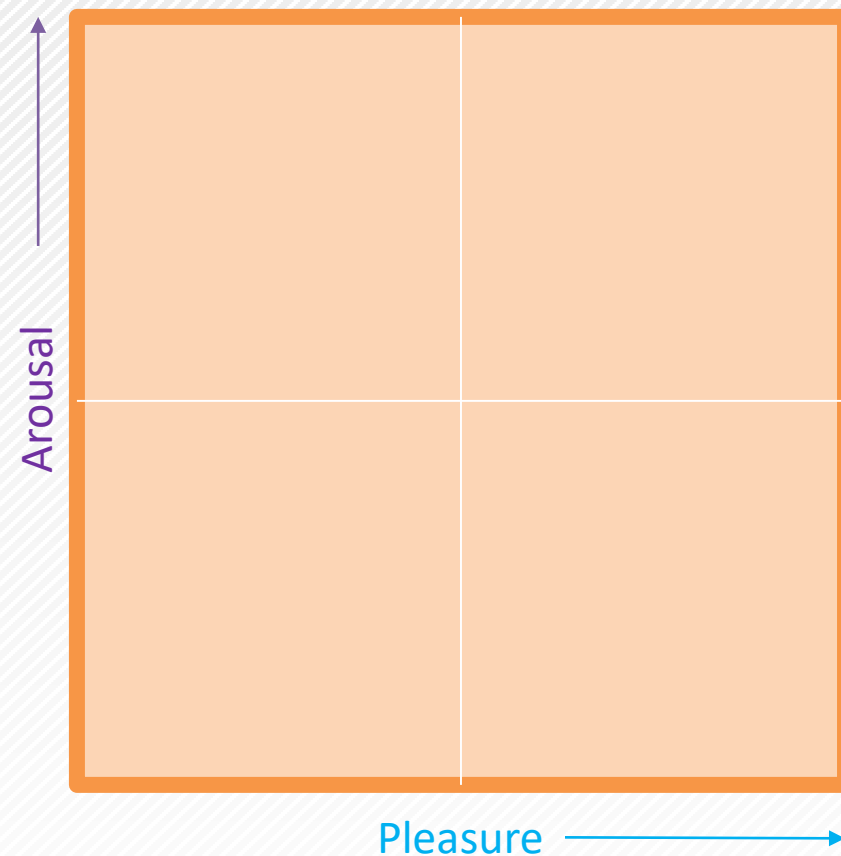
#### Cons:

- The more dimension, the harder to debug, balance
- Depending on mood expression, assets cost can go out of hands.



# EMOTIONAL PIPELINE

## PAD MODEL ADAPTABILITY



# EMOTIONAL PIPELINE

## PAD MODEL ADAPTABILITY

### Pleasure

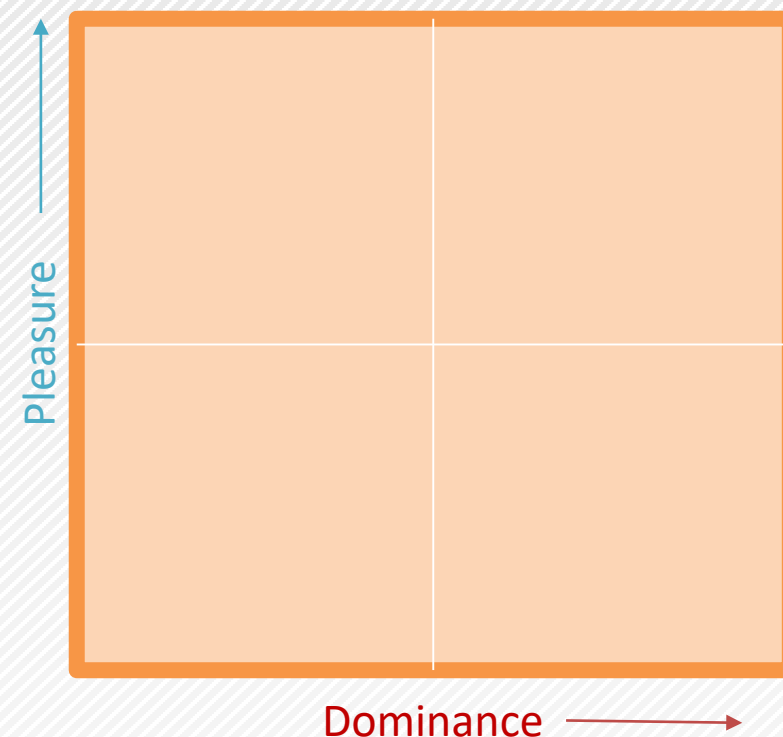
How **pleasant** is an emotion.

P+	P-
Exuberant	Afraid
Dependent	Hostile
Relaxed	Disdainful
Docile	Depressed

### Arousal

How **intense** is an emotion.

A+	A-
Exuberant	Relaxed
Dependent	Docile
Afraid	Depressed
Hostile	Disdainful



### Dominance

How much **control** and **influence** the agent has over situations

D+	D-
Exuberant	Dependent
Relaxed	Docile
Hostile	Afraid
Disdainful	Depressed

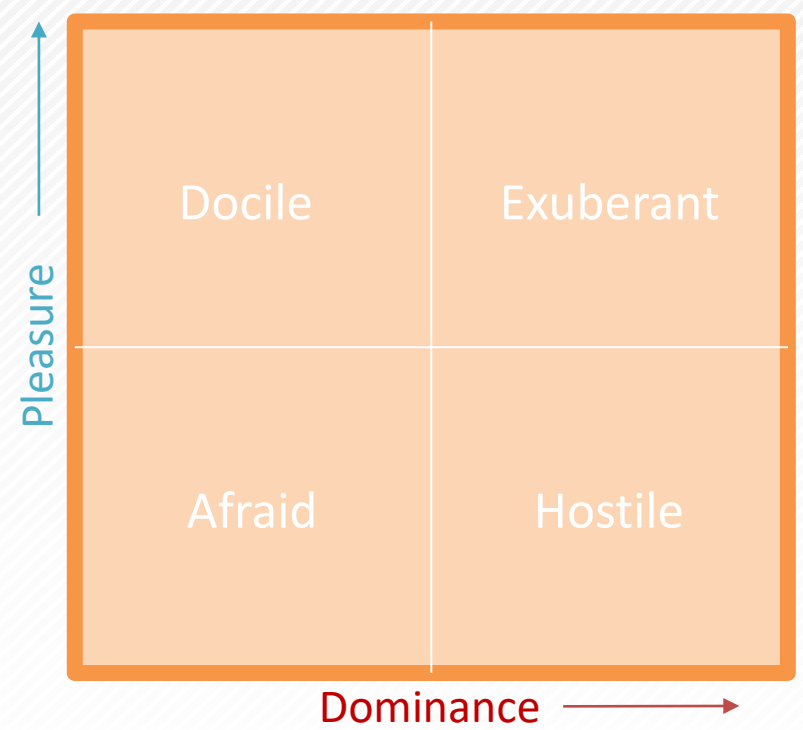
## Generated Emotions

Emotion	P	A	D
Hope	+	+	-
Fear	-	+	-
Joy	+	+	+
Distress	-	-	-
Pride	+	+	+
Shame	-	+	-
Admiration	+	+	-
Reproach	-	-	+
Love	+	+	+
Hate	-	+	+



# EMOTIONAL PIPELINE

## PAD MODEL ADAPTABILITY



## Generated Emotions

Emotion	P	A	D
Hope	+	+	-
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Pride	+	+	+
Shame	-	+	-
Admiration	+	+	-
Reproach	-	-	+
Love	+	+	+
Hate	-	+	+

Patrick Gebhard. 2005. ALMA: a layered model of affect. In *Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems (AAMAS '05)*.

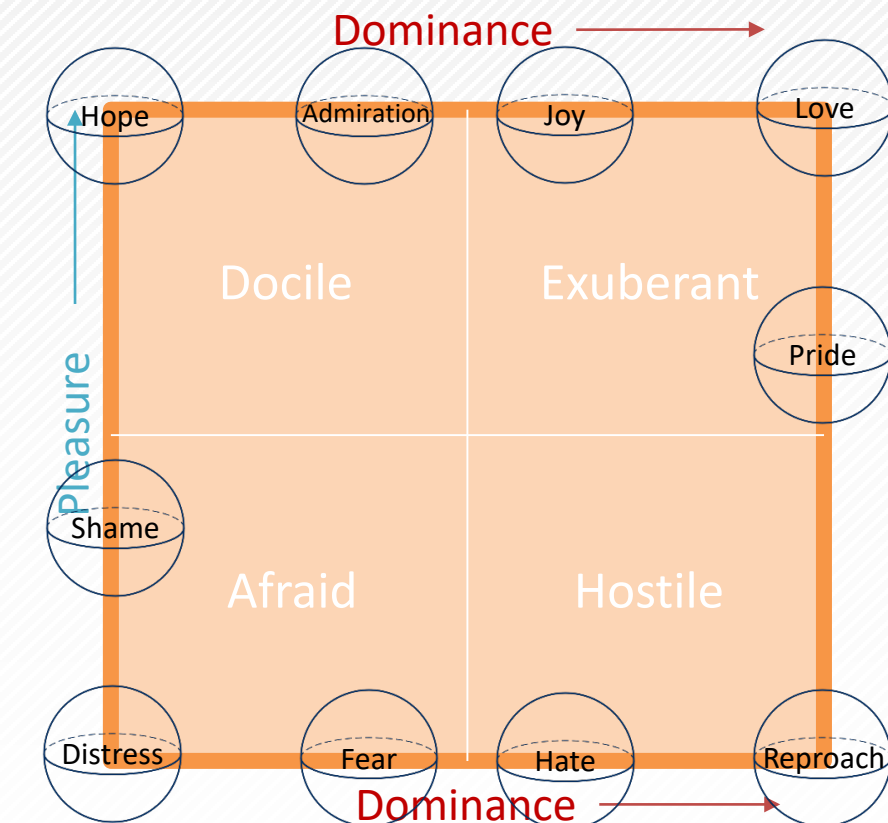
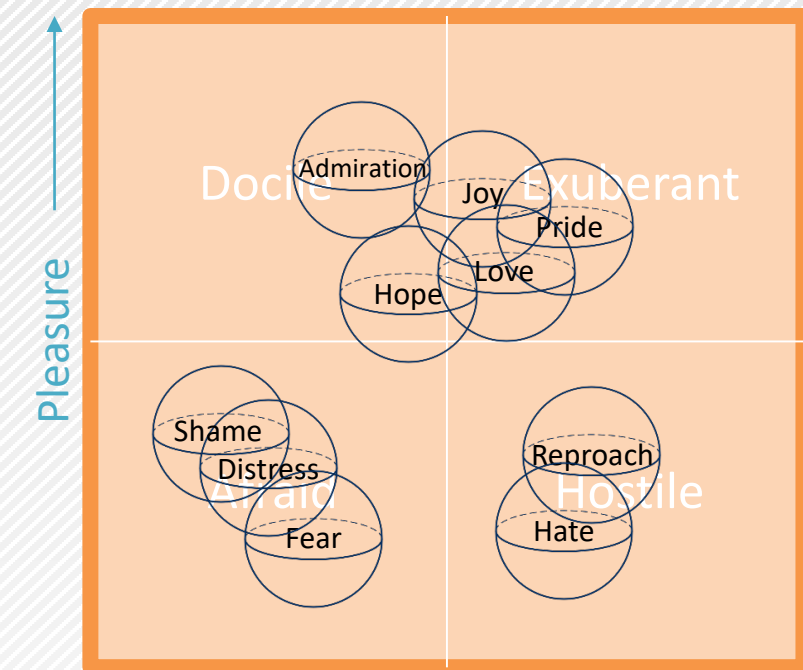
# EMOTIONAL PIPELINE

## PAD MODEL ADAPTABILITY - EMOTION PLACEMENTS

Emotion	P	A	D	Mood Octant
Admiration	0.5	0.3	-0.2	Dependent
Anger	-0.51	0.59	0.25	Hostile
Disliking	-0.4	0.2	0.1	Hostile
Disappointment	-0.3	0.1	-0.4	Anxious
Distress	-0.4	-0.2	-0.5	Bored
Fear	-0.64	0.6	-0.43	Anxious
FearsConfirmed	-0.5	-0.3	-0.7	Bored
Gloating	0.3	-0.3	-0.1	Docile
Gratification	0.6	0.5	0.4	Exuberant
Gratitude	0.4	0.2	-0.3	Dependent
HappyFor	0.4	0.2	0.2	Exuberant
Hate	-0.6	0.6	0.3	Hostile
Hope	0.2	0.2	-0.1	Dependent
Joy	0.4	0.2	0.1	Exuberant
Liking	0.4	0.16	-0.24	Dependent
Love	0.3	0.1	0.2	Exuberant
Pity	-0.4	-0.2	-0.5	Bored
Pride	0.4	0.3	0.3	Exuberant
Relief	0.2	-0.3	0.4	Relaxed
Remorse	-0.3	0.1	-0.6	Anxious
Reproach	-0.3	-0.1	0.4	Disdainful
Resentment	-0.2	-0.3	-0.2	Bored
Satisfaction	0.3	-0.2	0.4	Relaxed
Shame	-0.3	0.1	-0.6	Anxious

	P	D
Hope	0.2	-0.1
Fear	-0.64	-0.43
Joy	0.4	0.1
Distress	-0.4	-0.5
Pride	0.4	0.3
Shame	-0.3	-0.6
Admiration	0.5	-0.2
Reproach	-0.3	0.4
Love	0.3	0.2
Hate	-0.6	0.3

	P	D
Hope	1	-1
Fear	-1	-0.33
Joy	1	0.33
Distress	-1	-1
Pride	0.33	1
Shame	-0.33	-1
Admiration	1	-0.33
Reproach	-1	1
Love	1	1
Hate	-1	0.33



Patrick Gebhard. 2005. ALMA: a layered model of affect. In *Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems (AAMAS '05)*.

# EMOTIONAL PIPELINE

[Watch video \(click\)](#)



# EMOTIONAL PIPELINE

## PERSONALITY

- Simple structure (utility parameters in [0..1])
  - Laziness = 0.8
  - Curiosity = 0.3
  - Honesty = 0.1
  - Obedience = 0.9
  - ...





# EMOTIONAL PIPELINE

## PERSONALITY EXPRESSION

- Decision Making (Goal selection, planning, learning, etc)
- Base body animation strong variation (Way of doing the action) (Wonder)
- Way of Speaking (Wonder)
- Default mood position

[Watch video \(click\)](#)

Philanthropism  
Rationalism  
Idealism  
Enthusiasm



# EMOTIONAL PIPELINE

## WONDER EXAMPLE

- Choose where to express them, where they have influences
  - Decision Making
    - Any number of personalities should be manageable as it has only design cost in a majority of the cases
  - Animations, Speech, assets-related applications
    - Can quickly go out of hands. (Wonder example)

# EMOTIONAL PIPELINE

## PERSONALITY ADAPTABILITY

We have 8 personalities in Wonder

- Cheerfulness
- Independence
- Passion
- Confidence
- Logic
- Integrity
- Kindness
- Cooperation



Personalities in Wonder decide:

- Base animation of walk/idle/reactions...
- Way of speaking (all speeches)

8 personalities X 4 moods + 1 base = 33 variant animations

Personalities Principles

- Idealism
- Enthusiasm
- Rationalism
- Philanthropism

4 personalities X 4 moods + 1 base = 17 variant animations

# TROUBLESHOOTING

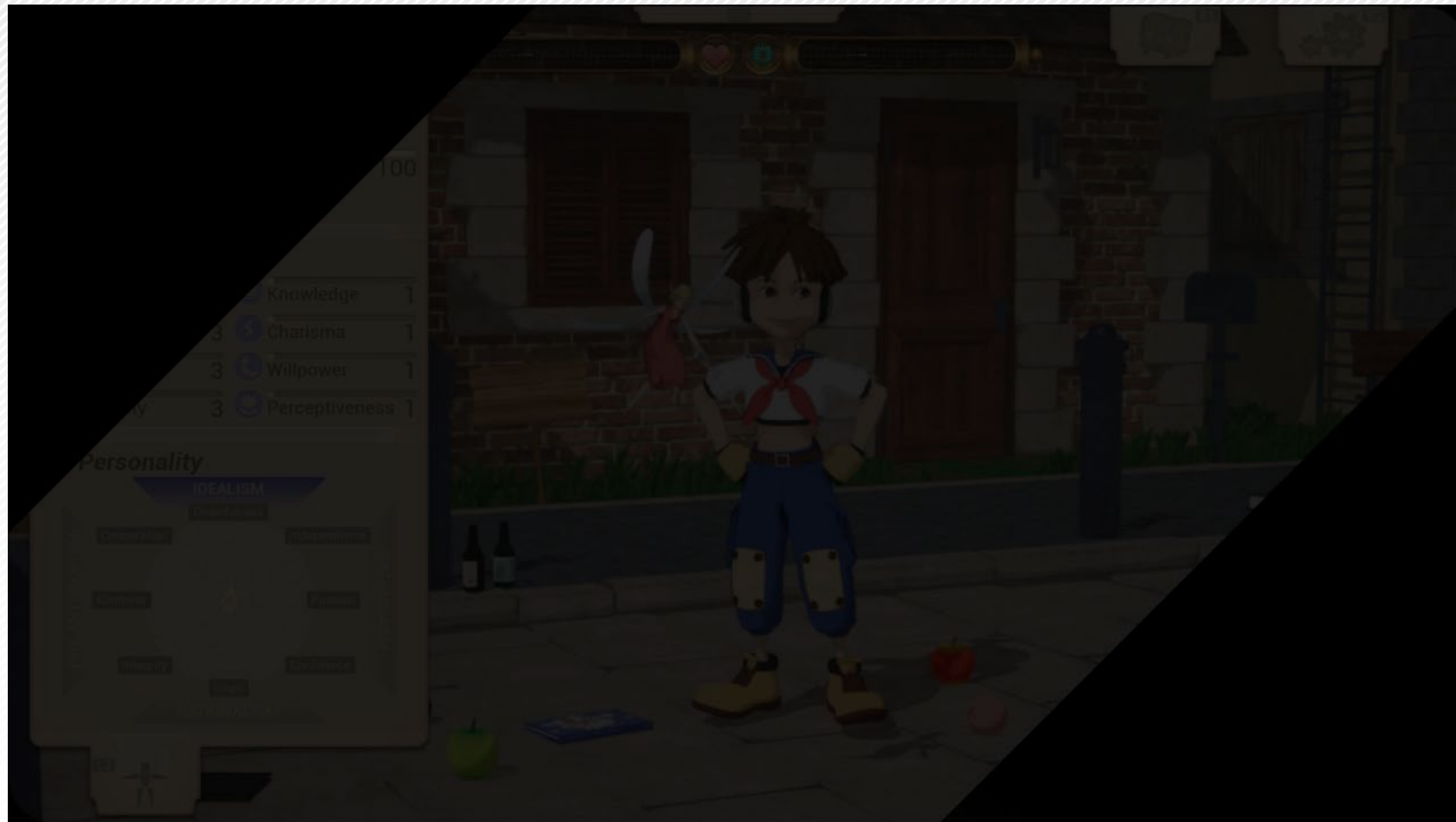
## DEBUG TOOLS AND TWEAKS





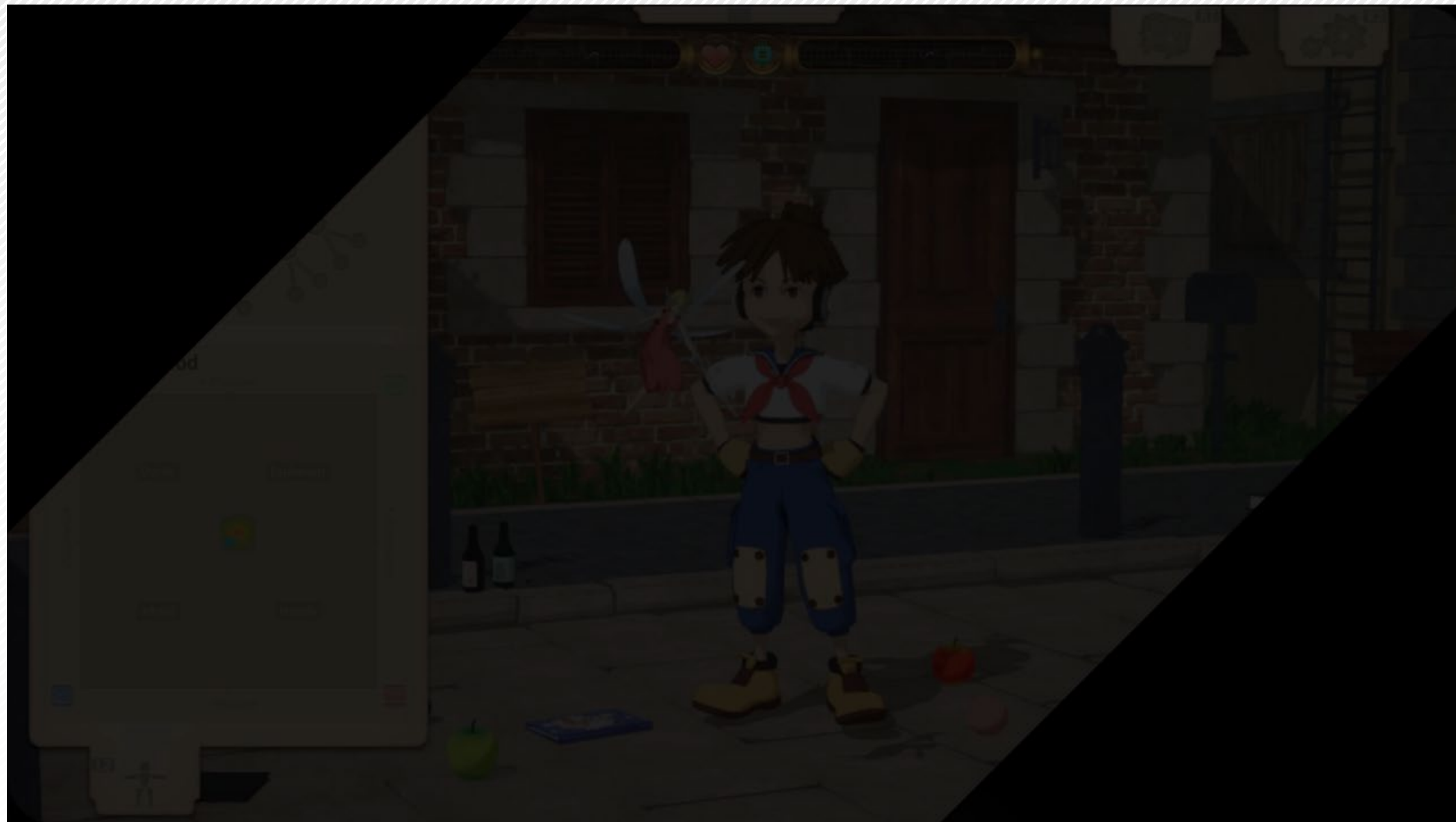
# ■ DEBUG TOOLS AND BALANCE

[Watch video \(click\)](#)



# ■ DEBUG TOOLS AND BALANCE

[Watch video \(click\)](#)



# ■ DEBUG TOOLS AND BALANCE

- Mood heat map
- Personality history: evolution of each parameter with the source (action, etc)
- Emotion history: Time, source, parameters
- Emotion overall information: influence score, occurrences

	Occurences	Average Intensity	Average Duration	Influence Score
Joy	52	0.8	4	166.4
Distress	31	0.55	4	68.2
Pride	25	0.9	2.5	56.25
Shame	34	0.75	3	76.5

Influence Score = SUM(Intensity\*Duration)

# ■ DEBUG TOOLS AND BALANCE

- Emotion / Mood balance:

- The mood is always in this area

- Compute influence score: per emotion:  $\text{SUM}(\text{Intensity} * \text{Duration})$ 
      - Highest influence score emotion is the culprit
    - Investigate the culprit:
      - How many times each emotion occurs relative to the other?
        - » A lot more? Reduce the number of occurrences. If not possible, go next step
      - How strongly the emotion is (Intensity)
        - » Always very intense? Reduce intensity/fix scoring so that 0-1 range is used. If the intensity makes sense, go next step:
      - How long it last (Duration):
        - » Adjust time to influence less
          - Knowing influence score of the counter emotion, adjust duration to equilibrate. If it makes sense already, go next
      - Everything looks fine?
        - » The counter emotion does not occur enough, too low intensity, or duration is too short. Investigate it in the same way.

	Occurrences	Average Intensity	Average Duration	Influence Score
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*Thank you for watching!*

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AI Engineer – SQUARE ENIX CO., LTD

[boedagau@square-enix.com](mailto:boedagau@square-enix.com)