



Nonverbal Behavior Generator

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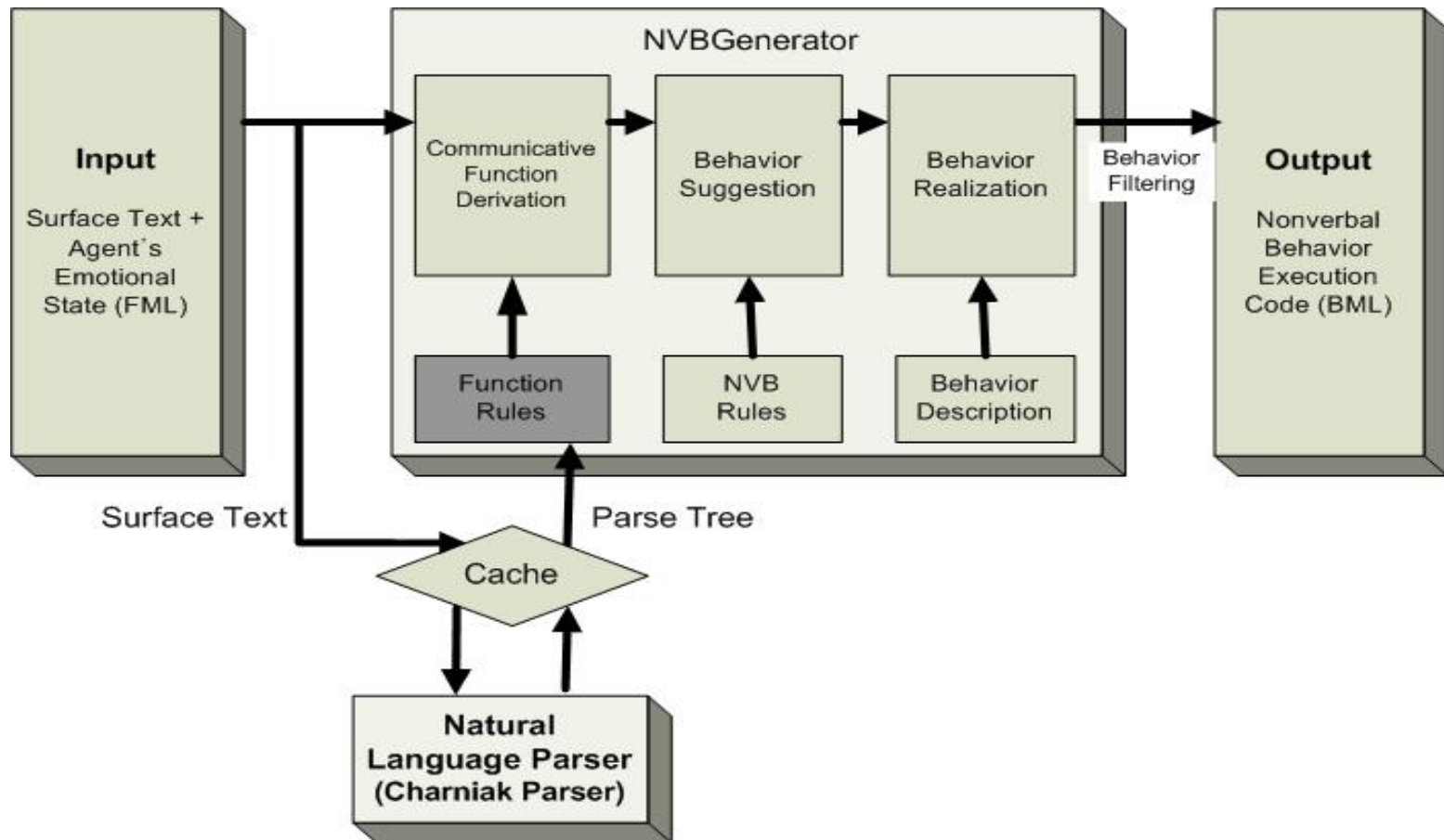


NVBG Overview

■ Goal

- Reads FML + BML (speech) message and generates NVB specified in BML
- Research goal: Robust NVB generation that can use markup of communicative function if provided, but can also extract/infer it if not
- Clear distinction of function and behavior

Architecture of NVBG



Example of Nonverbal Behavior Generation

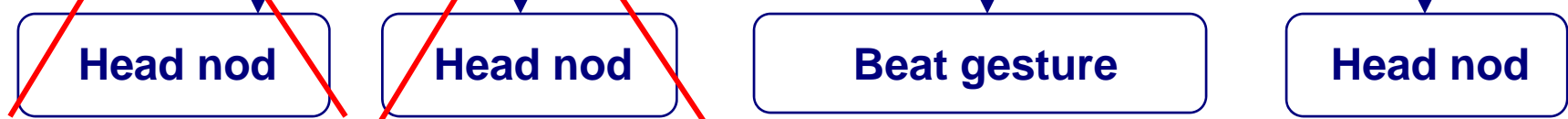
Surface Text:

I was mad at him.

Function Rules:



Behavior Rules:



Input Message Types

Message Type	FML Includes	BML Outputs
Speech	<turn> in FML <speech> in BML	Various NVB according to syntactic/semantic structure of surface text
Gaze	<visualAttention> (rationale behind what's affecting gaze behavior)	Parameters for gaze behaviors (eg. angle, offset, etc.)
Emotion	<affect>	Emotion doesn't directly generate BML msg. Instead, it implicitly modifies NVBs
Listener Feedback	<listenerFeedback>	Different facial expression and head movements according to the listener's agreement with the speaker
Negotiation Stance	<negotiationStance>	Changes the agent's posture

Message Formats

Output

```
<?xml versid
<act>
  <participan
```

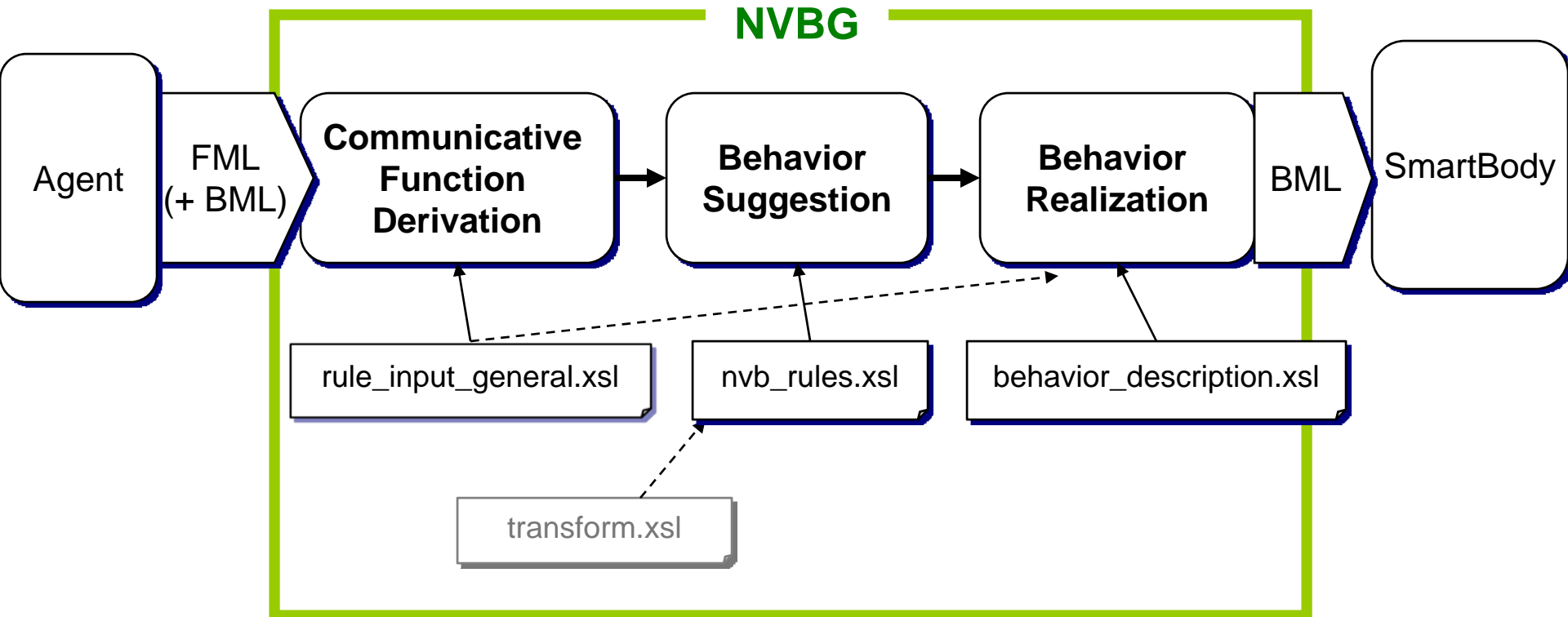
FML

BML
(speech)

BML for
behaviors
generated by
NVBG

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<act><participant id="elder-al-hassan" role="actor"/>
<bml>
  <speech id="sp1" ref="" type="application/ssml+xml">
    <mark name="T0"/>I
    <mark name="T1"/>
    <mark name="T2"/>was
    <mark name="T3"/>
    <mark name="T4"/>mad
    <mark name="T5"/>
    <mark name="T6"/>at
    <mark name="T7"/>
    <mark name="T8"/>him.
    <mark name="T9"/>
  </speech>
  <!--first_VP Animation-->
  <animation name="HandsAtSide_RArm_MidBeat" priority="5"
    ready="sp1:T0" stroke="sp1:T3"/>
  <!--Noun clause nod-->
  <head amount="0.10" priority="5" ready="sp1:T8" relax="sp1:T9"
    repeats="0.5" type="NOD"/>
</bml>
```

Behavior Generation Process



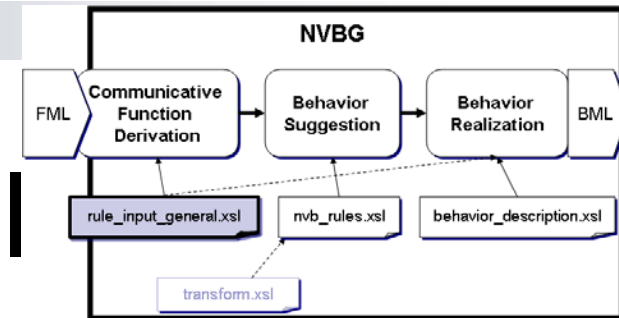
NVB Rules – from surface text

Derivation	Function	Behavior
No, not, nothing, cannot, none	Negation	Head shakes on phrase
Really, very, quite, great, absolutely, gorgeous...	Intensification	Head nod and brow frown on word
Yes, yeah, I do, We have, It's true, OK	Affirmation	Head nods and brow raise on phrase
I guess, I suppose, I think, maybe, probably, perhaps, could	Assumption / Possibility	Head nods on phrase
But, however	Contrast	Head moved to side and brow raise
Everything, all, whole, several, plenty, full...	Inclusivity	Lateral head sweep and brow flash on word
You, me	Believability	Gestures pointing towards self or other

NVB Rules – from parse tree

Derivation	Function	Behavior
INT (interjection)	Interjection	Head nod on word
First <NP> (noun phrase)	Believability	Big head nod on start of the noun phrase
<NP> (noun phrase)	Believability	Head nod on start of noun phrase
First <VP> (verb phrase)	Believability	Beat gesture on start of the first verb phrase

rule_input_general.xml



- Specifies NVB rule, keywords, priority, gesture clips to be called
- If simply changing the animation clips called (without modifying the NVB rules), modify this file and it's done!
- Adding a rule (ex. 'emo_negative')

```
<!-- negative -->
```

```
<rule keyword="emo_negative" priority="1" >
```

```
  <pattern>mad</pattern>
```

```
  <pattern>argument</pattern>
```

```
  <pattern>harm</pattern>
```

```
  <pattern>trouble</pattern>
```

```
</rule>
```

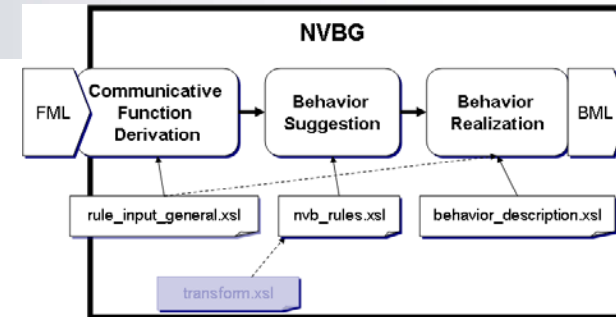
transform.xsl

- Creates <rule> element
- Specifies the parameters needed for each rule (ex. speech_id, ready_time, relax_time, priority, etc.)

```
<xsl:when test="$rule_name='emo_negative'">
<xsl:element name="rule">
<xsl:attribute name="ready">...
<xsl:attribute name="relax">...
<xsl:attribute name="type">...
<xsl:attribute name="priority">...
<xsl:text>&#10; </xsl:text>
```

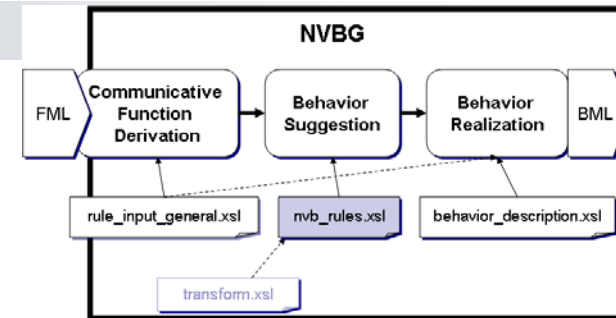
```
    <xsl:call-template name="emo_negative" >
      <xsl:with-param name="speech_id" select="$sp_id" />
      <xsl:with-param name="ready_time" select="$ready" />
      <xsl:with-param name="relax_time" select="$relax" />
      <xsl:with-param name="priority" select="./@priority" />
    </xsl:call-template>
  </xsl:element>
</xsl:when>
```

Call
template
with these
parameters



nvb_rules.xsl

- Specifies which (generic) behavior is associated with each nvb rule



```
<!-- emo_negative: head nod and brow frown -->
```

```
<xsl:template name="emo_negative">
```

```
  <xsl:param name="speech_id" />
```

```
  <xsl:param name="ready_time" />
```

```
  <xsl:param name="relax_time" />
```

```
  <xsl:param name="priority"/>
```

```
  <xsl:comment>Emotion Negative</xsl:comment>
```

```
  <xsl:call-template name="nod">
```

```
    <xsl:with-param name="speech_id" select="$speech_id" />
```

```
    <xsl:with-param name="ready_time" select="$ready_time" />
```

```
    <xsl:with-param name="relax_time" select="$relax_time" />
```

```
    <xsl:with-param name="priority" select="$priority" />
```

```
  </xsl:call-template>
```

```
  <xsl:call-template name="brow_frown" >
```

```
    <xsl:with-param name="speech_id" select="$speech_id" />
```

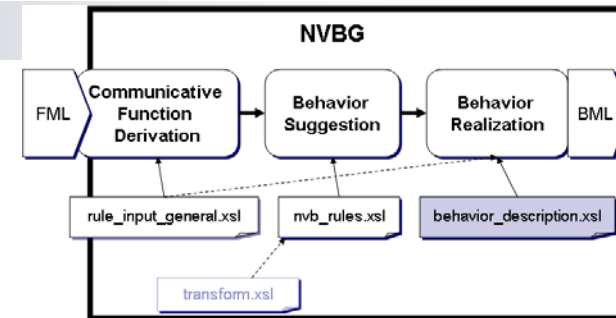
```
    ..
```

```
  </xsl:call-template>
```

```
</xsl:template>
```

Call
template
with these
parameters

behavior_description.xsl



- Creates the actual BML code for each generic behavior
- Specified behaviors
 - Nods:
 - big_nod, nod, small_nod
 - Shakes:
 - big_shake, shake, small_shake, shake_twice
 - Head orientations:
 - head_to_left, head_to_right, head_up, head_down, head_tilt_right, head_tilt_left
 - Eye brow movements:
 - brow_frown, brow_raise
 - Mouth movements:
 - smile
 - Animations:
 - ani_beat, ani_greeting, ani_you, ani_me, ani_negation, ani_contrast, ani_assumption, ani_theoretical, ani_inclusivity, ani_question, ani_obligation