

Trainable Generation of Personality through Data-Driven Parameter Estimation

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Annual Meeting of the ACL, June 16th 2008

Statistical Language Generation

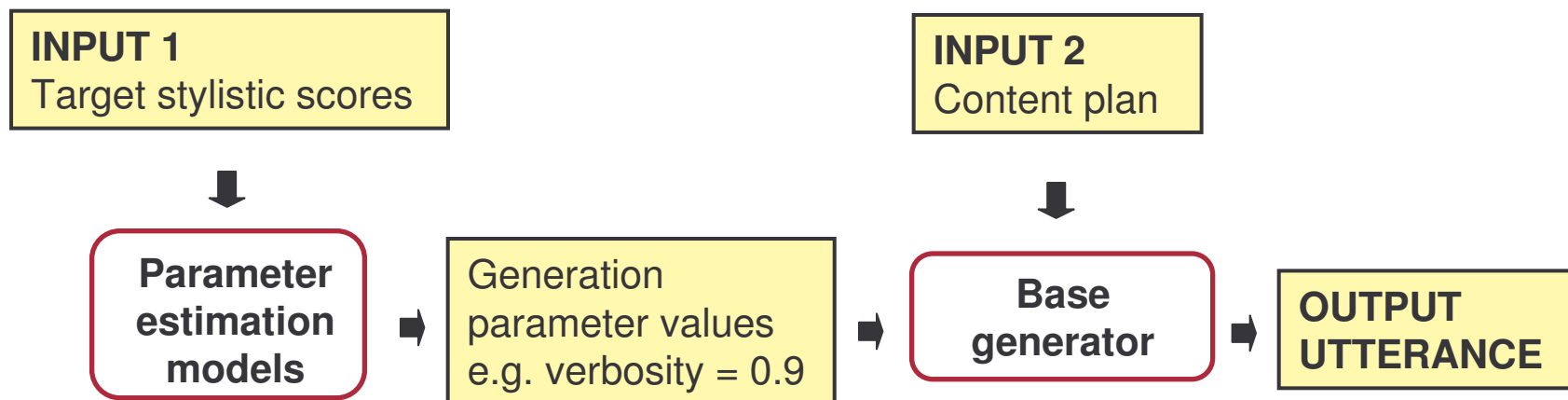
- Overgenerate and rank
 - Optimize utterance quality
 - N-gram models (Langkilde & Knight, 1998)
 - Higher-level features and user feedback (Rambow et al., 2001; Stent et al., 2004; Nakatsu & White, 2006)
 - Only top ranked utterances matter
- Data-driven stylistic control
 - Selection models target the full range
 - N-grams models (Isard et al. 2006)
 - Generation decision features (Mairesse & Walker, 2007)
 - Search for generation parameters yielding target style (Paiva & Evans, 2005)
 - No overgeneration

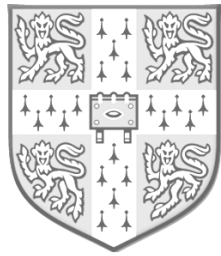
Objectives

- Stylistic control
 - Without overgeneration/search
 - Model **meaningful** stylistic dimensions
 - User feedback
 - Big Five personality traits
 - Multiple **simultaneous** stylistic effects
 - Over **continuous** scales
- E.g. recommend(Babbo)
 - **Extravert = 90%, agreeable = 90%**, etc.
'Yeah Babbo is a fantastic restaurant pal, I would really recommend it!'
 - **Extravert = 10%, agreeable = 10%**, etc.
'Err... well, Babbo is the only restaurant that is any good.'

Method - Parameter Estimation Models

1. Generate utterances with random parameter values
2. Collect stylistic ratings
3. Learn models that predict parameter settings *directly* from stylistic scores
 - No overgeneration/search





How to characterize individual differences in language?

Modeling Individual Differences in Dialogue

- Personality as a stylistic dimension
 - Most fundamental variation dimensions
 - Well defined in psychology studies
 - Many studies identify linguistic markers of personality
 - Standard validated questionnaires
 - Affect on dialogue
 - Similarity attraction
(Nass & Lee, 2001; Bickmore & Cassell, 2002)
 - Tutoring systems
(Porayska-Pomsta & Mellish, 2004; Wang et al., 2004)

The Big Five Personality Traits

- Factor analysis of trait-descriptive adjectives (Norman, 1963)

- Extraversion _____

- Sociability, assertiveness vs. quietness

- Emotional stability/Neuroticism _____

- Calmness vs. anxiety

- Agreeableness _____

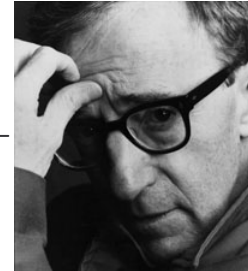
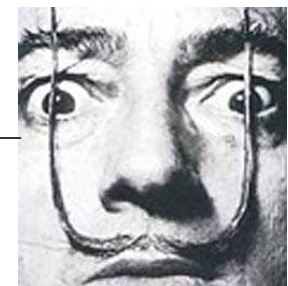
- Kindness vs. unfriendliness

- Conscientiousness _____

- Need for achievement, organization vs. impulsiveness

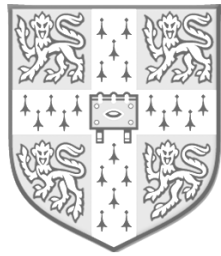
- Openness to experience _____

- Imagination, insight vs. conventionality



Some Linguistic Reflexes of Personality

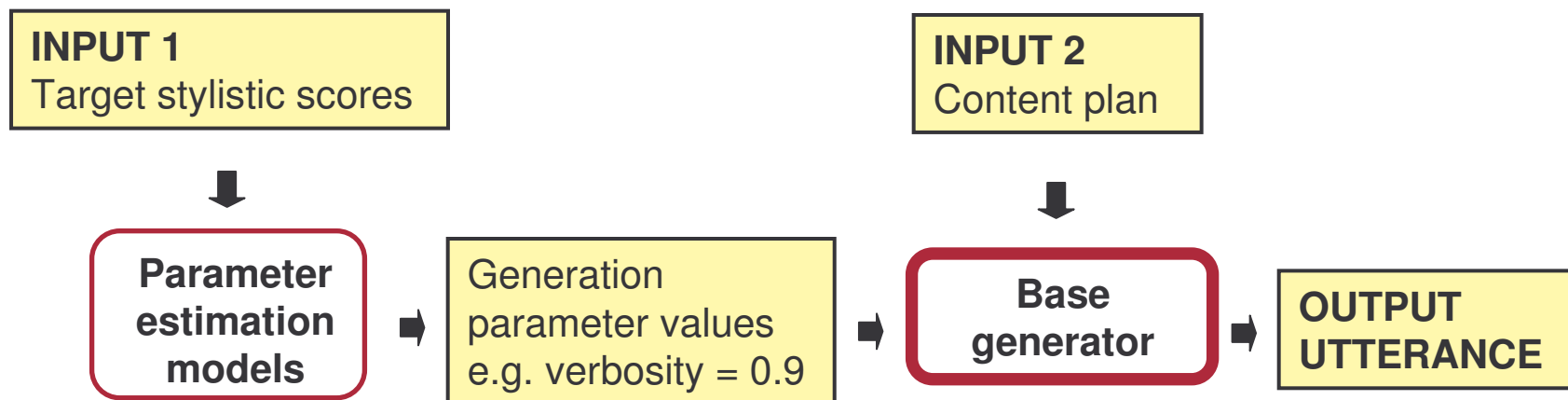
- **Extraversion** (Furnham, 1990; Scherer, 1979; Gill & Oberlander, 2002)
 - Talk more, faster, louder and more repetitively
 - Lower type/token ratio
 - Less formal, more references to context (Heylighen & Dewaele, 2002)
- **Neuroticism** (Pennebaker & King, 1999, Gill & Oberlander, 2003)
 - 1st person singular pronouns
 - Negative emotion words
 - E.g. 'hate', 'enemy', 'worthless'
- **Conscientiousness** (Pennebaker & King, 1999)
 - Fewer negations and negative emotion words



How can we control the personality
of the system?

Base Generator - PERSONAGE (Mairesse & Walker, 2007)

- PERSONAGE generator
 - Recommendations and comparison in the restaurant domain
 - Parameters derived from psychology findings
 - PERSONAGE generates **recognizable** personality



Mapping Findings to Parameters

NLG modules	Introvert findings	Extravert findings	Generation parameters	Intro	Extra
Content planning	Single topic	Many topics	VERBOSITY	low	high
	Strict selection	Think out loud	RESTATEMENTS	low	high
	Problem talk	Pleasure talk	CONTENT POLARITY CONCESSION POLARITY REPETITION POLARITY	low low low	high high high
...	...	...	...	...	...

Mapping Findings to Parameters

Vague, genre specific findings



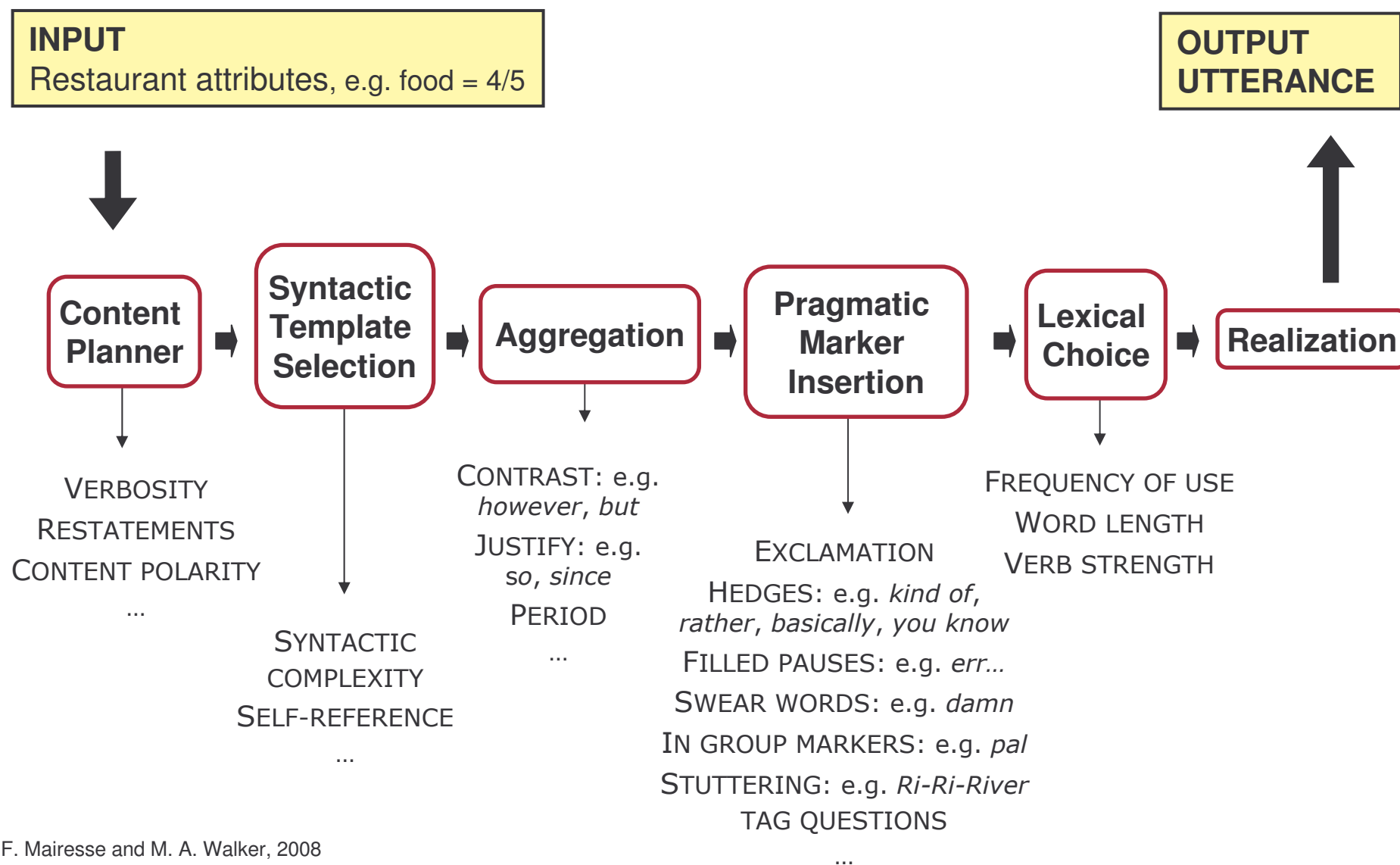
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Mapping Findings to Parameters

Vague, genre specific findings → 67 generation parameter hypotheses

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PERSONAGE's 67 Parameters



Evaluation Method – Ten-Item Personality Inventory (Gosling et al. 03)

Restaurant Description Survey - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.dcs.shef.ac.uk/~francois/experiment-all/survey-temp.html

tipi questionnaire

Section 1 - you ask your friend to compare Japonica and Dojo and this is what your friend says:

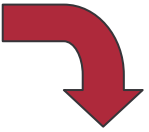
Utterance 1:

"Obviously, oh gosh Dojo, which has bad waiters, is a japanese and vegetarian place, a japanese and vegetarian place, with poor atmosphere. Actually, I mean, Japonica is a japanese and sushi place and the atmosphere is nice, also this restaurant has rather nice waiters, you know."

I see the concierge as...

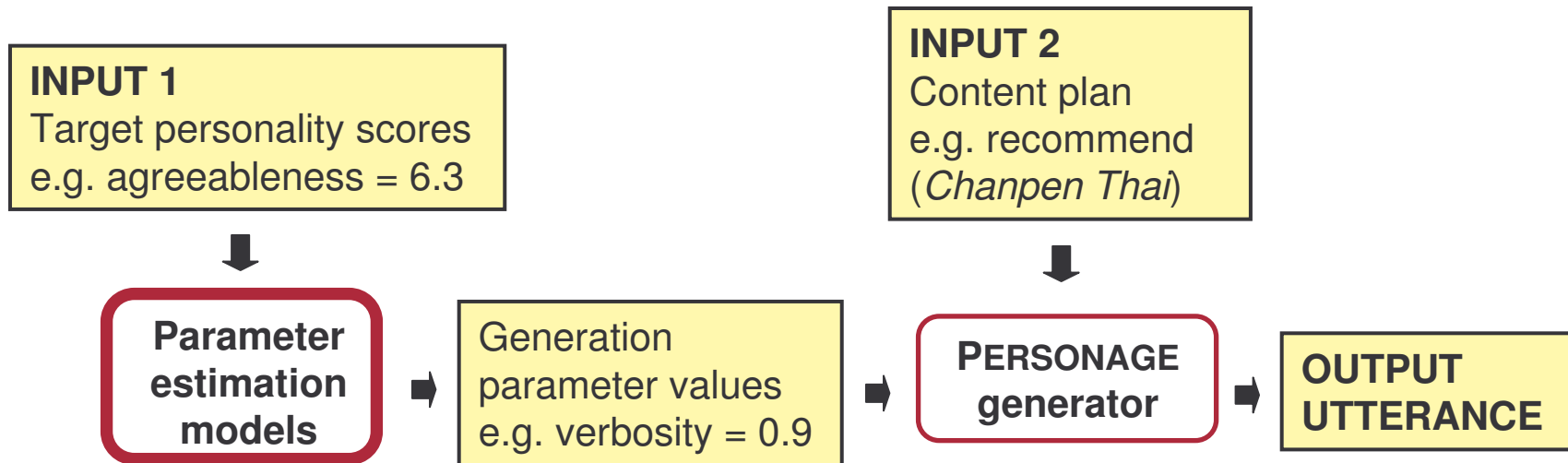
1. Extraverted, enthusiastic	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
2. Reserved, quiet	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
3. Critical, quarrelsome	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
4. Dependable, self-disciplined	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
5. Anxious, easily upset	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
6. Open to new experiences, complex	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
7. Sympathetic, warm	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
8. Disorganized, careless	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
9. Calm, emotionally stable	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
10. Conventional, uncreative	Disagree strongly	1	2	3	4	5	6	7	Agree strongly
The utterance sounds natural	Disagree strongly	1	2	3	4	5	6	7	Agree strongly

Done



Extraversion = 3.5
Neuroticism = 2.0
Agreeableness = 6.5
Conscient. = 4.0
Openness = 1.5

Parameter Estimation Models - Training



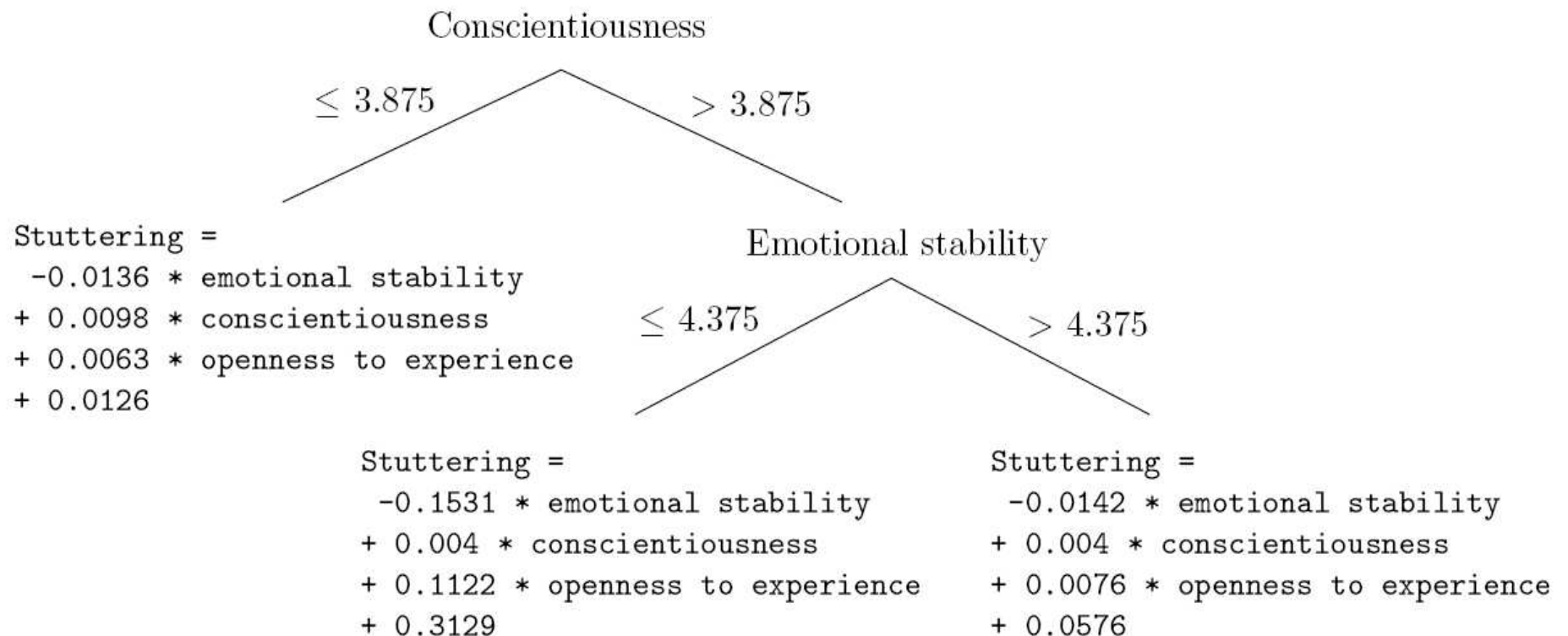
Example Continuous Parameter Estimation Model

- Data collection
 - 160 randomly generated utterances + generation decisions
 - Average ratings of 3 judges
- Training parameter estimation models
 - Independence assumption between parameters
 - Best models selected through cross-validation
- Example: CONTENT POLARITY
 - SVM regression with linear kernel

$$\begin{aligned}\text{CONTENT POLARITY} = & - 0.102 \times \text{emotional stability} \\ & + 0.970 \times \text{agreeableness} \\ & - 0.110 \times \text{conscientiousness} \\ & + 0.013 \times \text{openness to experience} \\ & + 0.054\end{aligned}$$

Example Continuous Parameter Estimation Model (2)

- Model tree predicting the STUTTERING parameter



Example Binary Parameter Estimation Model

- Binary parameters are predicted using classifiers
- EXCLAMATION parameter
 - AdaBoost classifier

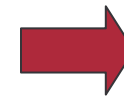
AdaBoost rule	Weight
if extraversion > 6.42 then <i>enabled</i> else <i>disabled</i>	1.81
if extraversion > 4.42 then <i>enabled</i> else <i>disabled</i>	0.38
if extraversion <= 6.58 then <i>enabled</i> else <i>disabled</i>	0.22
if extraversion > 4.71 then <i>enabled</i> else <i>disabled</i>	0.28
if agreeableness > 5.13 then <i>enabled</i> else <i>disabled</i>	0.42
if extraversion <= 6.58 then <i>enabled</i> else <i>disabled</i>	0.14
if extraversion > 4.79 then <i>enabled</i> else <i>disabled</i>	0.19
if extraversion <= 6.58 then <i>enabled</i> else <i>disabled</i>	0.17

Example Outputs for recommend(*Chimichurri Grill*)

recommend(Chimichurri Grill)	extra=1.00, ems=4.44, agree=3.34, consc=4.10, open=1.12
Err... Chimichurri Grill is the only restaurant that is any good. Even if this eating place is costly, it offers adequate food, alright? It provides mediocre ambience.	
recommend(Chimichurri Grill)	extra=4.10, ems=6.85, agree=7.00, consc=3.58, open=4.34
I would suggest Chimichurri Grill.	
recommend(Chimichurri Grill)	extra=4.18, ems=3.38, agree=1.00, consc=1.97, open=4.59
You would probably appreciate Chimichurri Grill. Err... it's a latin american restaurant, also the ambience is damn poor. It offers friendly staff, even if it's quite costly alright?	
recommend(Chimichurri Grill)	extra=5.00, ems=2.92, agree=4.48, consc=1.00, open=7.00
Chimichurri Grill is a latin american restaurant, also it's located in Midtown West. It has quite friendly waiters. It offers adequate food. I imagine you would appreciate it.	
recommend(Chimichurri Grill)	extra=6.56, ems=1.51, agree=4.00, consc=4.89, open=4.03
Ok, Chimichurri Grill offers poor ambience, even if it provides... it has nice waiters! Although the food is adequate, it's damn costly. This restaurant is one of my favourite places.	

Large-Scale Evaluation Experiment

- 24 judges rated 50 utterances
 - Each utterance hits a combination of Big Five targets



Extraversion = 3.5
Neuroticism = 1.7
Agreeableness = 6.5
Conscientiousn. = 4.0
Openness = 4.5

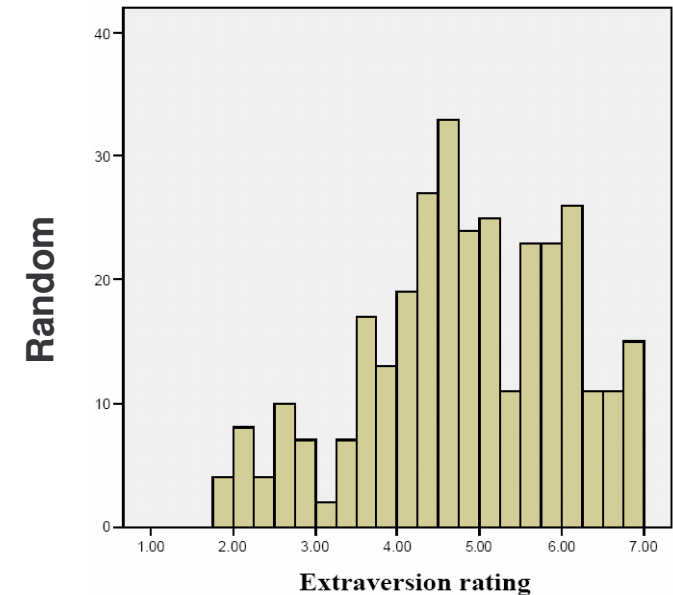
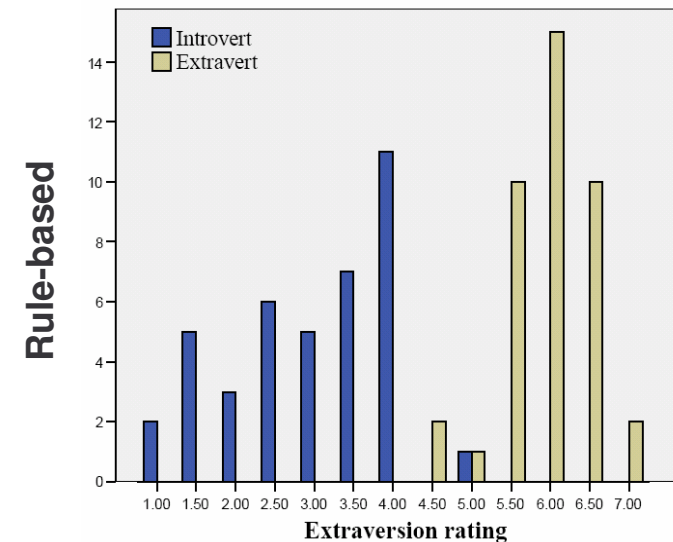
- Correlation between target scores and average ratings

Trait	r_{avg}
Extraversion	.80 ●
Emotional stability	.64 ●
Agreeableness	.68 ●
Conscientiousness	-.02
Openness to experience	.41 ●

● statistically significant correlation
 $p < .05$, ● $p = .07$ (two-tailed)

Data-driven vs. Rule-based Methods

- Rule-based approach produces more extreme utterances
 - Stochastic exploration does not generate enough extreme data
 - Hybrid methods?
- **But**
 - Data-driven approaches produce continuous variation



Future Work

- Application to new domains
 - Dialogue systems
 - Intelligent tutoring systems
- Interactive narrative systems
 - E.g. Façade (Mateas & Stern, 2003)
 - AAAI Spring Symposium



Summary – Parameter Estimation Models

- Data-driven method for modelling personality **continuously**
- Multiple traits can be recognized **simultaneously**
 - In a very specific domain
 - Within a single utterance
- **No overgeneration/search**

Thank you

- Java demo of PERSONAGE available
<http://www.dcs.shef.ac.uk/cogsys/personage.html>

- Related papers

François Mairesse and Marilyn Walker. A Personality-based Framework for Utterance Generation in Dialogue Applications. In *AAAI Spring Symposium on Emotion, Personality and Social Behavior*, Stanford, March 2008.

François Mairesse and Marilyn Walker. PERSONAGE: Personality Generation for Dialogue. In *Proceedings of the 45th Annual Meeting of the ACL*, Prague, June 2007.