
# Discourse Analytics and Educational Data Mining

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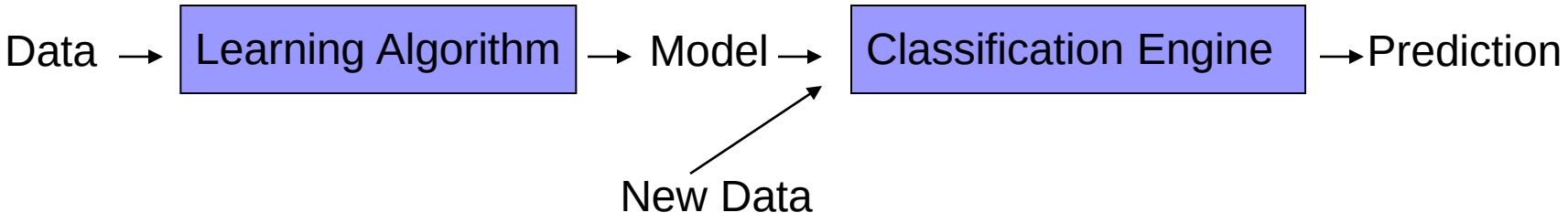
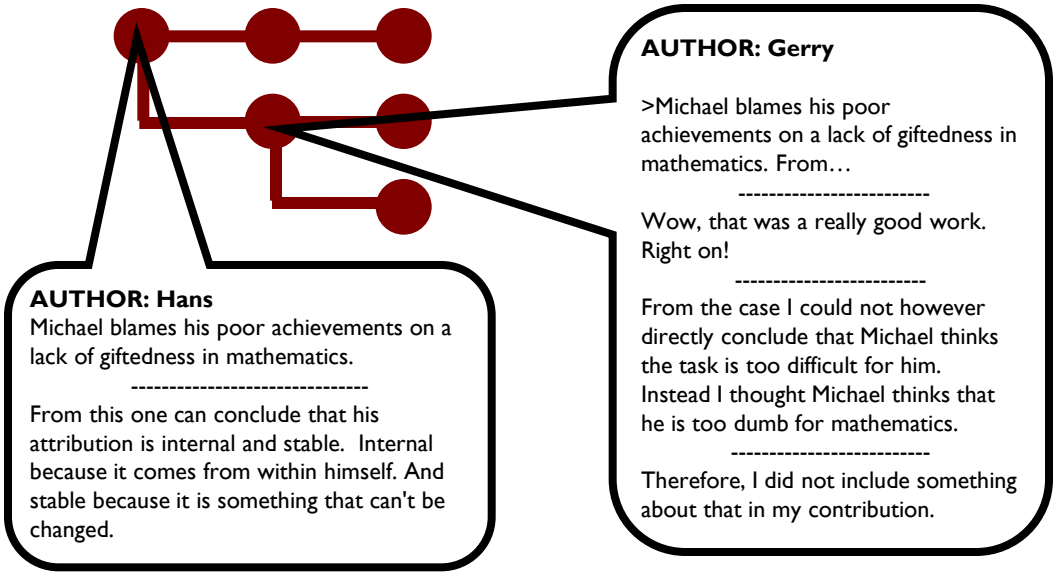
# Overview of TagHelper Article Results

# What is machine learning?

- Automatically or *semi-automatically*
  - Inducing rules from data
  - Making predictions

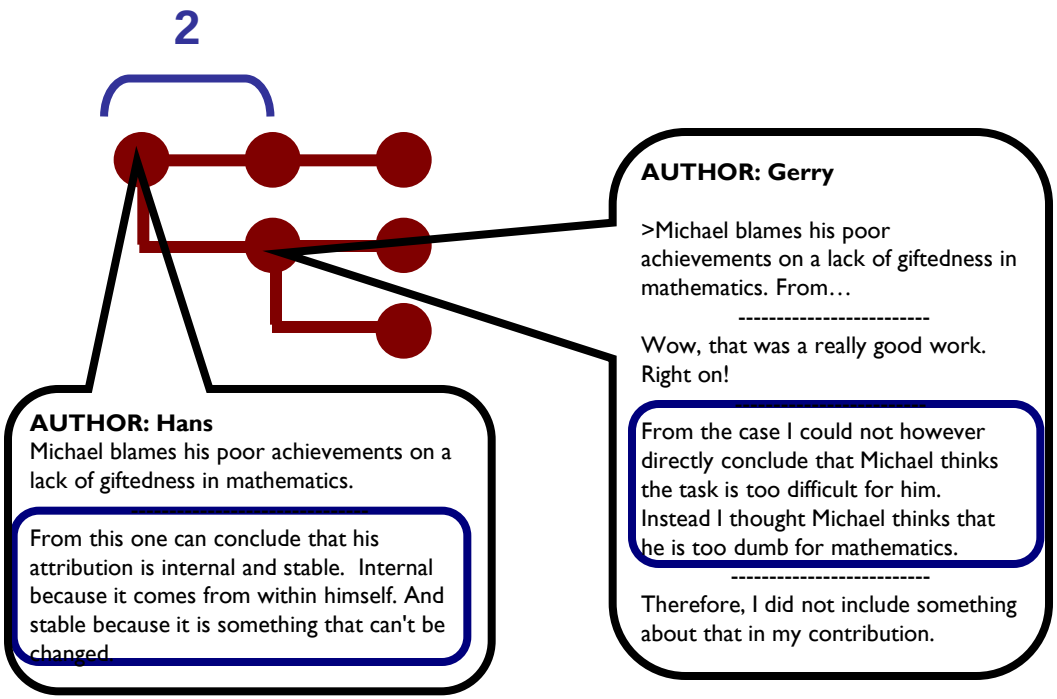


# Identifying Transactivity in Threaded Discussions



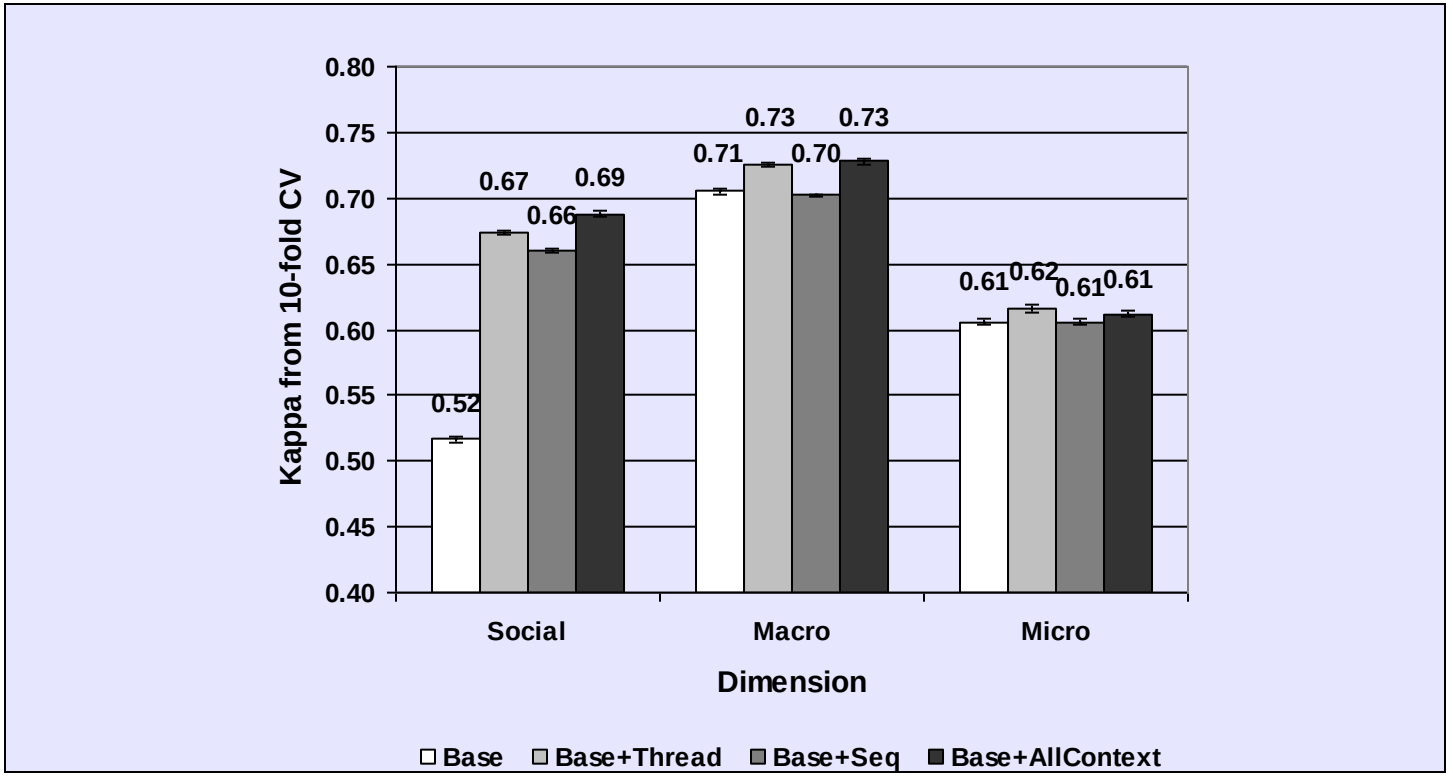

- Social modes of co-construction (Weinberger & Fischer, 2006)
  - To what degree or in what ways learners refer to the contributions of their learning partners
- TagHelper tools achieves reliability of .69 Kappa (Rosé et al., 2008)

# Thread Structure Features

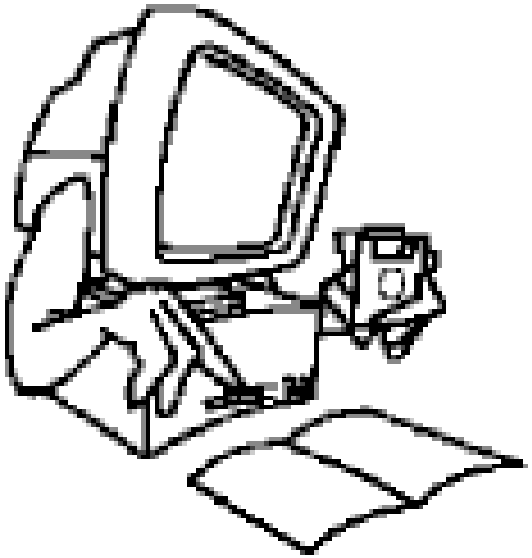



- Thread structure features
  - ***depth*** (numeric): the depth in the thread where a message appears
  - ***parent_child_similarity*** (numeric): semantic similarity (cosine similarity) between the current message segment to all its parent message segments. The highest value is chosen

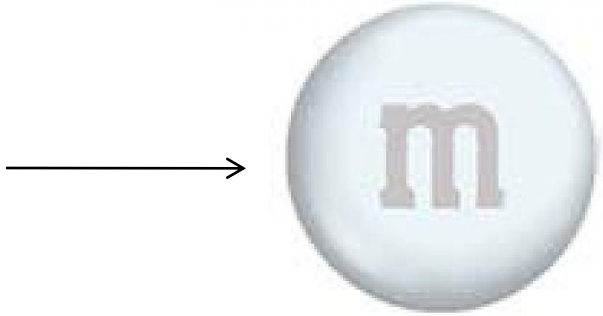
# Evaluating Context-Based Features



# Important caveat!!



- Machine learning isn't magic
- But it can be useful for identifying meaningful patterns in your data when used properly
- Proper use requires insight into your data




?

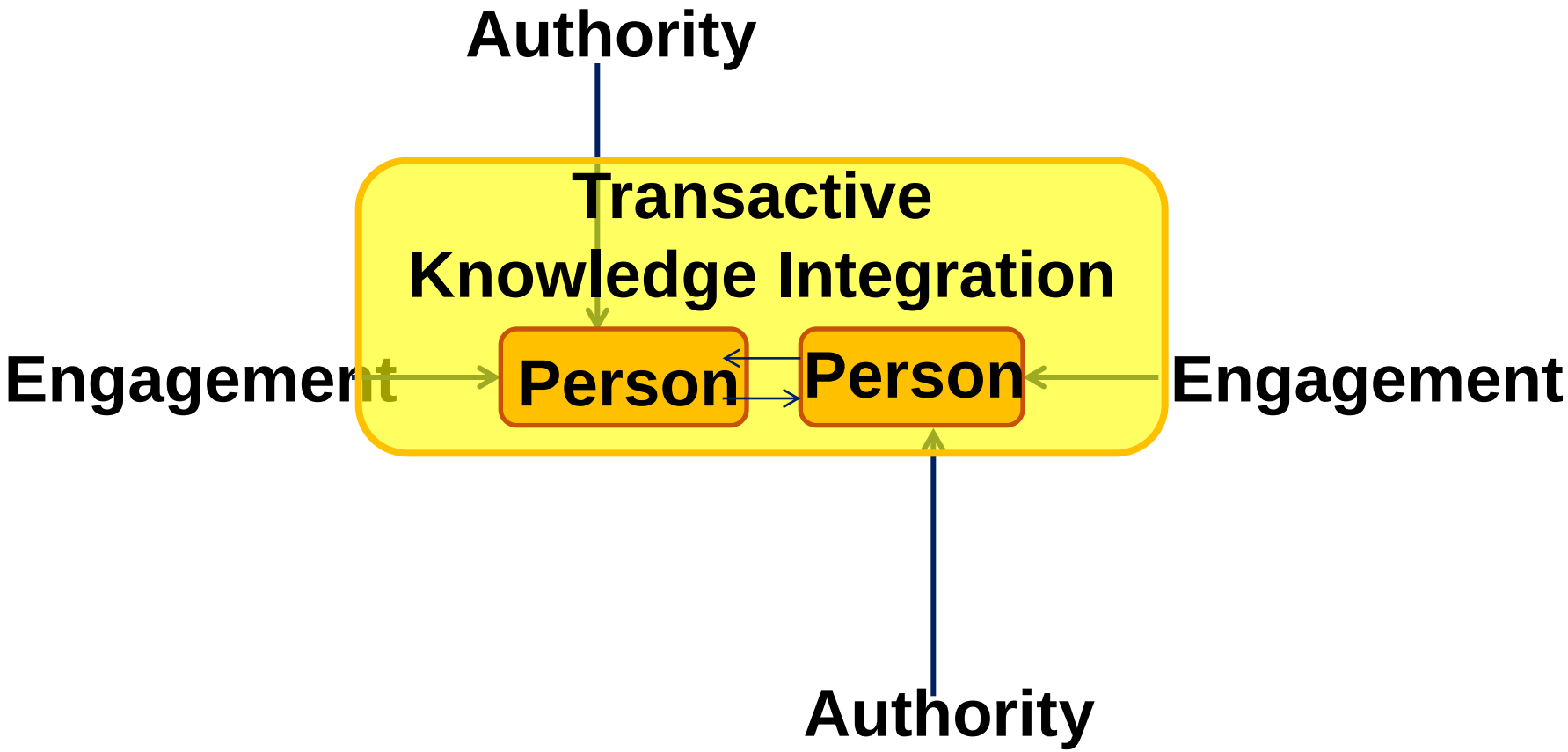
# Discussion Questions

- Do you believe the results from this paper are strong enough to convince you to use automated analysis in your work?
  - If not, what would you need to see?
- How would you summarize the issues with respect to reliability and validity when using automated coding in comparison with hand coding?
- In what specific ways could you imagine using automated coding in your own research?

# SouFLé (part 1)

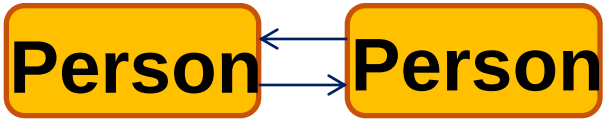
Transactivity

# SouFLé Framework (Howley et al., 2013)



# Souflé Framework

(Howley et al., in press)

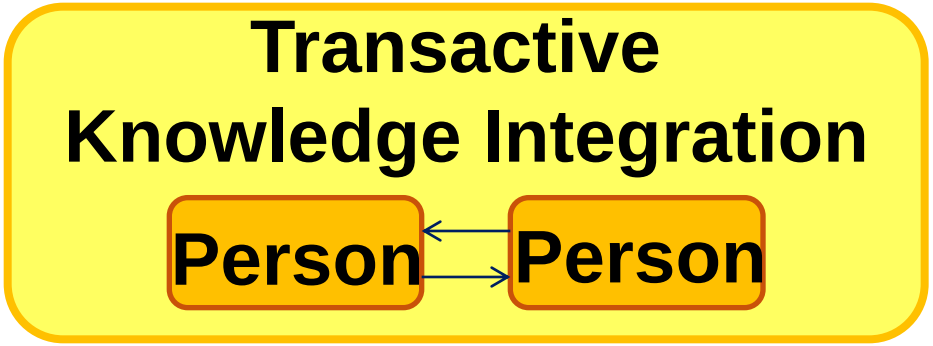



3 Dimensions:

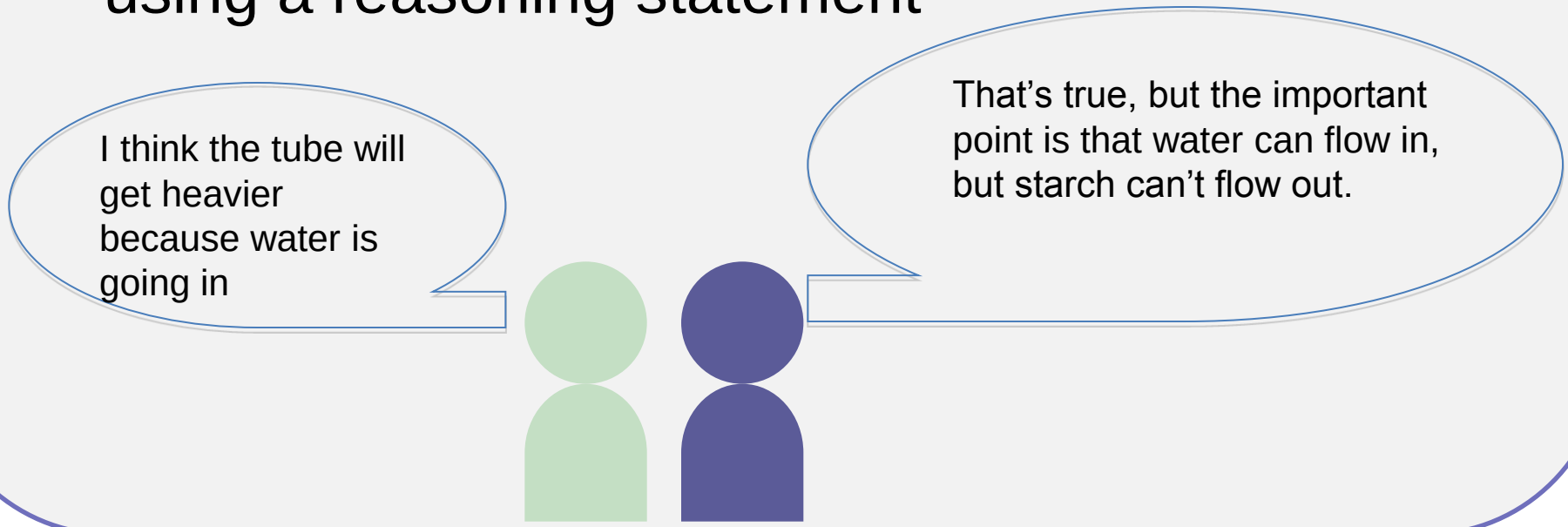
- Transactivity
- Engagement
- Authoritativeness

# Souflé Framework

(Howley et al., in press)



- Definition of Transactivity
  - building on an idea expressed earlier in a conversation
  - using a reasoning statement



# Transactivity (Berkowitz & Gibbs, 1983)

- Findings
  - Moderating effect on learning (Joshi & Rosé, 2007; Russell, 2005; Kruger & Tomasello, 1986; Teasley, 1995)
  - Moderating effect on knowledge sharing in working groups (Gweon et al., 2011)
- Computational Work
  - Can be automatically detected in:
    - Threaded group discussions (Kappa .69) (Rosé et al., 2008)
    - Transcribed classroom discussions (Kappa .69) (Ai et al., 2010)
    - Speech from dyadic discussions (R = .37) (Gweon et al., 2012)
      - Predictable from a measure of speech style accommodation computed by an unsupervised Dynamic Bayesian Network (Jain et al., 2012)

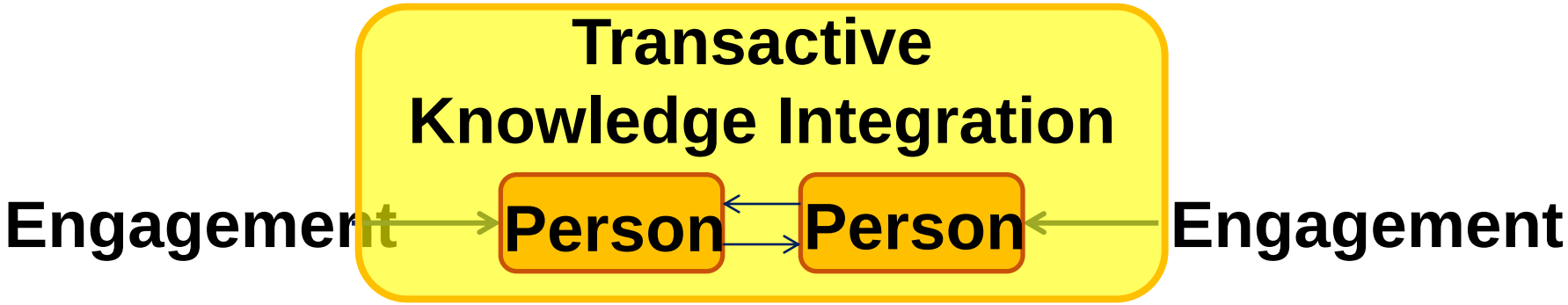
| | | | Reasoning | Transactivity |
|---|---|---|---|---|
| AUTHOR | TEXT | TIME | | |
| Doctor Bob | Hi - I'm Doctor Bob, your instructor for today's lab. | 05.07.13 | | |
| Sa04 | Well bob, I hope you don't mind that I'm actively hostile to robots. | 05.07.36 | | |
| Doctor Bob | You're working together, but you've each got a different design goal - it's at the top of | 05.07.39 | | |
| Doctor Bob | Take a moment to share your goal with your partner. | 05.07.42 | | |
| sa08 | most environmentally friendly | 05.08.00 | | |
| Sa04 | my goal is to maximize power. yours? | 05.08.10 | | |
| Doctor Bob | To help you meet your design goals, we are going to discuss some of the parameters | 05.08.43 | | |
| Doctor Bob | Lets start with Tmax. | 05.08.46 | | |
| sa08 | so basically, we comprmise on greeness and power | 05.10.53 | | |
| Doctor Bob | The heat rejected by the cycle increases by increasing Tmax. | 05.11.13 | X | |
| Doctor Bob | We see this in Graph 3 of the worksheet. | 05.11.16 | | |
| Doctor Bob | BTW: Is it safe to keep increasing Tmax? | 05.12.17 | | |
| sa08 | no | 05.12.33 | | |
| Sa04 | nope. you'll blow out your turbine | 05.12.33 | X | |
| Doctor Bob | Good. Material properties constrain the maximum temperature we can use in a Cycle. For our cycle, Tmax cannot be more than 570C | 05.12.39 | X | X |
| Doctor Bob | Try using this understanding that our team now shares to come up with a potential value of Tmax (T @ S2) that will help you meet your objectives. | 05.12.44 | | |
| sa08 | We don't want it to be at 570 both for the material and [the environment] | 05.12.48 | X | X |
| sa08 | well, for power and efficiency, we want a high tmax, but environmentally, we want a lower one. It has to be higher than 410 for steam quality | 05.14.03 | X | X |
| sa08 | so somwhere between 410 and 570 | 05.14.26 | X | X |
| sa08 | what about right in the middle, what about 500? | 05.14.40 | | |
| Sa04 | seems reasonable | 05.14.57 | | |
| sa08 | We choose 500 degrees C | 05.15.21 | | |
| Sa04 | however, environmental friendliness can be increased by either increasing efficiency or by reducing waste heat, so maybe it's better to just max out our temperature. | 05.15.53 | X | |

# Discussion Questions

- How does the construct of transactivity relate to conversational or non-conversational constructs you have investigated in your own work?
- Based on your understanding of transactivity, which of the following would you expect to correlate with it and why:
  - Level of rapport within groups
  - Usage of dialect specific language features
  - Gesture and gaze
- How might non-linguistic and extra-linguistic features that correlate with transactivity be used in an automated conversation analysis approach?

# SouFLé (part 2)

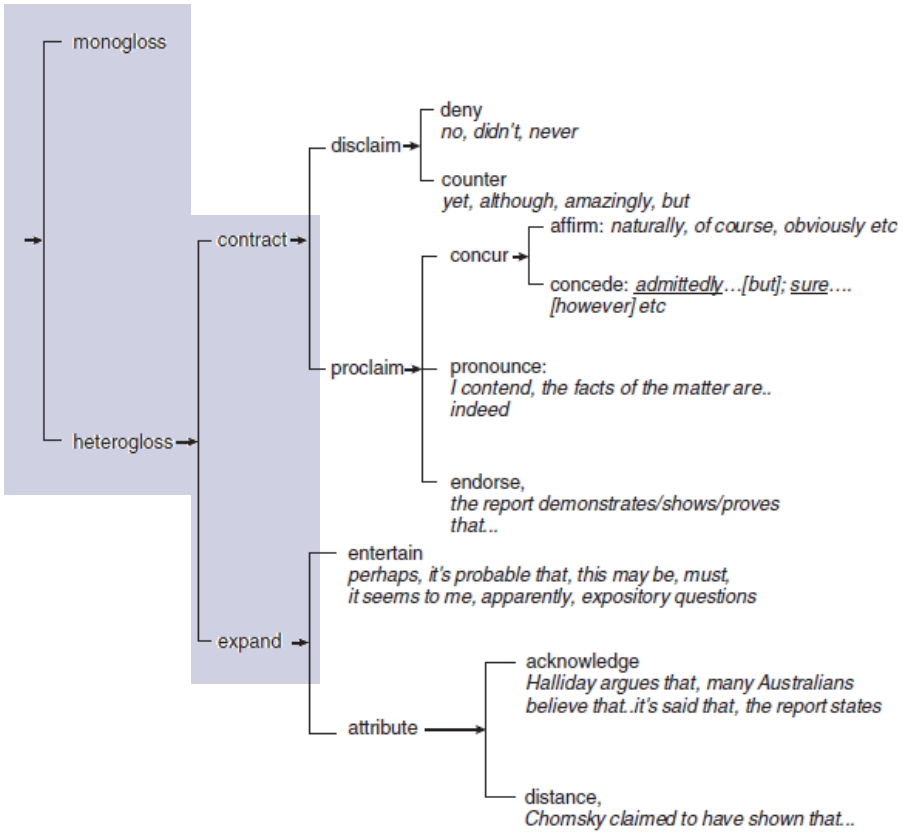
Engagement/Heteroglossia


Transactive
Knowledge Integration
Engagement
Person
Person
Engagement

# Engagement

(Martin & White, 2005, p117)

- System of Engagement
  - Showing openness to the existence of other perspectives
  - Less final / Invites more discussion
- Example:
  - **[M]** Nuclear is a good choice
  - **[HE]** I consider nuclear to be a good choice
  - **[HC]** There's no denying that nuclear is a superior choice
  - **[NA]** Is nuclear a good choice?



# Engagement (Martin & White, 2005)

- Findings
  - *Correlational analysis:* Strong correlation between displayed openness of group members and articulation of reasoning (R = .72) (Dyke et al., 2013)
  - *Intervention study:* Causal effect on propensity to articulate ideas in group chats (effect size .6 standard deviations) (Kumar et al., 2011)
    - Mediating effect of idea contribution on learning in scientific inquiry (Wang et al., 2011)

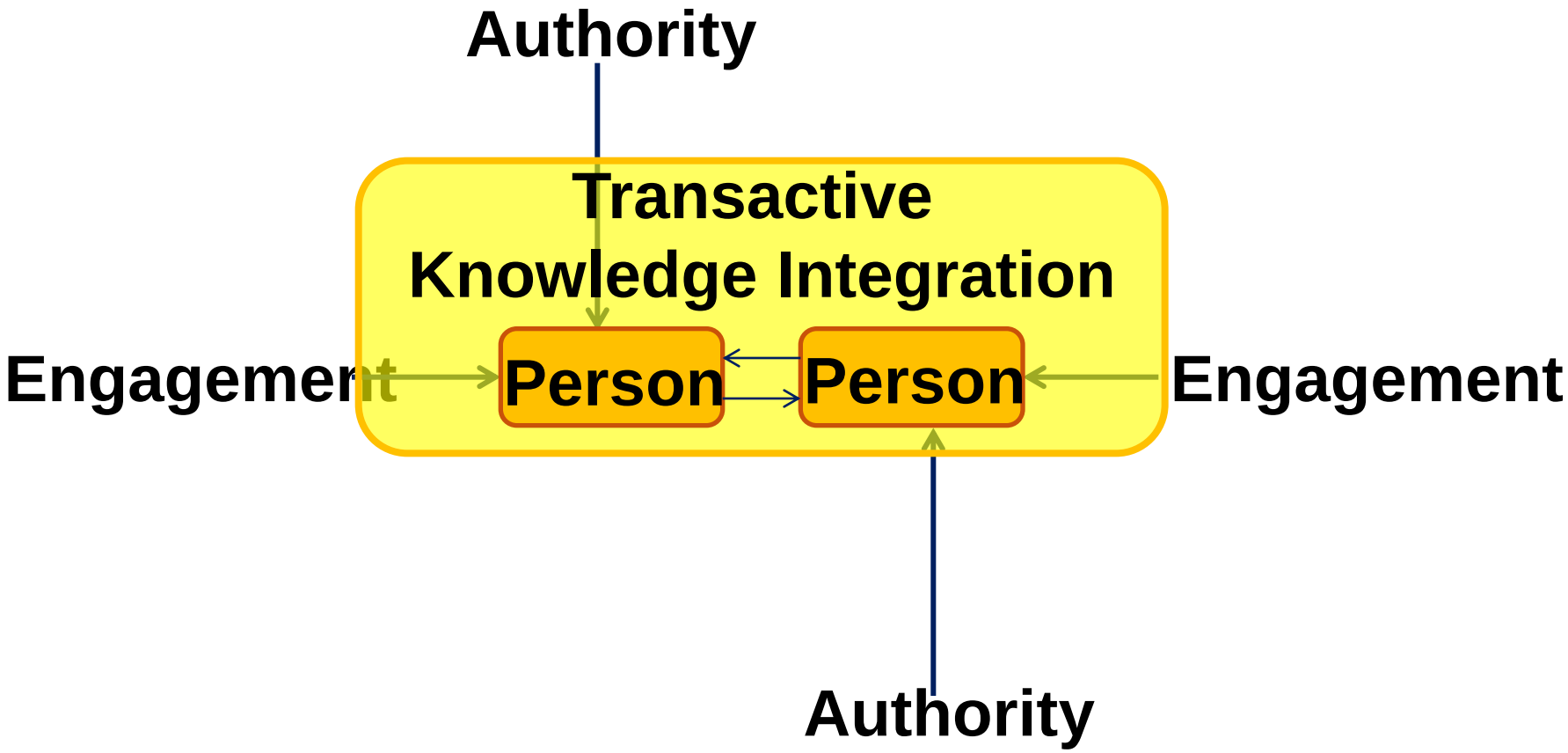
| | | | Engagement |
|---|---|---|---|
| AUTHOR | TEXT | TIME | |
| Doctor Bob | Hi - I'm Doctor Bob, your instructor for today's lab. | 05.07.13 | [M]ono |
| Sa04 | Well bob, I hope you don't mind that I'm actively hostile to robots. | 05.07.36 | [HE]xpand |
| Doctor Bob | You're working together, but you've each got a different design goal - it's at the top of | 05.07.39 | [M]ono |
| Doctor Bob | Take a moment to share your goal with your partner. | 05.07.42 | |
| sa08 | most environmentally friendly | 05.08.00 | [M]ono |
| Sa04 | my goal is to maximize power. yours? | 05.08.10 | [M]ono |
| Doctor Bob | To help you meet your design goals, we are going to discuss some of the parameters | 05.08.43 | [M]ono |
| Doctor Bob | Lets start with Tmax. | 05.08.46 | |
| sa08 | so basically, we comprmise on greeness and power | 05.10.53 | [M]ono |
| Doctor Bob | The heat rejected by the cycle increases by increasing Tmax. | 05.11.13 | [M]ono |
| Doctor Bob | We see this in Graph 3 of the worksheet. | 05.11.16 | [HE]xpand |
| Doctor Bob | BTW: Is it safe to keep increasing Tmax? | 05.12.17 | |
| sa08 | no | 05.12.33 | [M]ono |
| Sa04 | nope. you'll blow out your turbine | 05.12.33 | [M]ono |
| Doctor Bob | Good. Material properties constrain the maximum temperature we can use in a Cycle. For our cycle, Tmax cannot be more than 570C | 05.12.39 | [M]ono |
| Doctor Bob | Try using this understanding that our team now shares to come up with a potential value of Tmax (T @ S2) that will help you meet your objectives. | 05.12.44 | |
| sa08 | We don't want it to be at 570 both for the material and [the environment] | 05.12.48 | [HE]xpand |
| sa08 | well, for power and efficiency, we want a high tmax, but environmentally, we want a lower one. It has to be higher than 410 for steam quality | 05.14.03 | [HE]xpand |
| sa08 | so somwhere between 410 and 570 | 05.14.26 | [M]ono |
| sa08 | what about right in the middle, what about 500? | 05.14.40 | [HE]xpand |
| Sa04 | seems reasonable | 05.14.57 | [HE]xpand |
| sa08 | We choose 500 degrees C | 05.15.21 | [HE]xpand |
| Sa04 | however, environmental friendliness can be increased by either increasing efficiency or by reducing waste heat, so maybe it's better to just max out our temperature. | 05.15.53 | [HE]xpand |

# Discussion Questions

- How does the construct of Engagement relate to conversational or non-conversational constructs you have investigated in your own work?
- What might make Engagement easier or harder to recognize automatically than transactivity?
- How would you explain the correlation between Engagement and articulation of Reasoning in discussions?

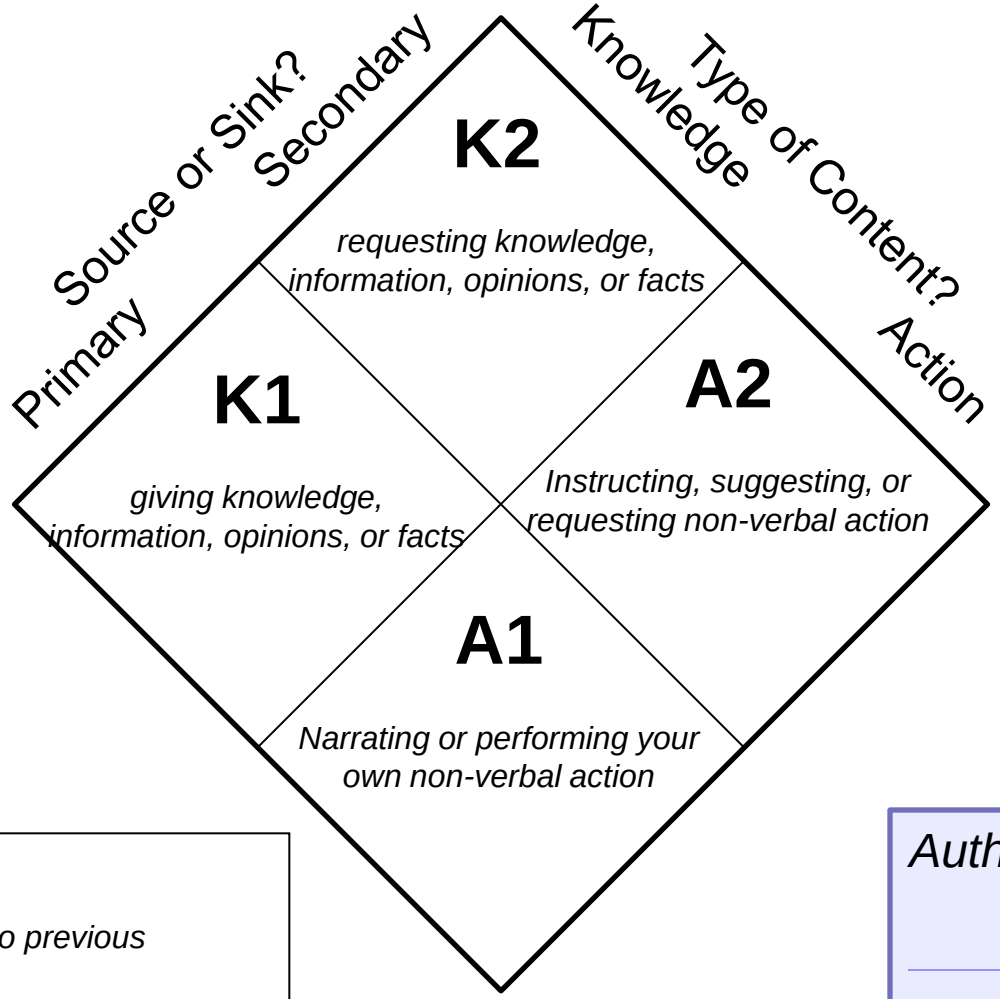
# SouFLé (part 3)

Authoritativeness


Authority
Transactive
Knowledge Integration
Engagement
Person
Person
Engagement
Authority

# The Negotiation Framework

(Martin & Rose, 2003)




*Additionally…*

**ch** *(direct challenge to previous utterance)*

**o** *(all other moves, backchannels, etc.)*

*Authoritativeness:*

**K1 + A2**

**K1 + K2 + A1 + A2**

# Authoritativeness (Martin & Rose, 2003)

- Findings
  - Authoritativeness measures display how students respond to aggressive behavior in groups (Howley et al., in press)
  - Authoritativeness predicts learning (R = .64) and self-efficacy (R = .35) (Howley et al., 2011)
  - Authoritativeness predicts trust in doctor-patient interactions (R values between .25 and .35) (Mayfield et al., under review)
- Computational Work
  - Detectable in collaborative learning chat logs (R = .86)
  - Detectable in transcribed dyadic discussions in a knowledge sharing task (R = .95) (Mayfield & Rosé, 2011)
  - Detectable in transcribed doctor-patient interactions (R = .96) (Mayfield et al., under review)

| | | | Authority |
|---|---|---|---|
| AUTHOR | TEXT | TIME | |
| Doctor Bob | Hi - I'm Doctor Bob, your instructor for today's lab. | 05.07.13 | K1 |
| Sa04 | Well bob, I hope you don't mind that I'm actively hostile to robots. | 05.07.36 | K1 |
| Doctor Bob | You're working together, but you've each got a different design goal - it's at the top of | 05.07.39 | K1 |
| Doctor Bob | Take a moment to share your goal with your partner. | 05.07.42 | A2 |
| sa08 | most environmentally friendly | 05.08.00 | K1 |
| Sa04 | my goal is to maximize power. yours? | 05.08.10 | K1/ K2 |
| Doctor Bob | To help you meet your design goals, we are going to discuss some of the parameters | 05.08.43 | K1 |
| Doctor Bob | Lets start with Tmax. | 05.08.46 | A1 |
| sa08 | so basically, we comprmise on greeness and power | 05.10.53 | A1 |
| Doctor Bob | The heat rejected by the cycle increases by increasing Tmax. | 05.11.13 | K1 |
| Doctor Bob | We see this in Graph 3 of the worksheet. | 05.11.16 | K1 |
| Doctor Bob | BTW: Is it safe to keep increasing Tmax? | 05.12.17 | O |
| sa08 | no | 05.12.33 | K2 |
| Sa04 | nope. you'll blow out your turbine | 05.12.33 | K2 |
| Doctor Bob | Good. Material properties constrain the maximum temperature we can use in a Cycle. For our cycle, Tmax cannot be more than 570C | 05.12.39 | K1 |
| Doctor Bob | Try using this understanding that our team now shares to come up with a potential value of Tmax (T @ S2) that will help you meet your objectives. | 05.12.44 | A2 |
| sa08 | We don't want it to be at 570 both for the material and [the environment] | 05.12.48 | K1 |
| sa08 | well, for power and efficiency, we want a high tmax, but environmentally, we want a lower one. It has to be higher than 410 for steam quality | 05.14.03 | K1 |
| sa08 | so somwhere between 410 and 570 | 05.14.26 | K1 |
| sa08 | what about right in the middle, what about 500? | 05.14.40 | K1 |
| Sa04 | seems reasonable | 05.14.57 | o |
| sa08 | We choose 500 degrees C | 05.15.21 | A1 |
| Sa04 | however, environmental friendliness can be increased by either increasing efficiency or by reducing waste heat, so maybe it's better to just max out our temperature. | 05.15.53 | K1 |

# Discussion Questions

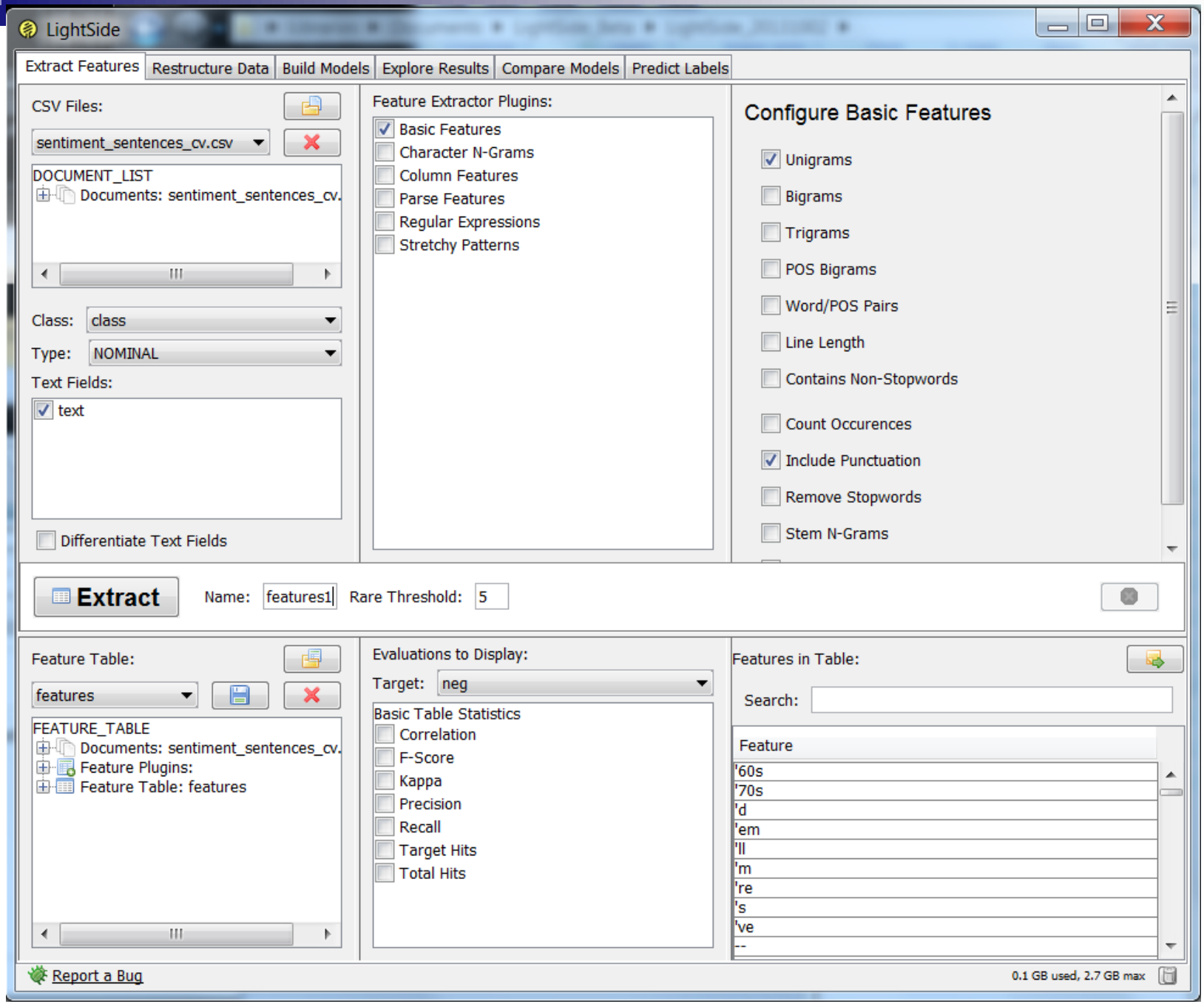
- How does the construct of Authoritativeness relate to conversational or non-conversational constructs you have investigated in your own work?

- How would you explain the connection between Authoritativeness and Self-efficacy? Would you be surprised if there was a correlation in learning contexts but not for doctors in doctor-patient interactions?

- What might explain the correlation between Authoritativeness and learning?

# LightSIDE: A more powerful tool for Automated Process Analysis

# Automated analysis – Quick Tour


LightSide
Extract Features
Restructure Data
Build Models
Explore Results
Compare Models
Predict Labels
CSV Files:
sentiment_sentences_cv.csv
DOCUMENT_LIST
Documents: sentiment_sentences_cv.
Class:
class
Type:
NOMINAL
Text Fields:
text
Differentiate Text Fields
Feature Extractor Plugins:
Basic Features
Character N-Grams
Column Features
Parse Features
Regular Expressions
Stretchy Patterns
Configure Basic Features
Unigrams
Bigrams
Trigrams
POS Bigrams
Word/POS Pairs
Line Length
Contains Non-Stopwords
Count Occurences
Include Punctuation
Remove Stopwords
Stem N-Grams
Extract
Name:
features1
Rare Threshold:
5
Feature Table:
features
FEATURE_TABLE
Documents: sentiment_sentences_cv.
Feature Plugins:
Feature Table: features
Evaluations to Display:
Target:
neg
Basic Table Statistics
Correlation
F-Score
Kappa
Precision
Recall
Target Hits
Total Hits
Features in Table:
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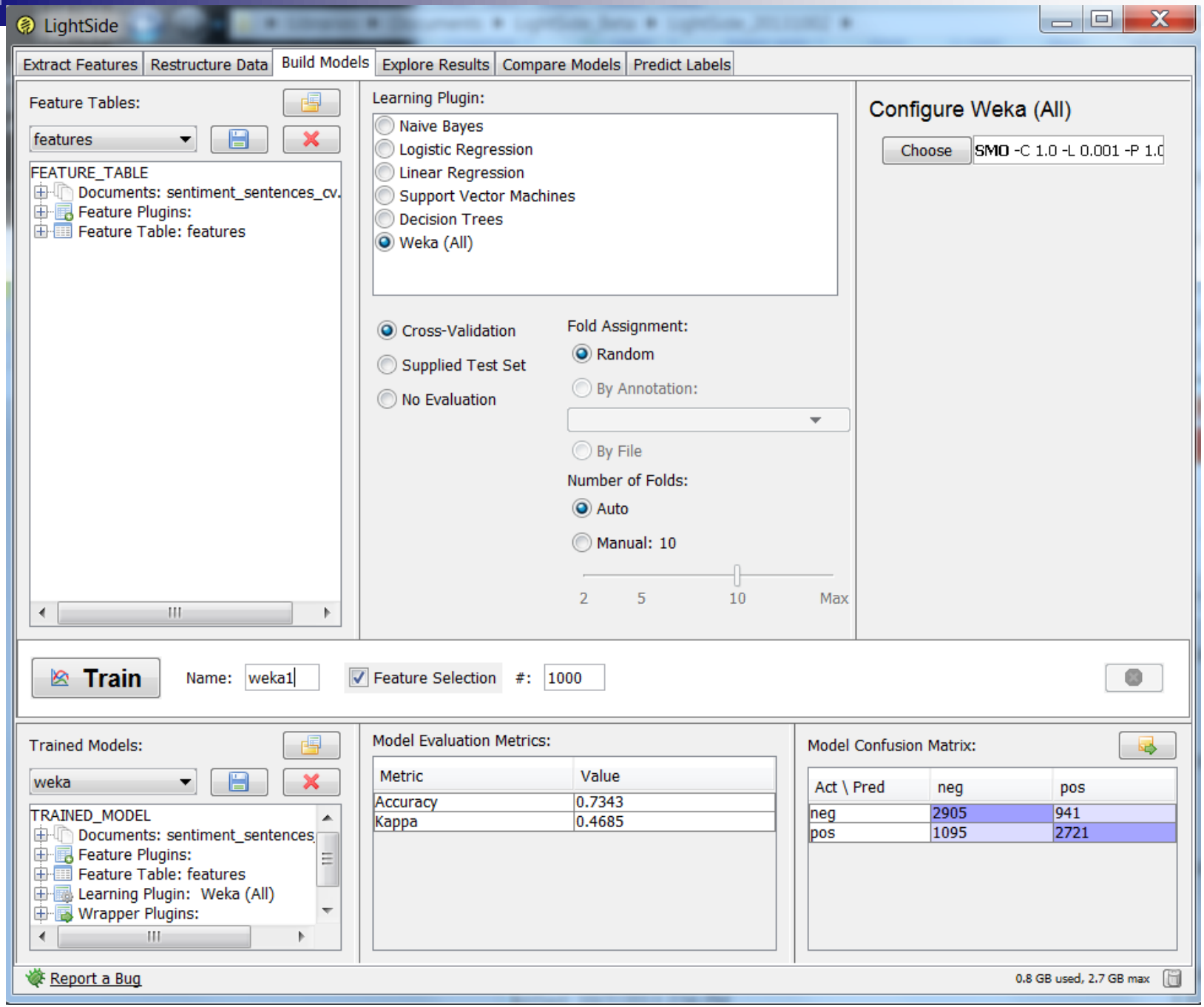
Report a Bug
0.1 GB used, 2.7 GB max


LightSide
Extract Features
Restructure Data
Build Models
Explore Results
Compare Models
Predict Labels
Feature Tables:
features
FEATURE_TABLE
Documents: sentiment_sentences_cv
Feature Plugins:
Feature Table: features
Learning Plugin:
Naive Bayes
Logistic Regression
Linear Regression
Support Vector Machines
Decision Trees
Weka (All)
Configure Weka (All)
Choose
SMO -C 1.0 -L 0.001 -P 1.0
Cross-Validation
Supplied Test Set
No Evaluation
Fold Assignment:
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By Annotation:
By File
Number of Folds:
Auto
Manual: 10
2
5
10
Max
Train
Name:
weka1
Feature Selection
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1000
Trained Models:
weka
TRAINED_MODEL
Documents: sentiment_sentences
Feature Plugins:
Feature Table: features
Learning Plugin: Weka (All)
Wrapper Plugins:
Model Evaluation Metrics:
Metric
Value
Accuracy
0.7343
Kappa
0.4685
Model Confusion Matrix:
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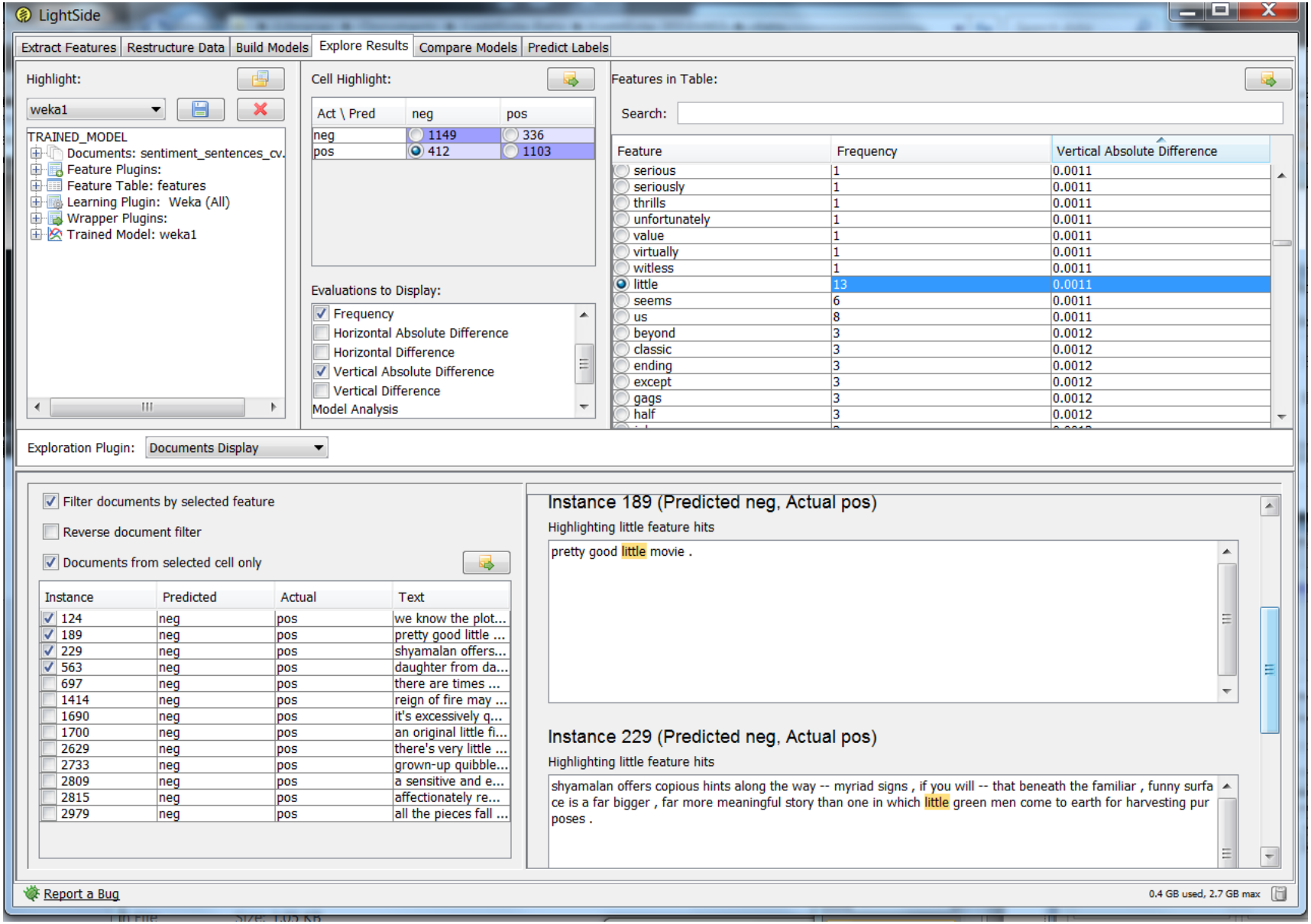
pos
neg
2905
941
pos
1095
2721
Report a Bug
0.8 GB used, 2.7 GB max


LightSide
Extract Features
Restructure Data
Build Models
Explore Results
Compare Models
Predict Labels
Highlight:
weka1
TRAINED_MODEL
Documents: sentiment_sentences_cv.
Feature Plugins:
Feature Table: features
Learning Plugin: Weka (All)
Wrapper Plugins:
Trained Model: weka1
Cell Highlight:
Act \ Pred
neg
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neg
1149
336
pos
412
1103
Evaluations to Display:
Frequency
Horizontal Absolute Difference
Horizontal Difference
Vertical Absolute Difference
Vertical Difference
Model Analysis
Features in Table:
Search:
Feature
Frequency
Vertical Absolute Difference
serious 1 0.0011
seriously 1 0.0011
thrills 1 0.0011
unfortunately 1 0.0011
value 1 0.0011
virtually 1 0.0011
witless 1 0.0011
little 13 0.0011
seems 6 0.0011
us 8 0.0011
beyond 3 0.0012
classic 3 0.0012
ending 3 0.0012
except 3 0.0012
gags 3 0.0012
half 3 0.0012
Exploration Plugin:
Documents Display
Filter documents by selected feature
Reverse document filter
Documents from selected cell only
Instance
Predicted
Actual
Text
124 neg pos we know the plot...
189 neg pos pretty good little ...
229 neg pos shyamalan offers...
563 neg pos daughter from da...
697 neg pos there are times ...
1414 neg pos reign of fire may ...
1690 neg pos it's excessively q...
1700 neg pos an original little fi...
2629 neg pos there's very little ...
2733 neg pos grown-up quibble...
2809 neg pos a sensitive and e...
2815 neg pos affectionately re...
2979 neg pos all the pieces fall ...
Instance 189 (Predicted neg, Actual pos)
Highlighting little feature hits
pretty good little movie .
Instance 229 (Predicted neg, Actual pos)
Highlighting little feature hits
shyamalan offers copious hints along the way -- myriad signs , if you will -- that beneath the familiar , funny surface is a far bigger , far more meaningful story than one in which little green men come to earth for harvesting purposes .
Report a Bug
0.4 GB used, 2.7 GB max

# Any Questions?