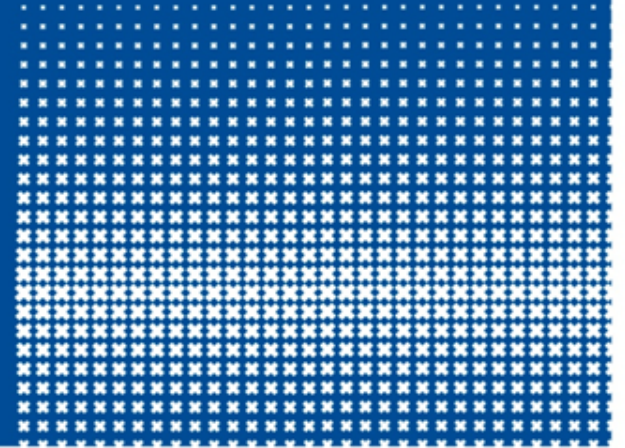




Jelke Bloem, Arjen Versloot, Fred Weerman



# Modelling Germanic Syntax

Word order changes and grammaticalization in verbal clusters

## Verbal clusters

### ■ Free order variation in Dutch

1. ik denk dat ik het begrepen<sub>2</sub> heb<sub>1</sub>  
I think that I it understood<sub>2</sub> have<sub>1</sub>
2. ik denk dat ik het heb<sub>1</sub> begrepen<sub>2</sub>  
I think that I it have<sub>1</sub> understood<sub>2</sub>

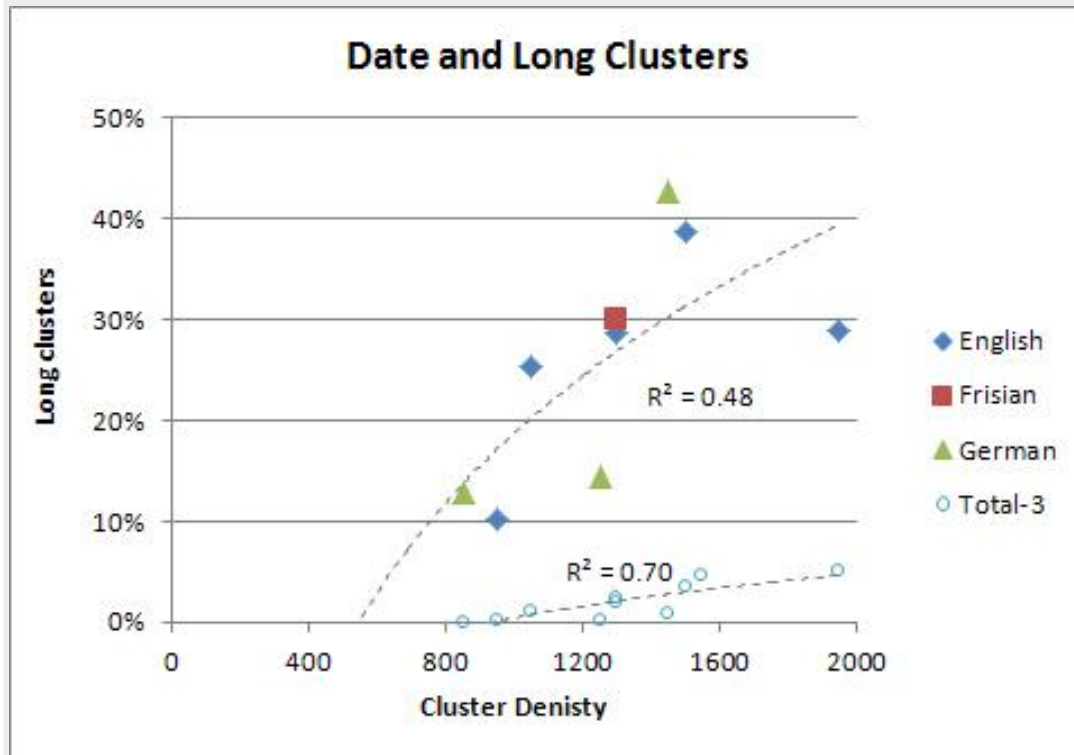
### ■ Frisian, German: Only descending order

### ■ English, Scandinavian: Only ascending order \*

# Model features

- Model in terms of 2 variables
  - 3 cluster types: mod+inf, have+PP, cop+PP
  - Clause type: main, sub
- 2 outcomes: **ascending** or **descending** order
- Initialize n agents with exemplar sentences
- Random agents transfer exemplars:
  - $p(\text{asc}|\text{mod-main}) = p(\text{asc}|\text{mod}) * p(\text{asc}|\text{main})$

# Growth of multi-verb constructions in Germanic Languages



- The growth of 2-verb clusters in Germanic languages since ca. 500
- The growth of 3-verb clusters in Germanic languages since ca. 800.

## Historical patterns underlying the model's starting position

- Constructions with *to have* growing from a very low level:

|                      | Old | Modern |
|----------------------|-----|--------|
| English: <i>have</i> | 2%  | 31%    |
| German: <i>haben</i> | 1%  | 36%    |

- Constructions with *participles* biased towards subordinate clauses:

| % participles   | main clauses | subordinate clauses |
|-----------------|--------------|---------------------|
| Old High German | 70%          | 95%                 |
| Old Frisian     | 15%          | 37%                 |

- Modals + infinitives* have a preference for **ascending** word order:

| ascending       | copula + part. | modal + infinitiv |
|-----------------|----------------|-------------------|
| Old High German | 58%            | 83%               |
| Old Frisian     | 15%            | 66%               |

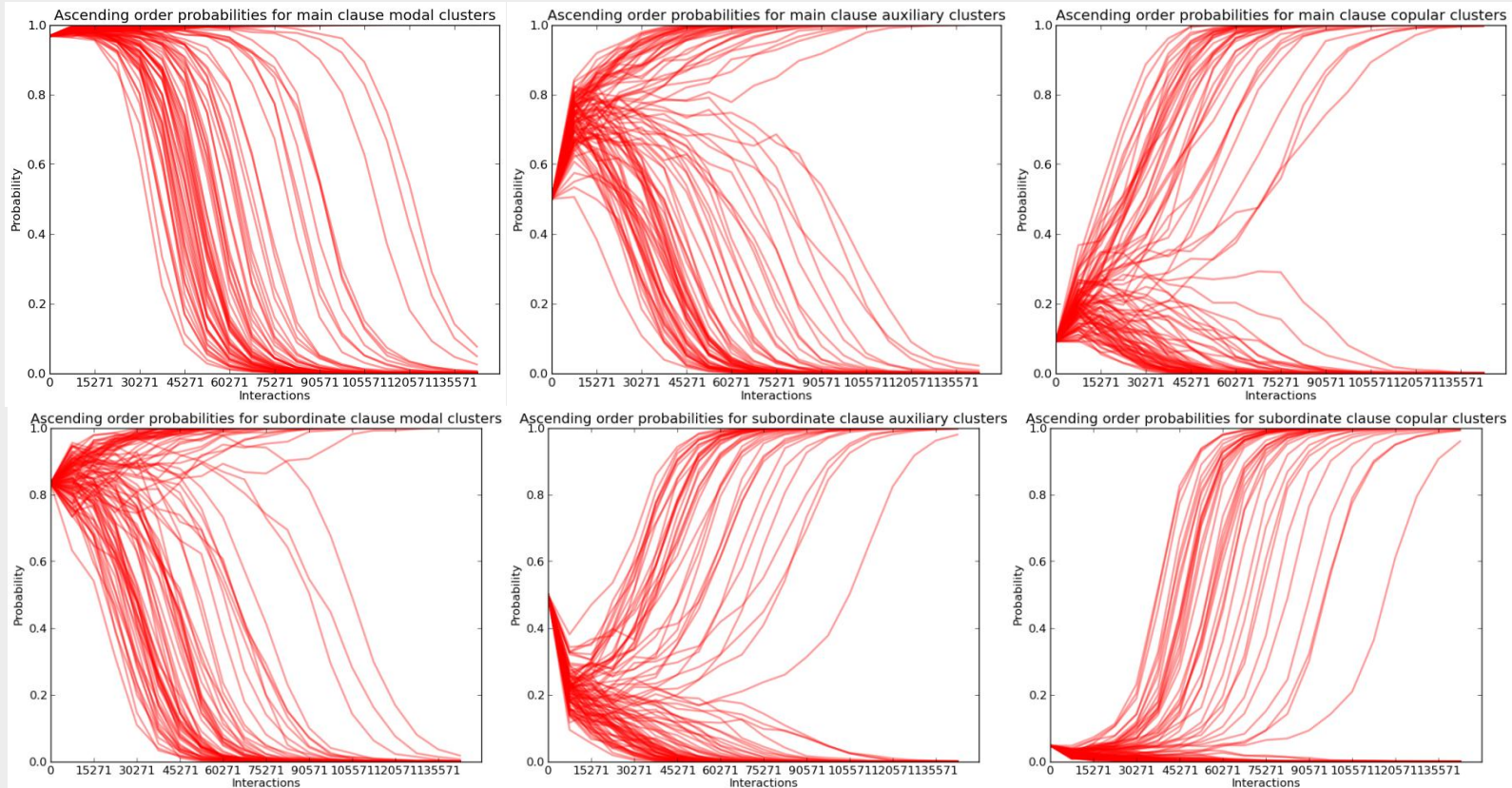
# Starting position for the algorithm

An “idealized” situations starts with:

- **ascending** *modal + infinitive* constructions, predominantly appearing in main clauses
- **descending** participium + copula constructions, predominantly appearing in subordinate clauses

|                    | Modal + inf. | <i>to have</i> + part. | copula + part. |
|--------------------|--------------|------------------------|----------------|
| main clause        | 30           | 1                      | 10             |
| subordinate clause | 5            | 1                      | 20             |

# Outcome for 30 agents, 5000 interactions even increase of *to have*-constructions and subordinate clauses



The model correctly predicts both dominant  
**ascending** (English) and **descending** (German)

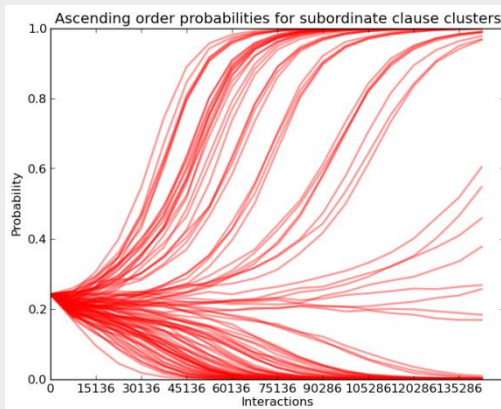
understood have | have understood

Modelling Germanic syntax



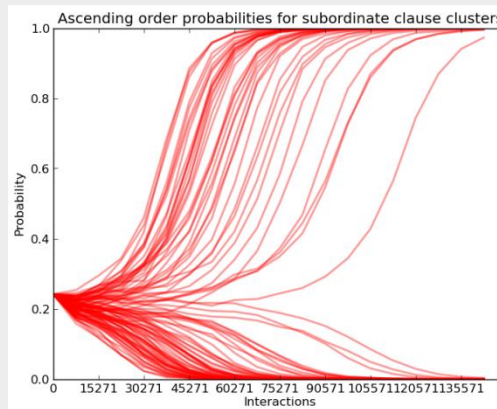
# Influence of the relative growth velocity of *to have*-constructions (typical for English)

quick growth ('English')



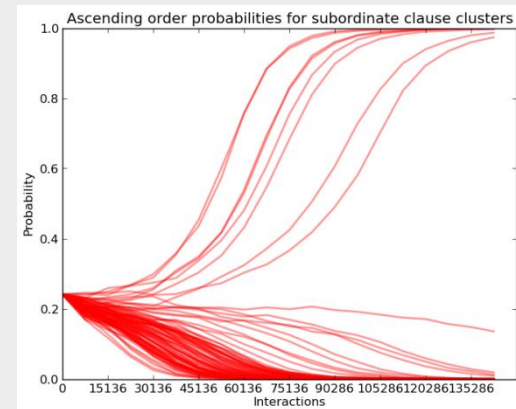
56%/35%

moderate growth



63%/36%

slow growth ('German')



92%/7%

The dominant word order may depend on different preference for specific constructions

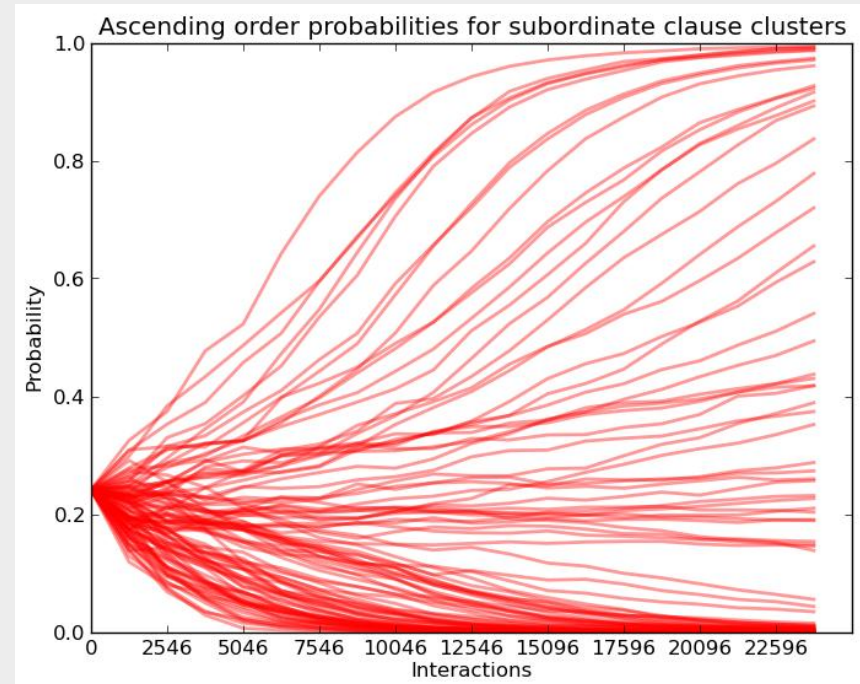


## Discussion

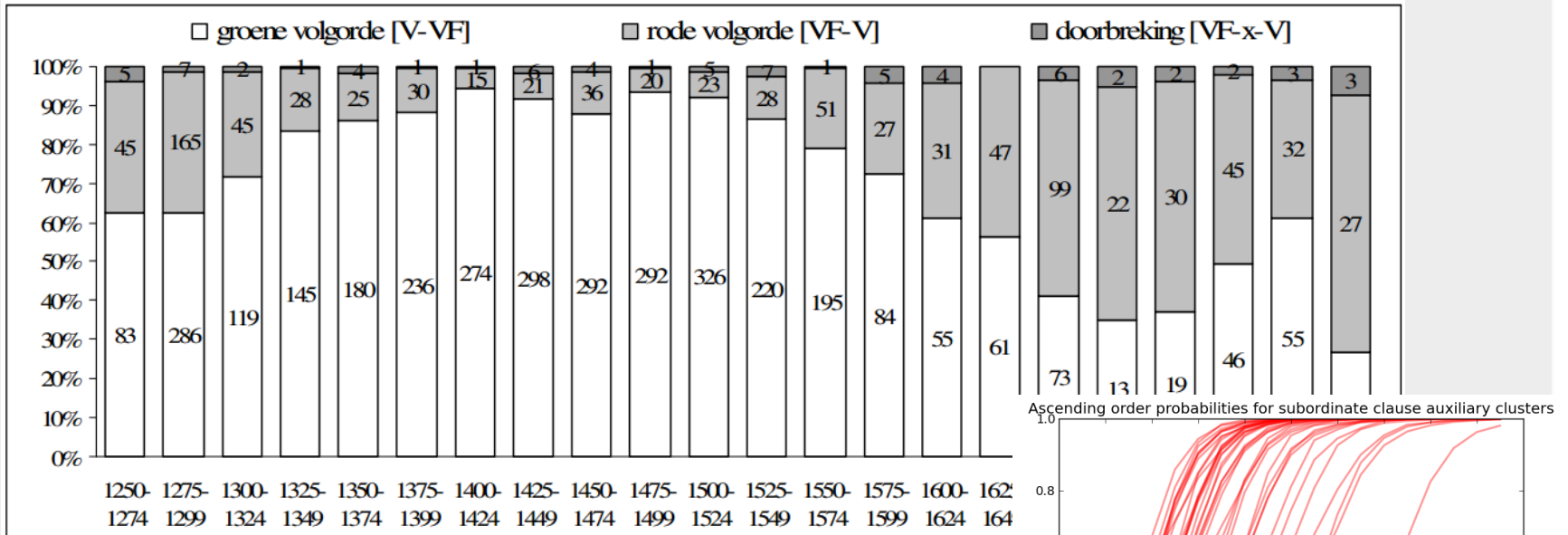
- Auxiliary type and clause type may be used as a diachronic explanation
- Grammaticalization or embedding?
  - This can not **be denied**. (main clause)
  - ... that it not **denied** can **be**. (Contrasting)
- Increased use of subordinate clauses may have changed base order to **descending**
- “Have” clusters support the opposite **ascending** order (English examples)
- Unstable phenomenon can be modelled well

# Dutch variation: a change in progress?

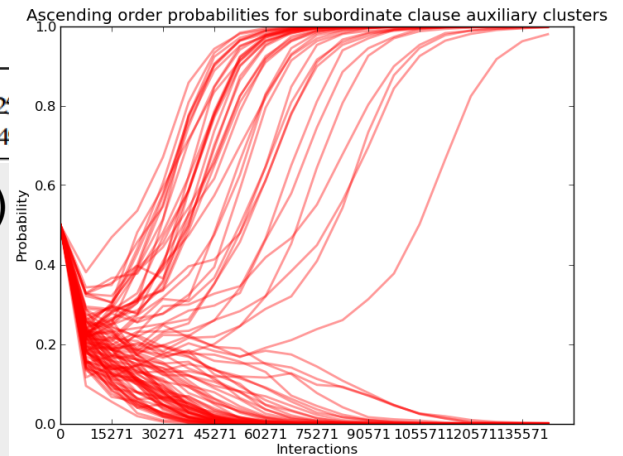
- Model may remain in unstable state for a while
  - Optionality
- Dutch is changing to 100% ascending order?



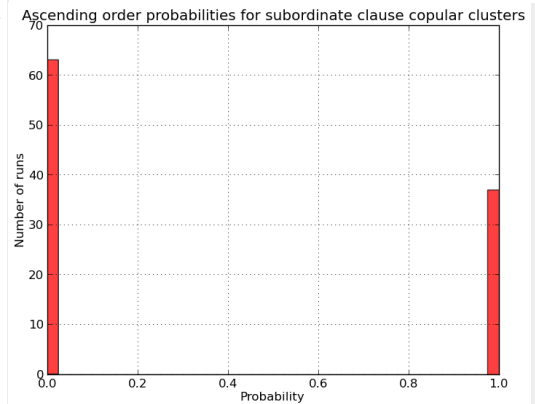
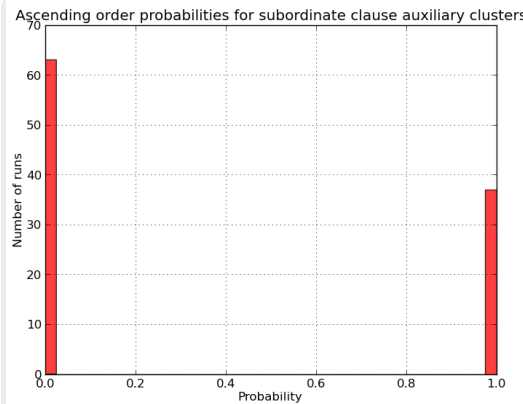
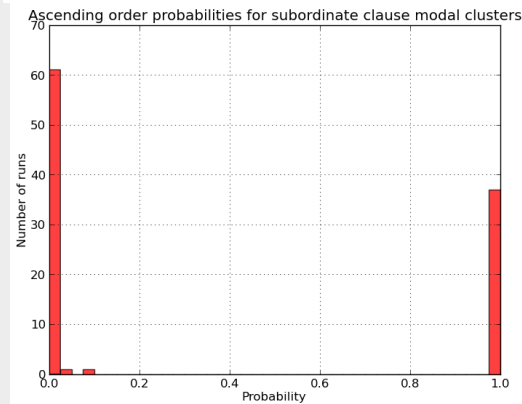
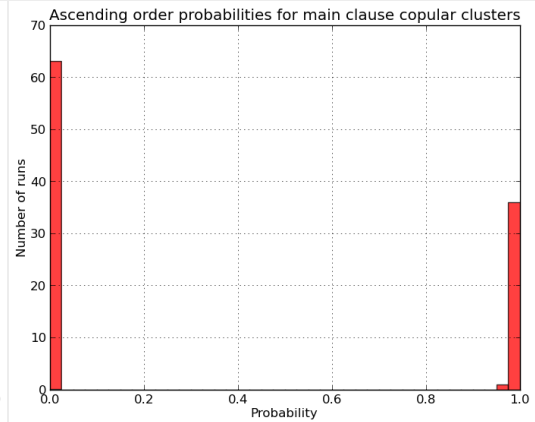
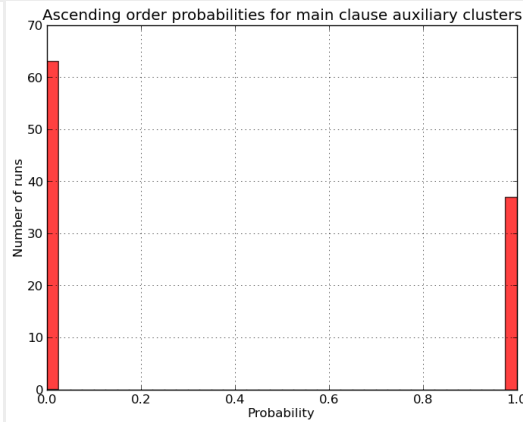
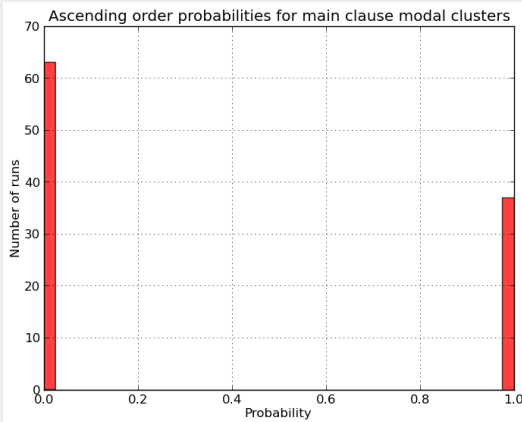
# Dutch historical change



Verb order in official texts (n = 4327) (Coussé 2008)



# Outcome for 30 agents, 5000 interactions even increase of *to have*-constructions and subordinate clauses



The model correctly predicts both dominant  
**ascending** (English) and **descending** (German)

understood have | have understood

# Diachronic change in cluster order

Model predictions:

| %green | mod+inf | habba+PP | cop+pp |
|--------|---------|----------|--------|
| main   | 100%    | 92%      | 70%    |
| sub    | 98%     | 33%      | 9%     |

Probabilities from early Modern Frisian text (c. 1550):

| %green | mod+inf | habba+PP | cop+pp |
|--------|---------|----------|--------|
| main   | 100%    | 100%     | 100%   |
| sub    | 100%    | 33%      | 20%    |

But: the 100% **ascending** main clause is the V2-effect, which our model does not yet account for

# Outcome probabilities (over ideal distributions)

## ■ Starting values:

|         |    |         |    |         |   |
|---------|----|---------|----|---------|---|
| mod-mc  | 30 | cop-mc  | 10 | heb-mc  | 1 |
| mod-sub | 5  | cop-sub | 20 | heb-sub | 1 |

$$p(\text{red}|\text{mod}) = 30 + 5 / (30+5+1+1) = 0.95$$

$$p(\text{red}|\text{mc}) = 30 + 1 / (30+1+10+1) = 0.74$$

$$p(\text{red}|\text{mod-mc}) = p(\text{red}|\text{mod}) * p(\text{red}|\text{mc}) = 0.7 / 70\%$$

$$P(\text{green}|\text{mod-mc}) = 1\%$$