Investigating Transition Probabilities in the *World Atlas of Language Structures*

Michael Cysouw
Max Planck Institute for Evolutionary Anthropology, Leipzig

Michael Cysouw
Max Planck Institute for Evolutionary Anthropology, Leipzig

Or:

Michael Cysouw
Max Planck Institute for Evolutionary Anthropology, Leipzig

Or:

What you see is *not* what you will get

Michael Cysouw

Max Planck Institute for Evolutionary Anthropology, Leipzig

Michael Cysouw
Max Planck Institute for Evolutionary Anthropology, Leipzig

Or:

Michael Cysouw
Max Planck Institute for Evolutionary Anthropology, Leipzig

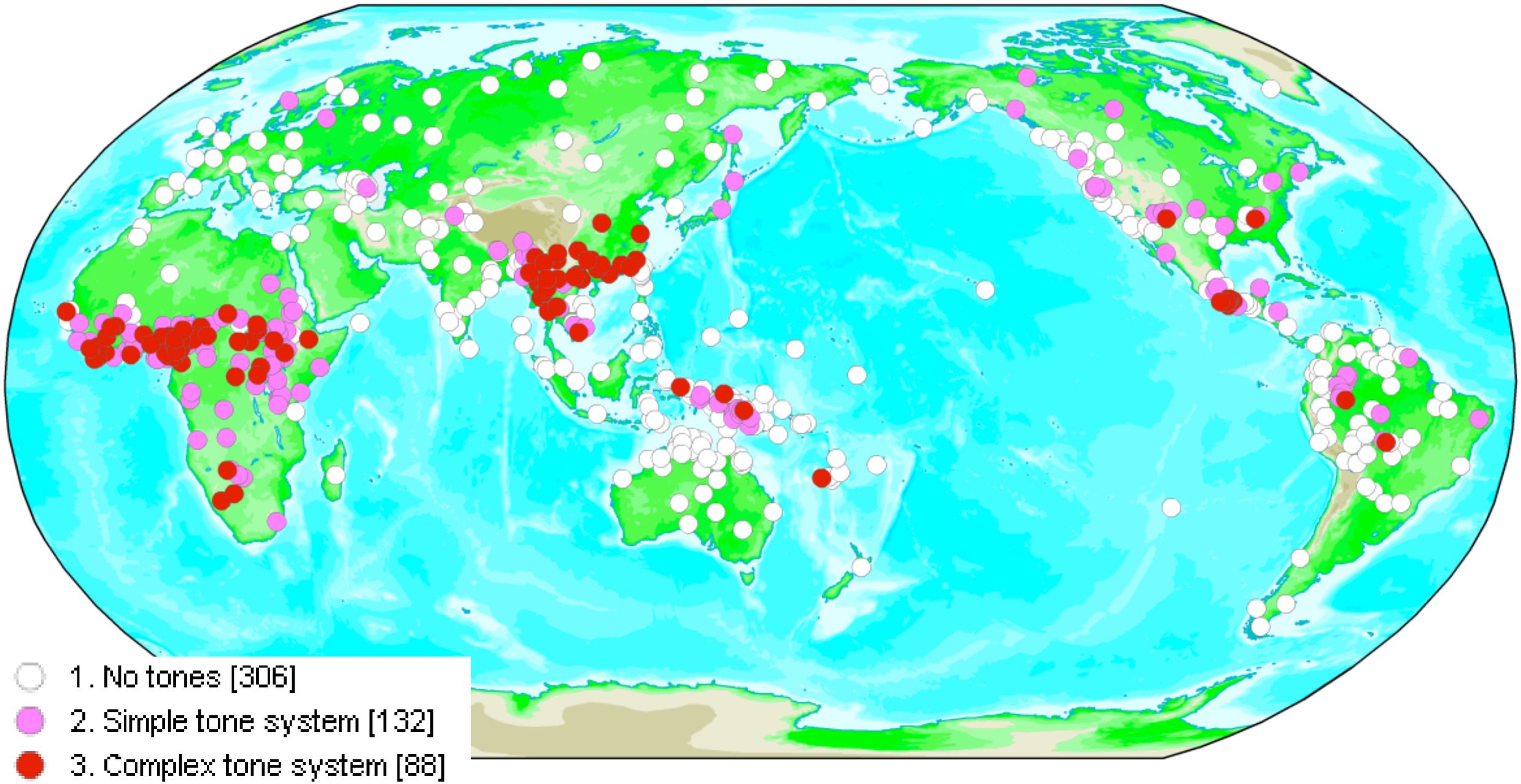
Or:

A plea for *"genealogical biased"* sampling

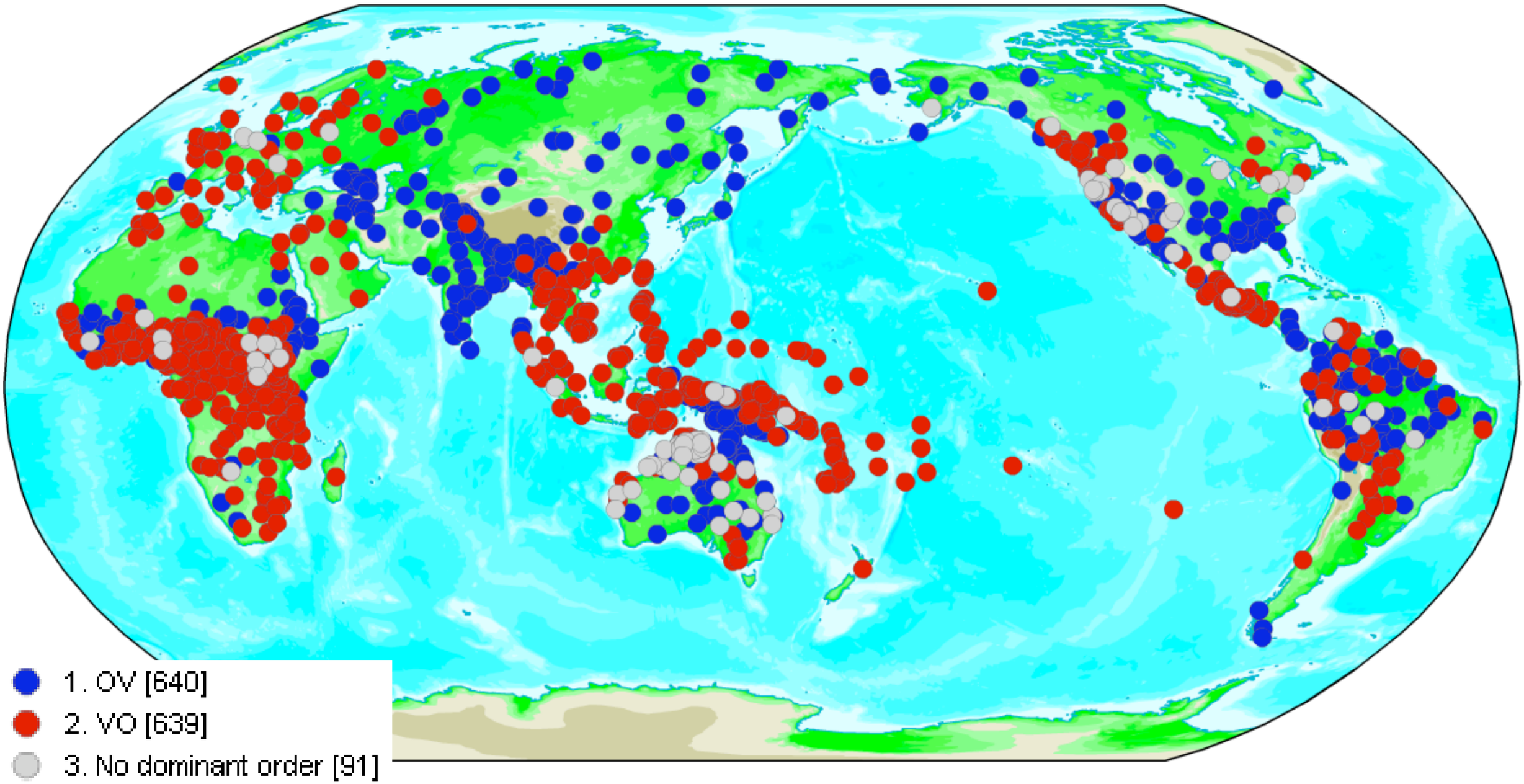
Michael Cysouw

Max Planck Institute for Evolutionary Anthropology, Leipzig

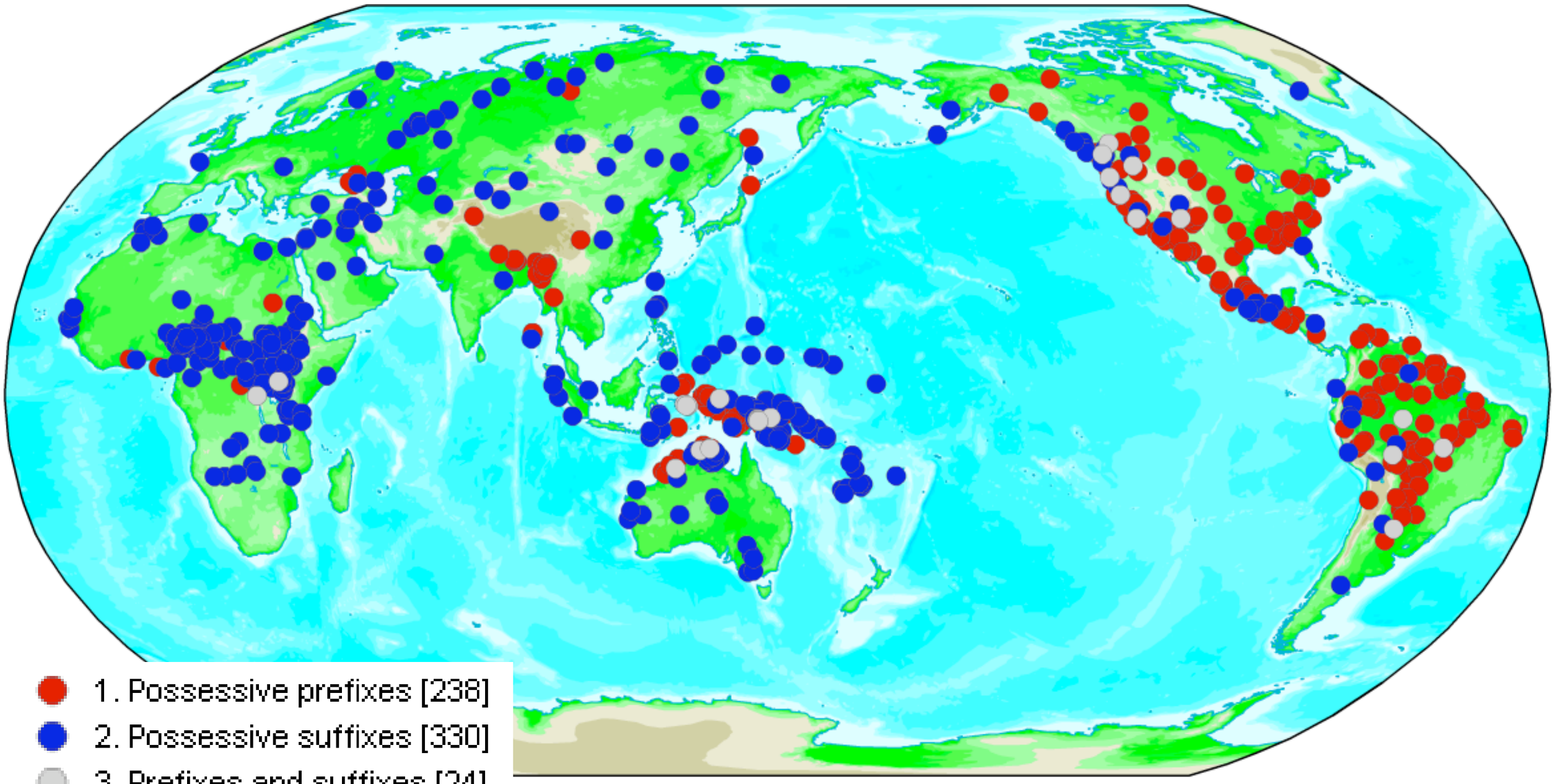
Tone
(Ian Maddieson)



Order of Object and Verb (Mathew Dryer)



Position of pronominal possessive affixes (Mathew Dryer)



Reactions to *Large Areal Consistencies*

Reactions to *Large Areal Consistencies*

- Matthew Dryer (starting from 1989):

Reactions to *Large Areal Consistencies*

- Matthew Dryer (starting from 1989):

  Problem for universals !

Reactions to *Large Areal Consistencies*

- Matthew Dryer (starting from 1989):

  Problem for universals !

- Johanna Nichols (starting from 1992):

Reactions to *Large Areal Consistencies*

- Matthew Dryer (starting from 1989):

  Problem for universals !

- Johanna Nichols (starting from 1992):

  Great for investigation of history !

Reactions to *Large Areal Consistencies*

- Matthew Dryer (starting from 1989):

  Problem for universals !

- Johanna Nichols (starting from 1992):

  Great for investigation of history !

- Elena Maslova (starting from 2001):

Reactions to *Large Areal Consistencies*

- Matthew Dryer (starting from 1989):

  Problem for universals !

- Johanna Nichols (starting from 1992):

  Great for investigation of history !

- Elena Maslova (starting from 2001):

  How strong is the historical influence ?

Dynamic Typology

(Maslova 2002, 2004)

Dynamic Typology
(Maslova 2002, 2004)

- It is not the actual frequencies that matter

Dynamic Typology
(Maslova 2002, 2004)

- It is not the actual frequencies that matter
- It is the stable distribution that matters

Dynamic Typology
(Maslova 2002, 2004)

- It is not the actual frequencies that matter
- It is the stable distribution that matters
- A stable distribution is a situation in which just as many languages change from A to B as change from B to A.

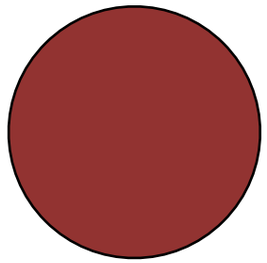
Dynamic Typology
(Maslova 2002, 2004)

- It is not the actual frequencies that matter
- It is the stable distribution that matters
  - A stable distribution is a situation in which just as many languages change from A to B as change from B to A.
  - The extent to which the actual is different from the stable situation signals an effect of history

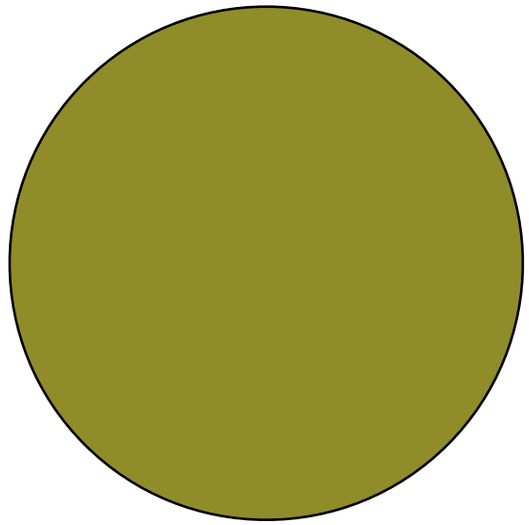
Type A

Type B

Type A

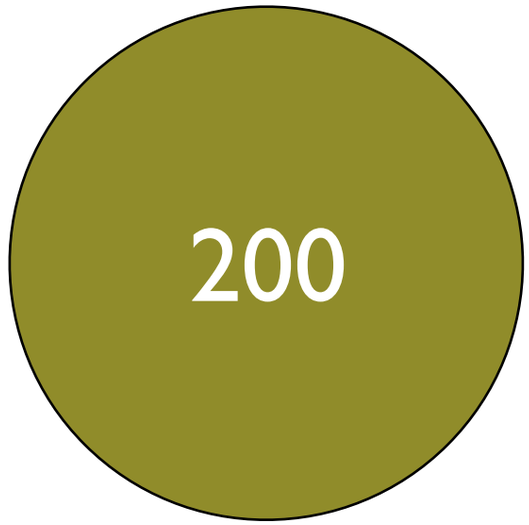


Type B



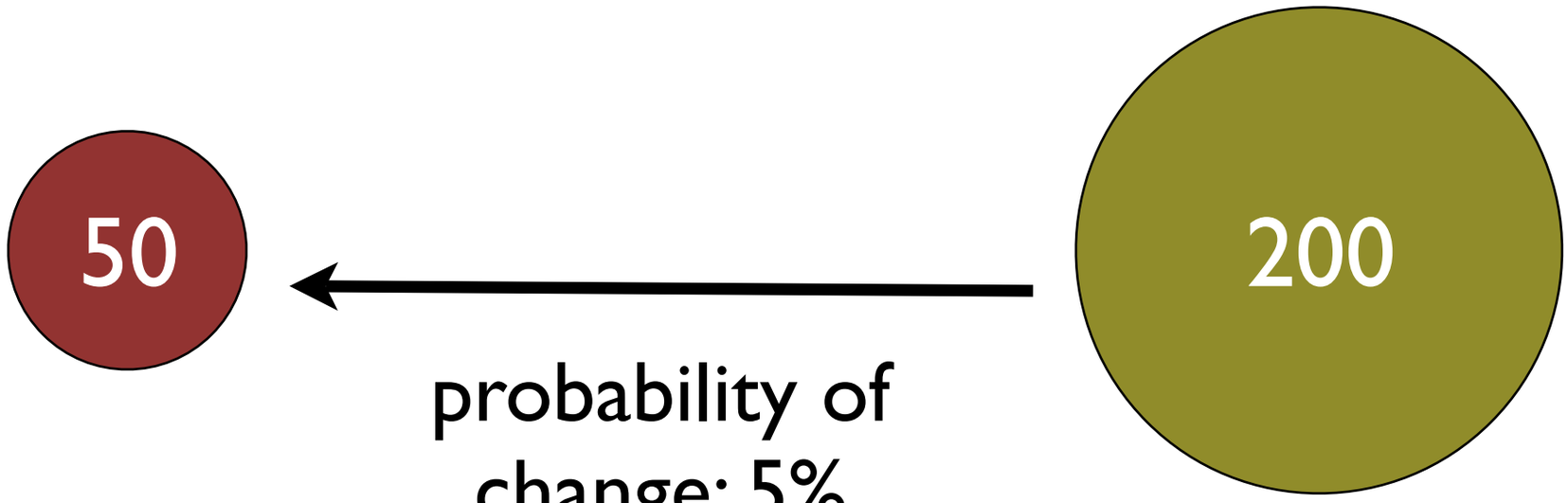
Type A

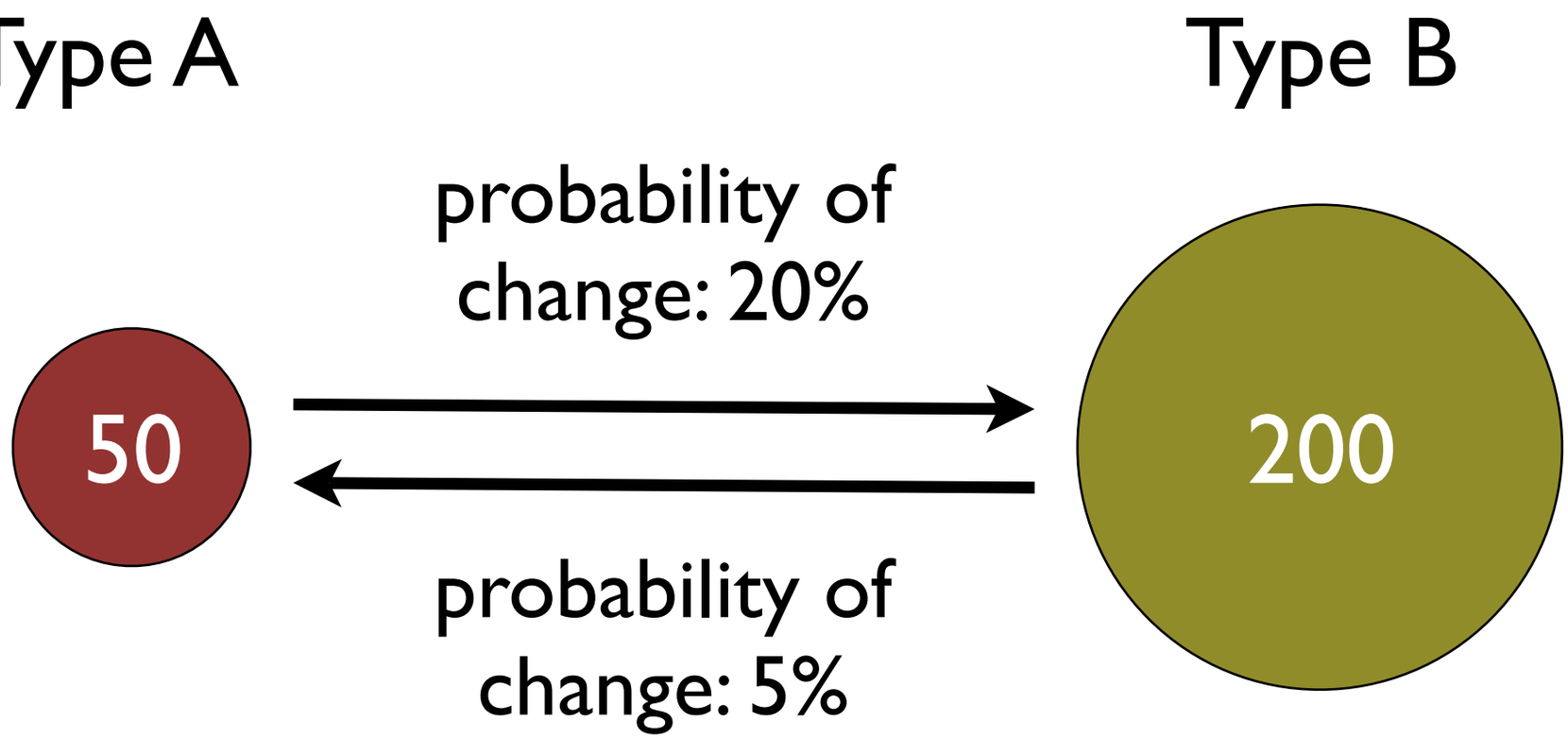
Type B

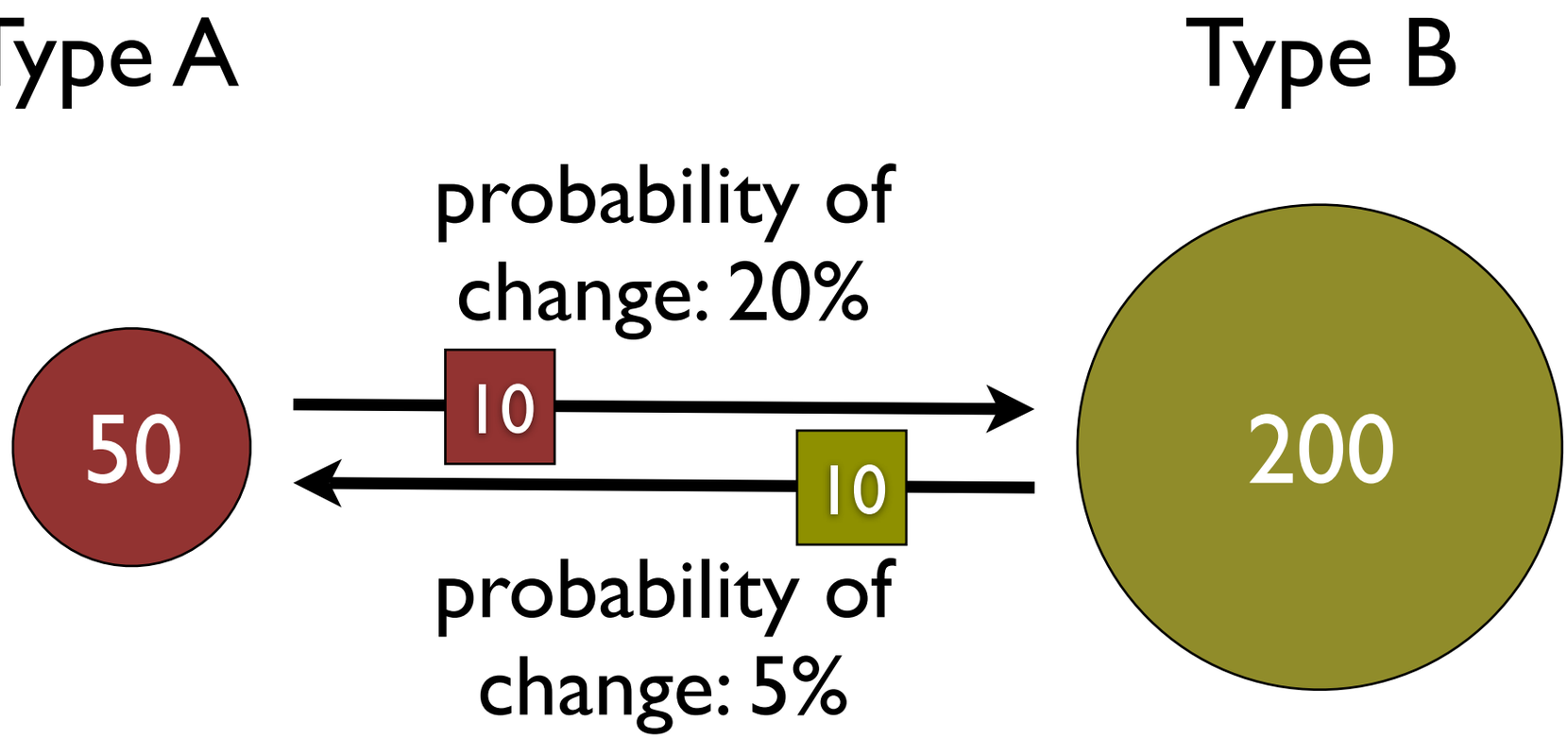


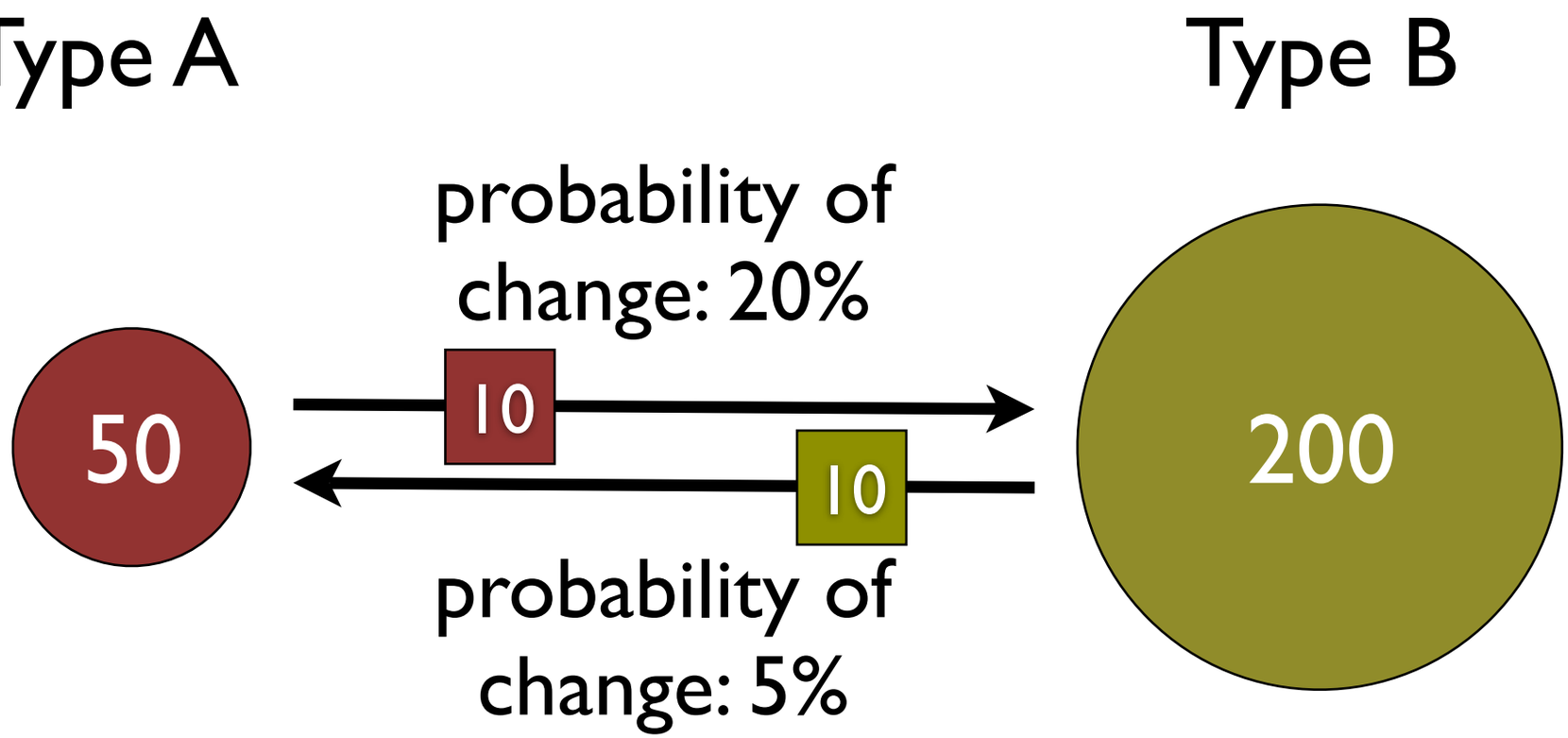
Type A

Type B

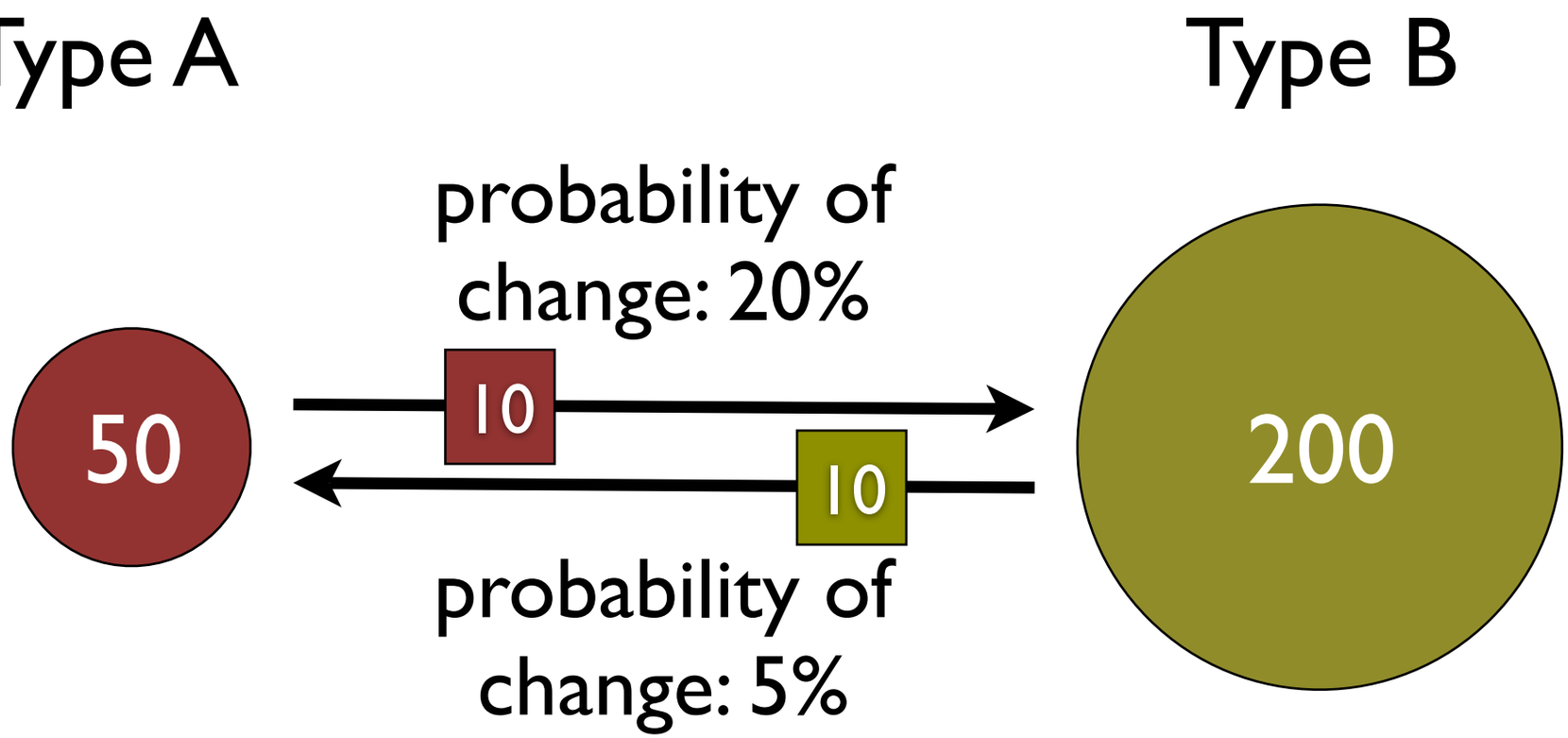


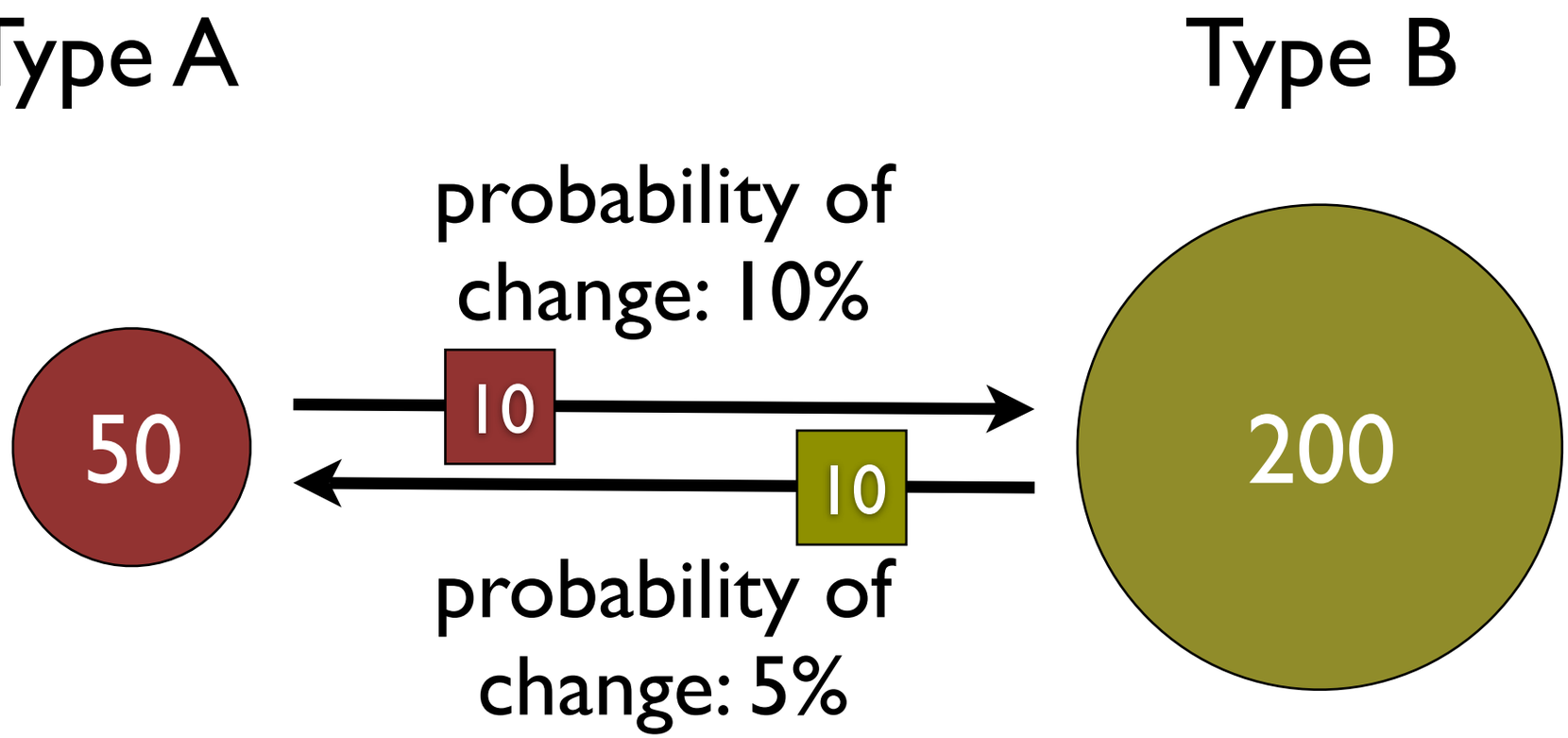

Type A
Type B
probability of change: 20%
50
200
probability of change: 5%

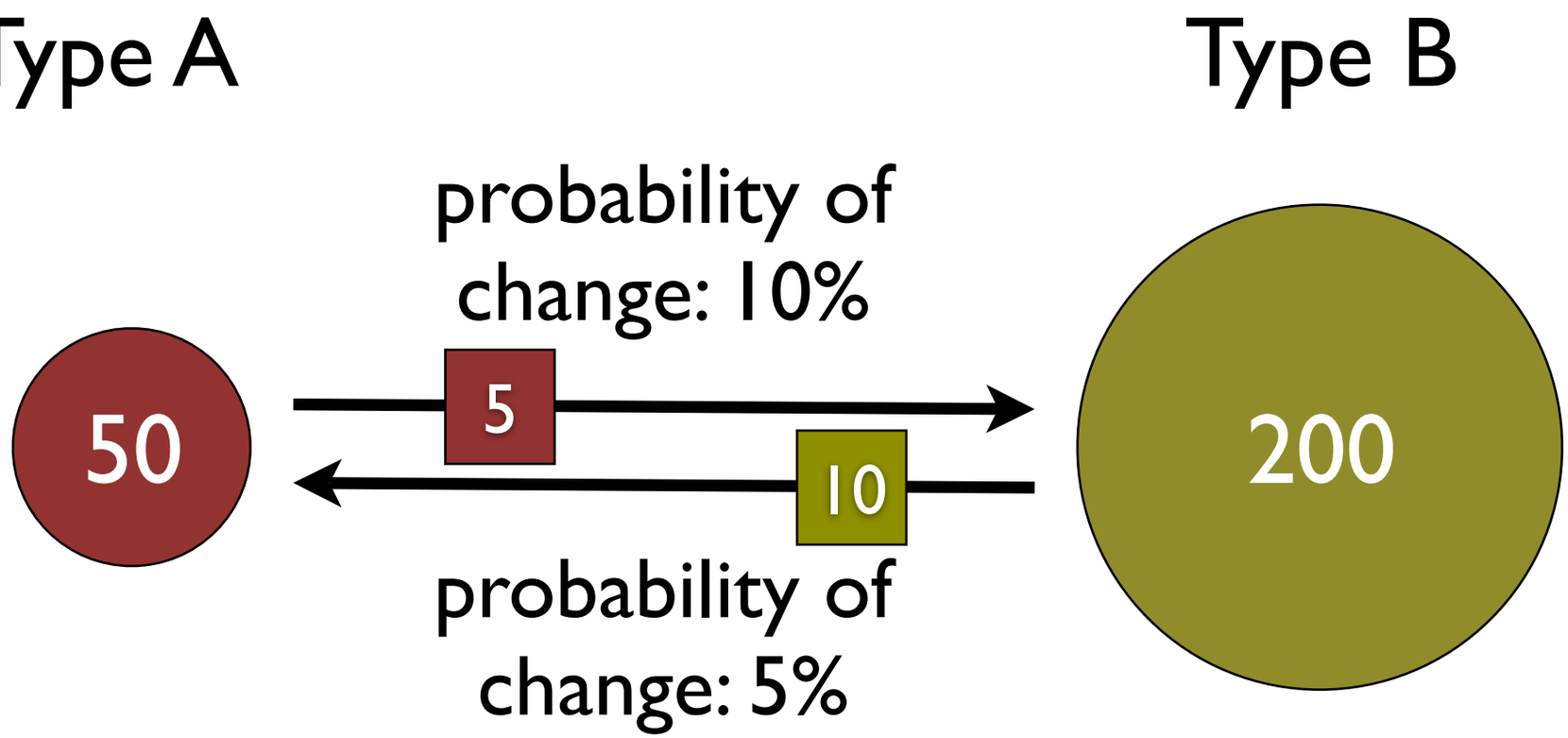

Type A
Type B
probability of change: 20%
50
10
10
200
probability of change: 5%

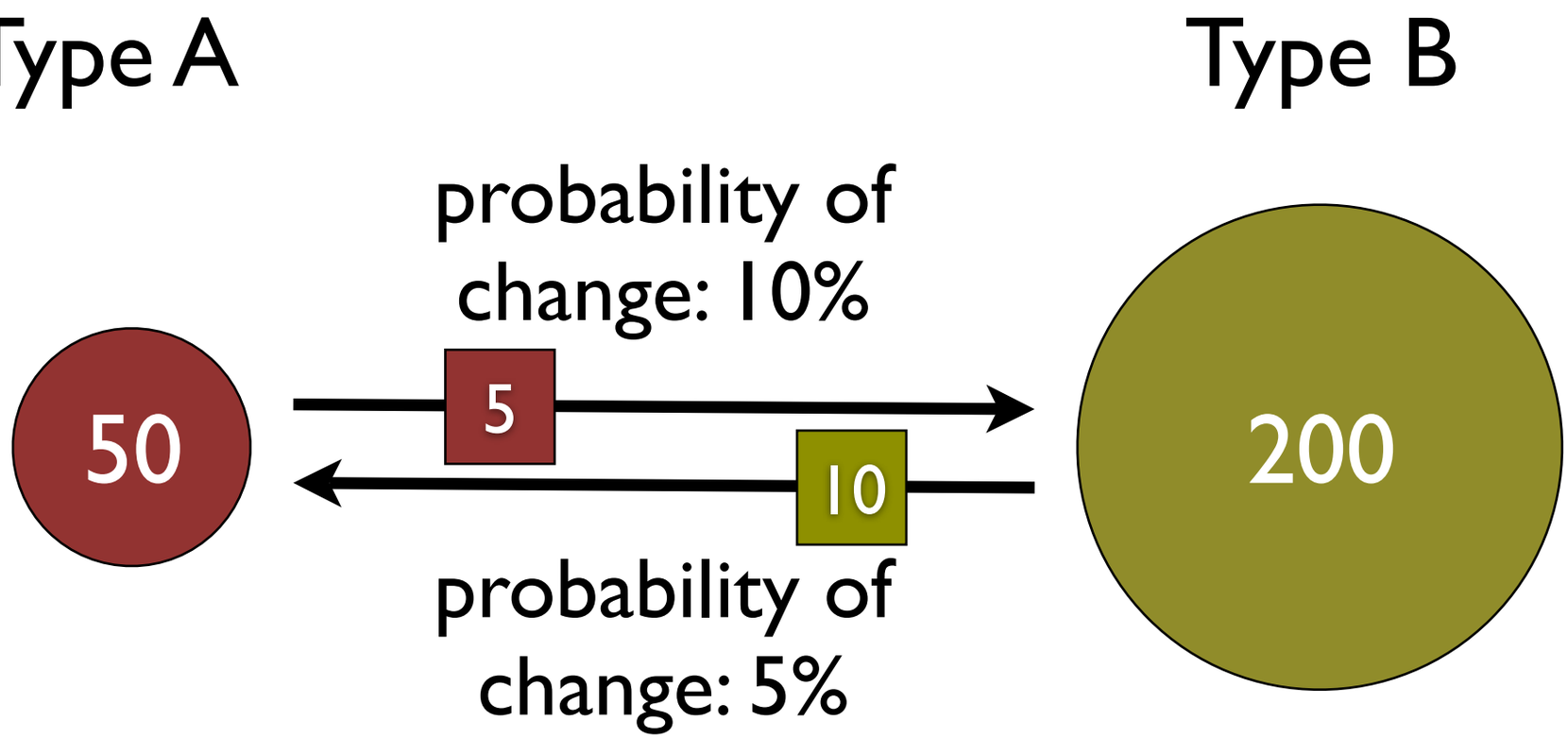


Stable distribution

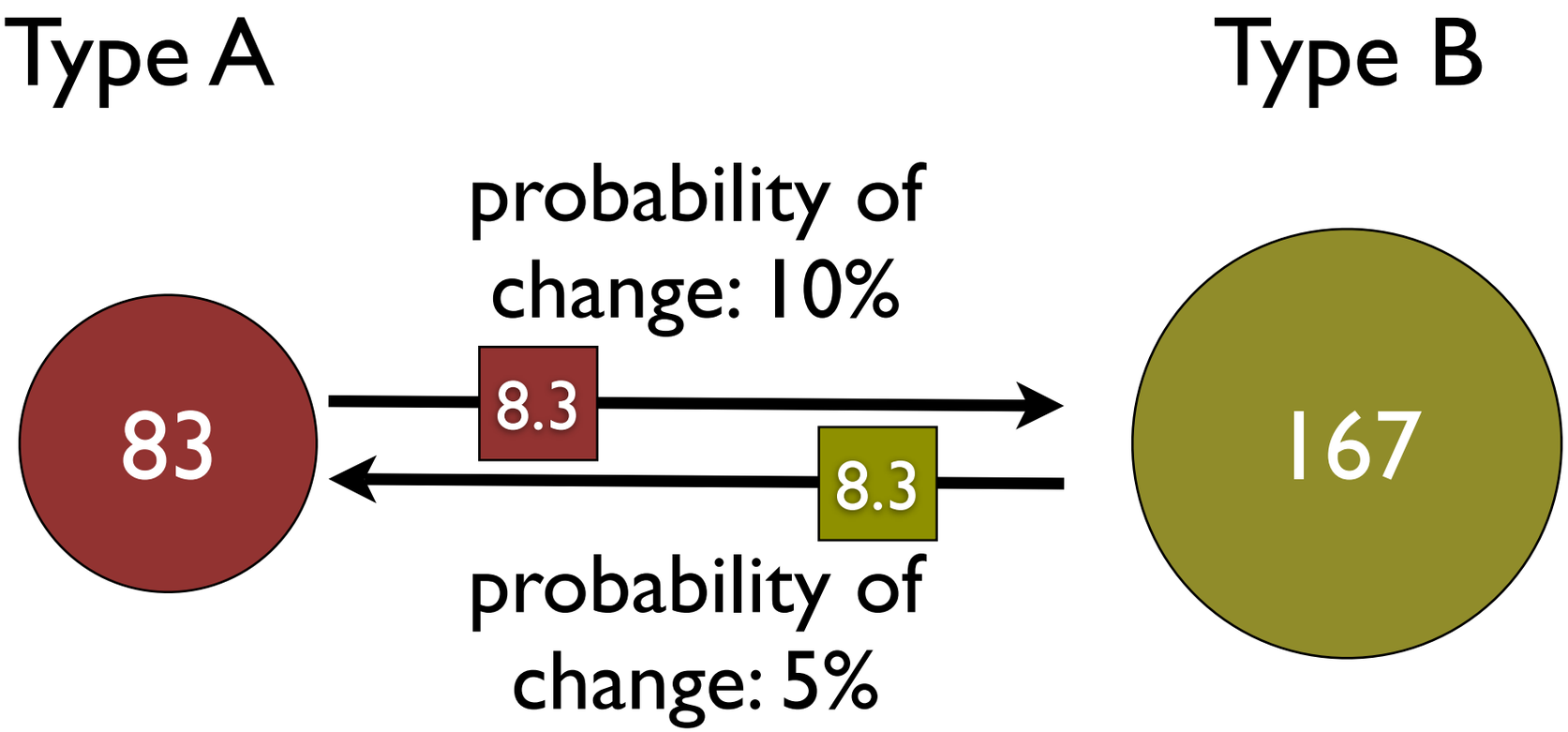

Type A
Type B
probability of change: 20%
50
10
10
200
probability of change: 5%

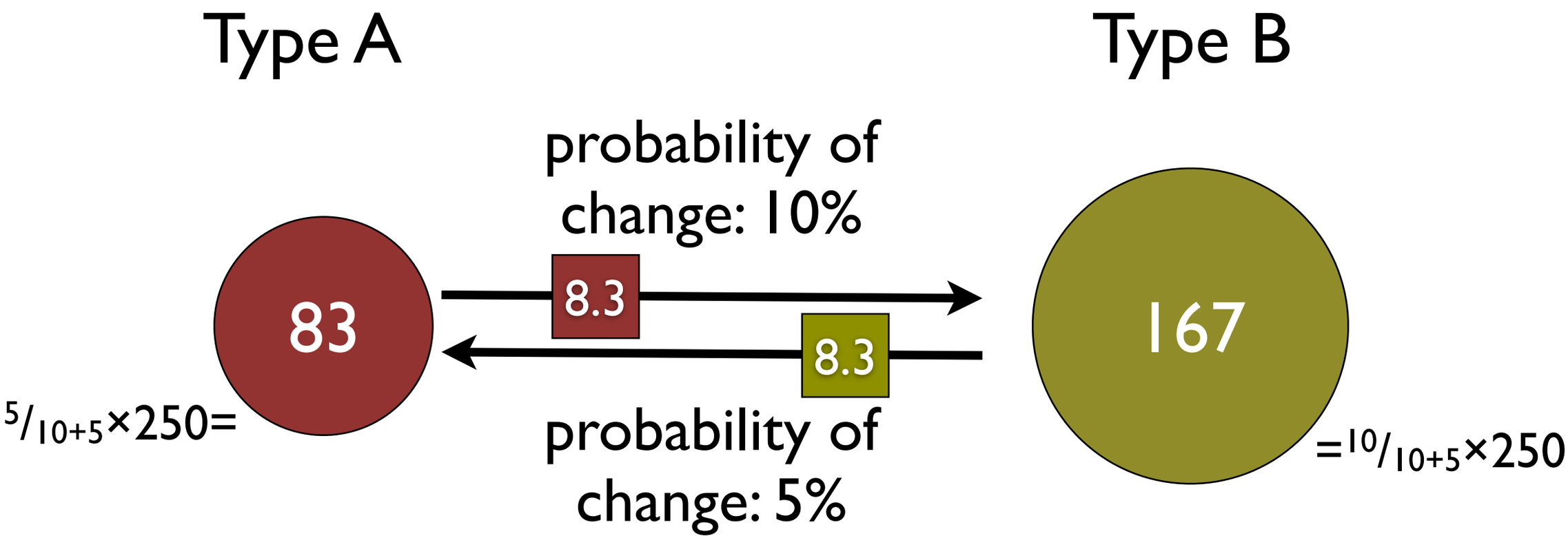

Type A
Type B
probability of change: 10%
50
10
10
200
probability of change: 5%

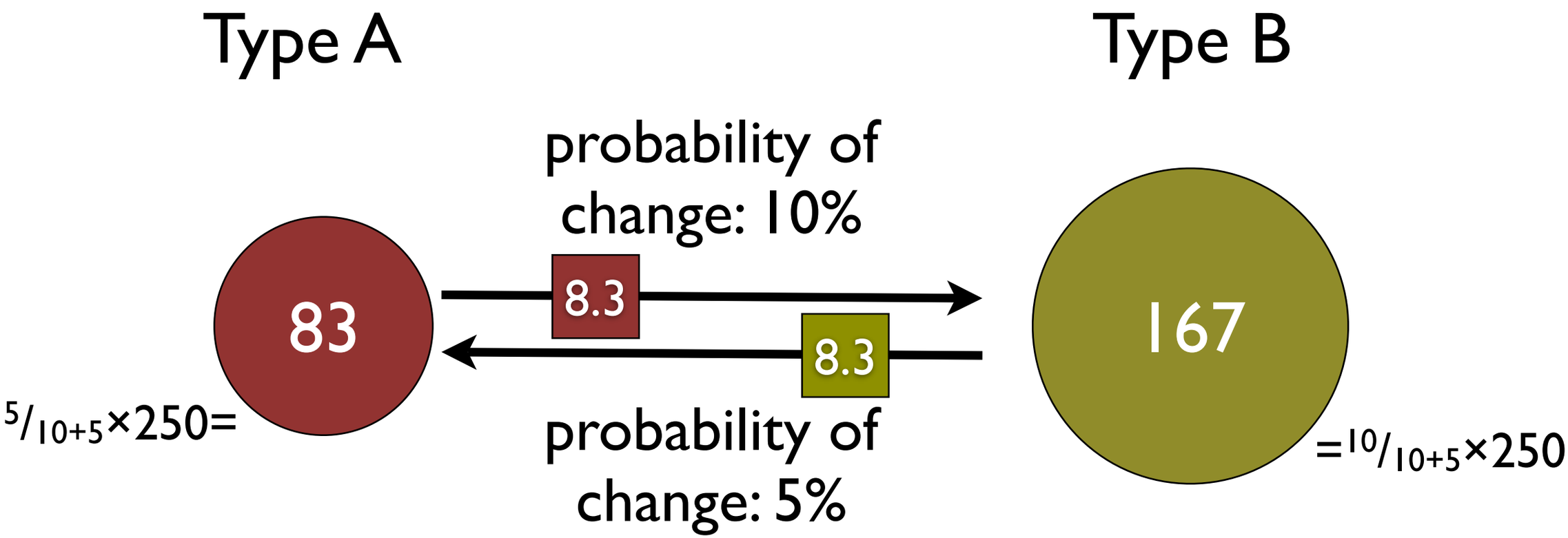

Type A
Type B
probability of change: 10%
50
5
10
200
probability of change: 5%



Instable distribution


Type A
Type B
probability of change: 10%
83
8.3
8.3
167
probability of change: 5%


Type A
Type B
probability of change: 10%
83
8.3
8.3
167
probability of change: 5%
5/10+5×250=
=10/10+5×250



Expected stable distribution

Estimating Transition Probabilities

Estimating Transition Probabilities

- Are transitions probabilities measurable at all ?

Estimating Transition Probabilities

- Are transitions probabilities measurable at all ?
- If yes: use group internal variation of many groups

Estimating Transition Probabilities

- Are transitions probabilities measurable at all ?
- If yes: use group internal variation of many groups
- For example:

Estimating Transition Probabilities

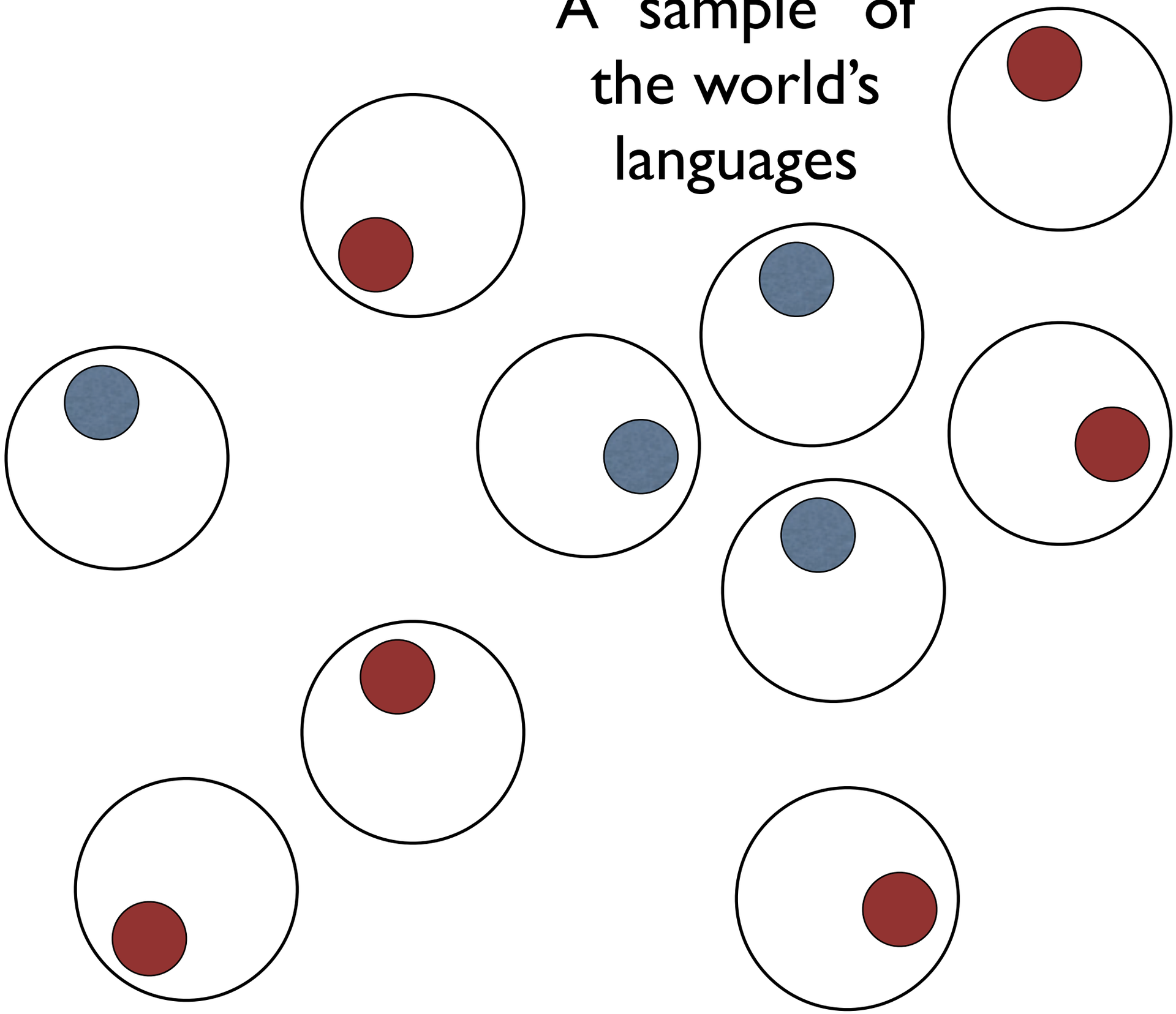
- Are transitions probabilities measurable at all ?
- If yes: use group internal variation of many groups
- For example:
  - Instead of 100 genealogically unrelated languages

Estimating Transition Probabilities

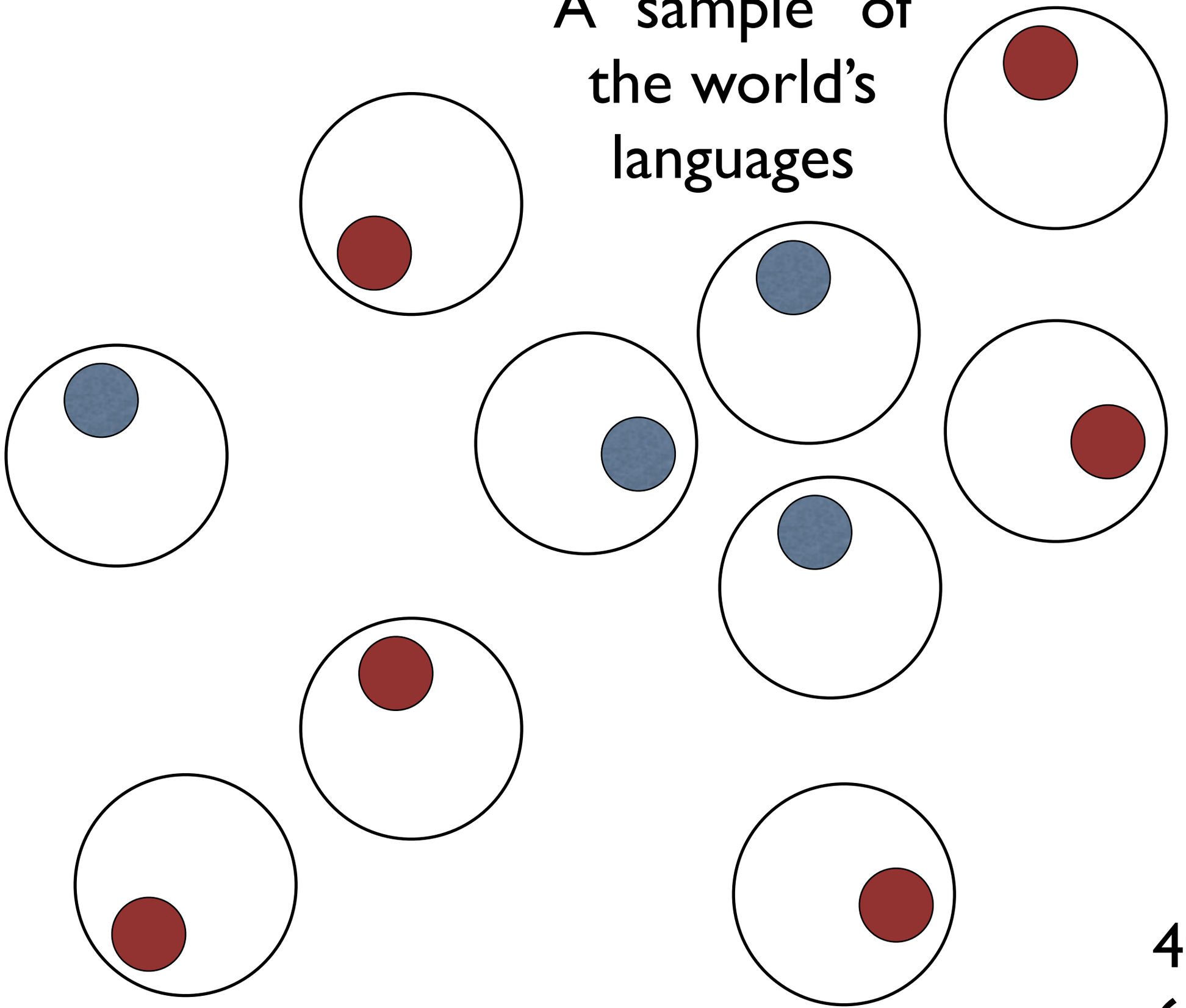
- Are transitions probabilities measurable at all ?
- If yes: use group internal variation of many groups
- For example:
  - Instead of 100 genealogically unrelated languages
  - take 25 groups of 4 closely related languages

The world's genera

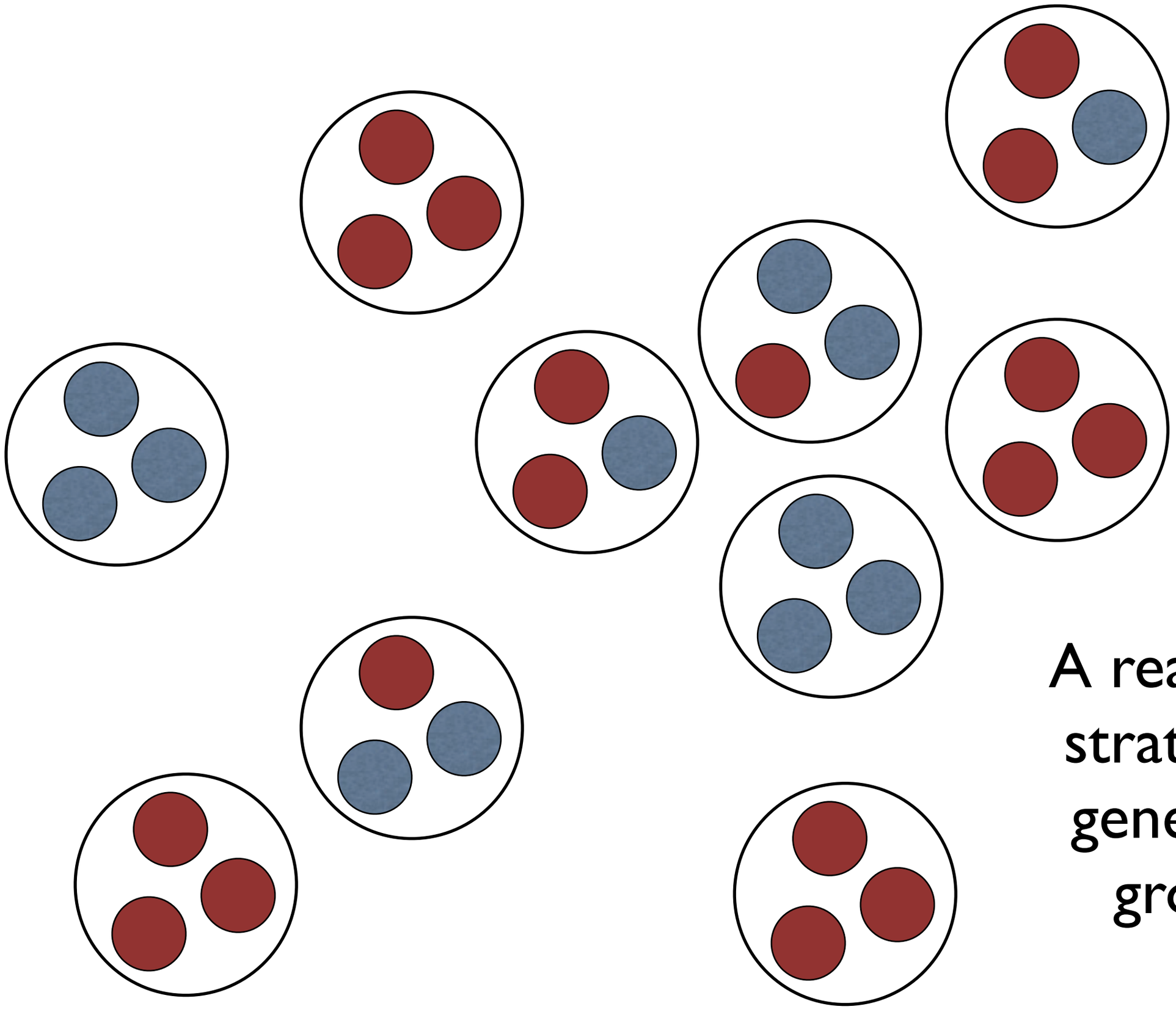
A "sample" of the world's languages



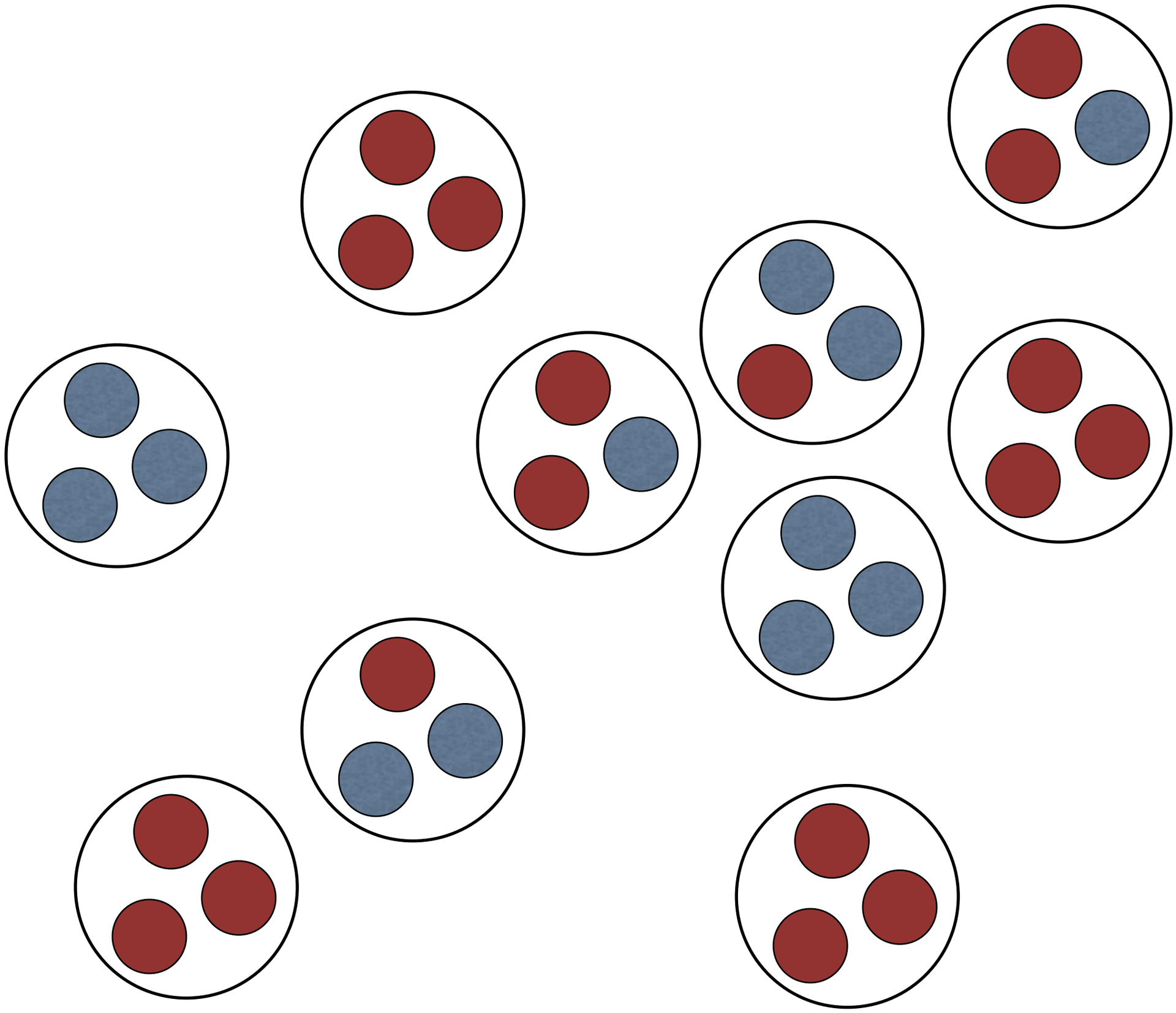
A "sample" of the world's languages



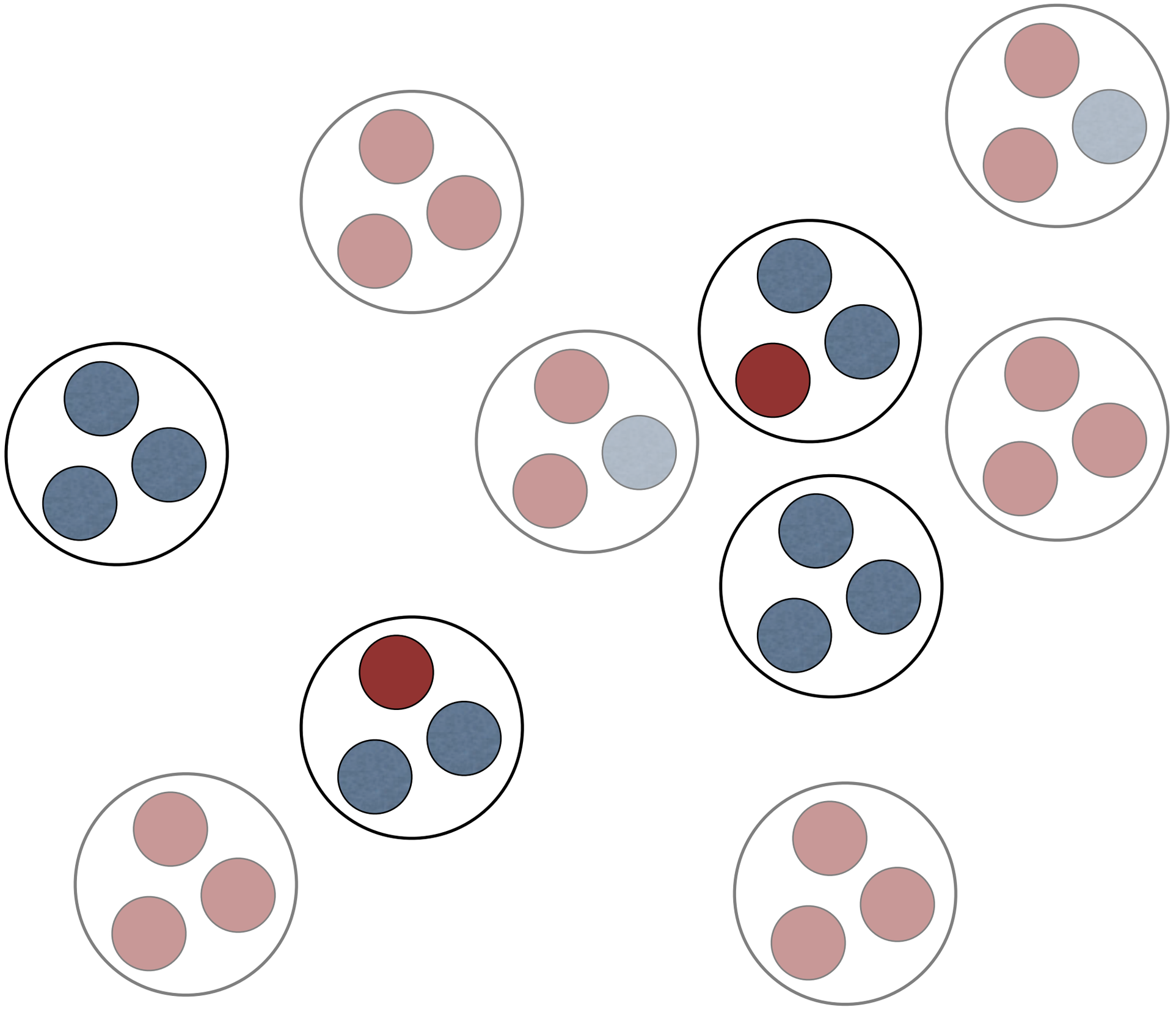
40% blue
60% red

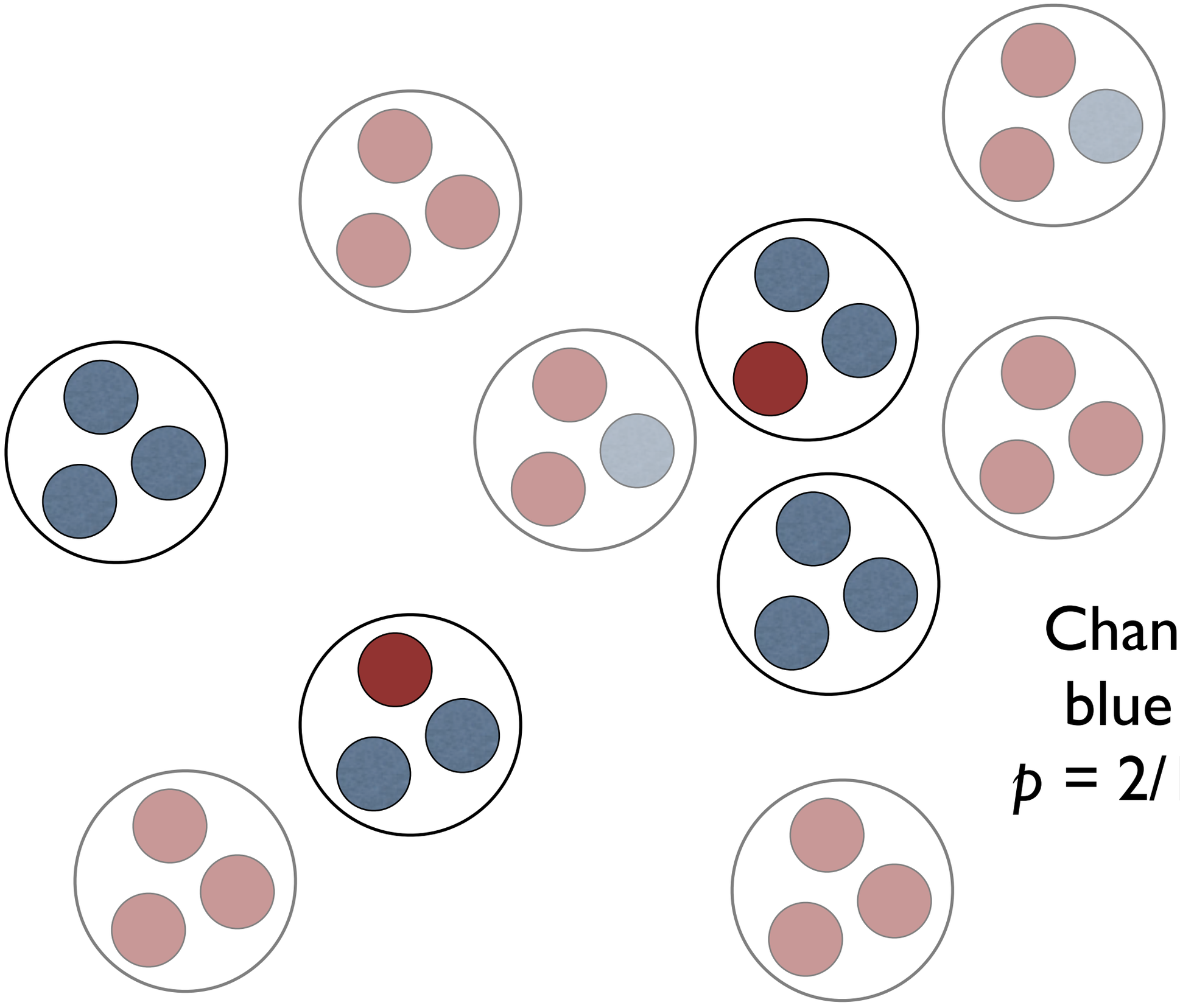


A real sample stratified for genealogical grouping

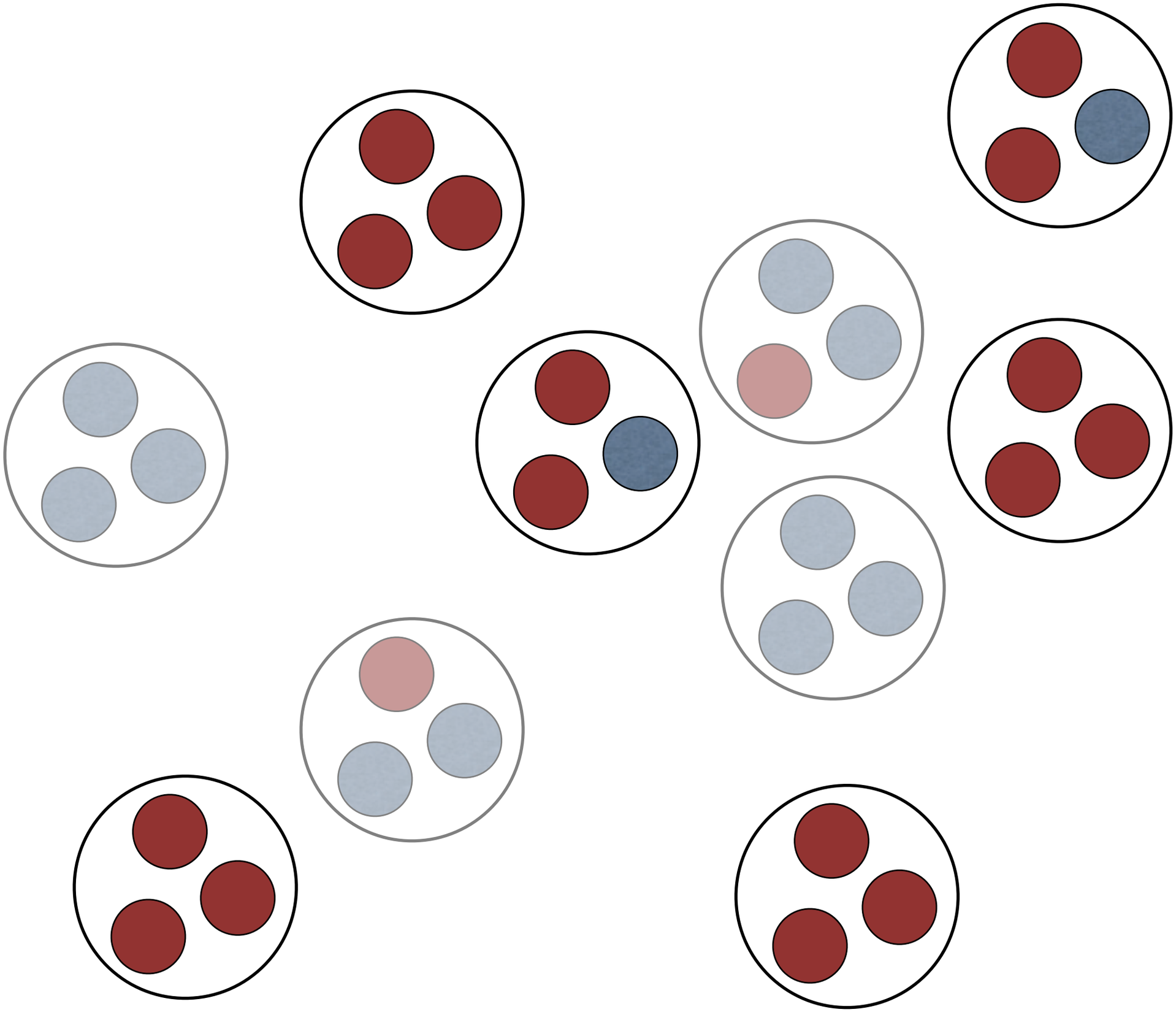


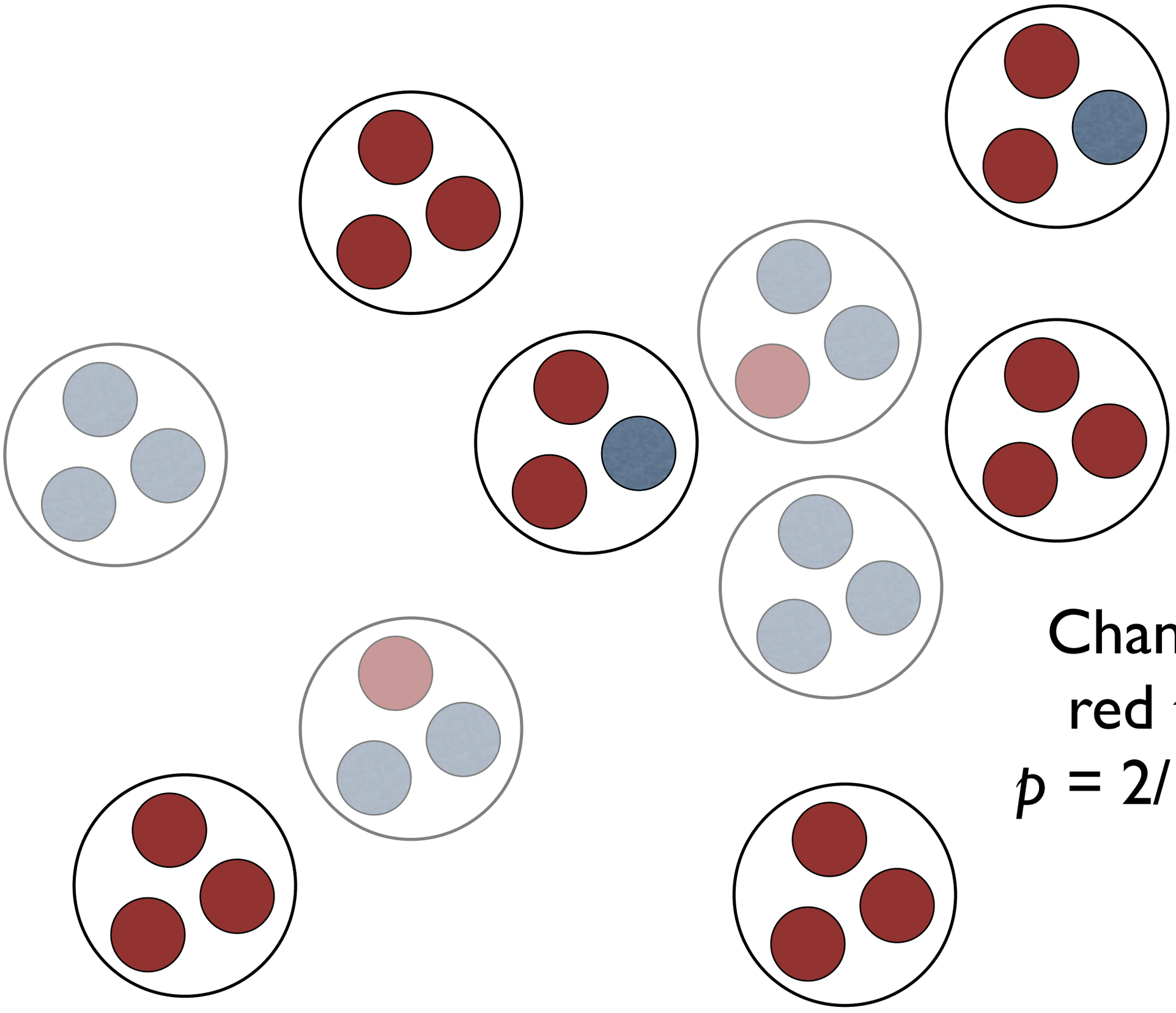
How to get probabilities of change ...





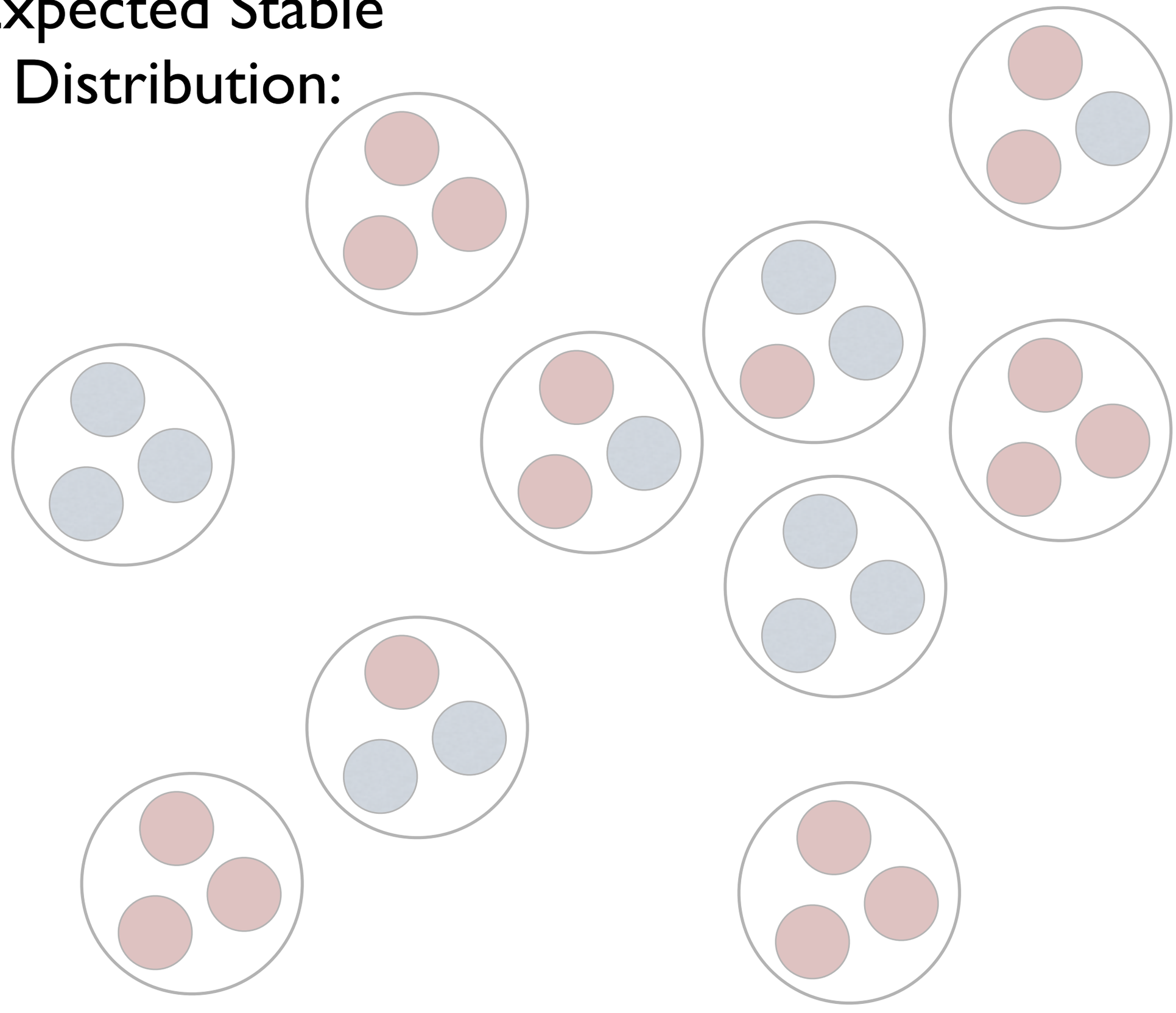
Change from blue to red:
p = 2/12 = 17%



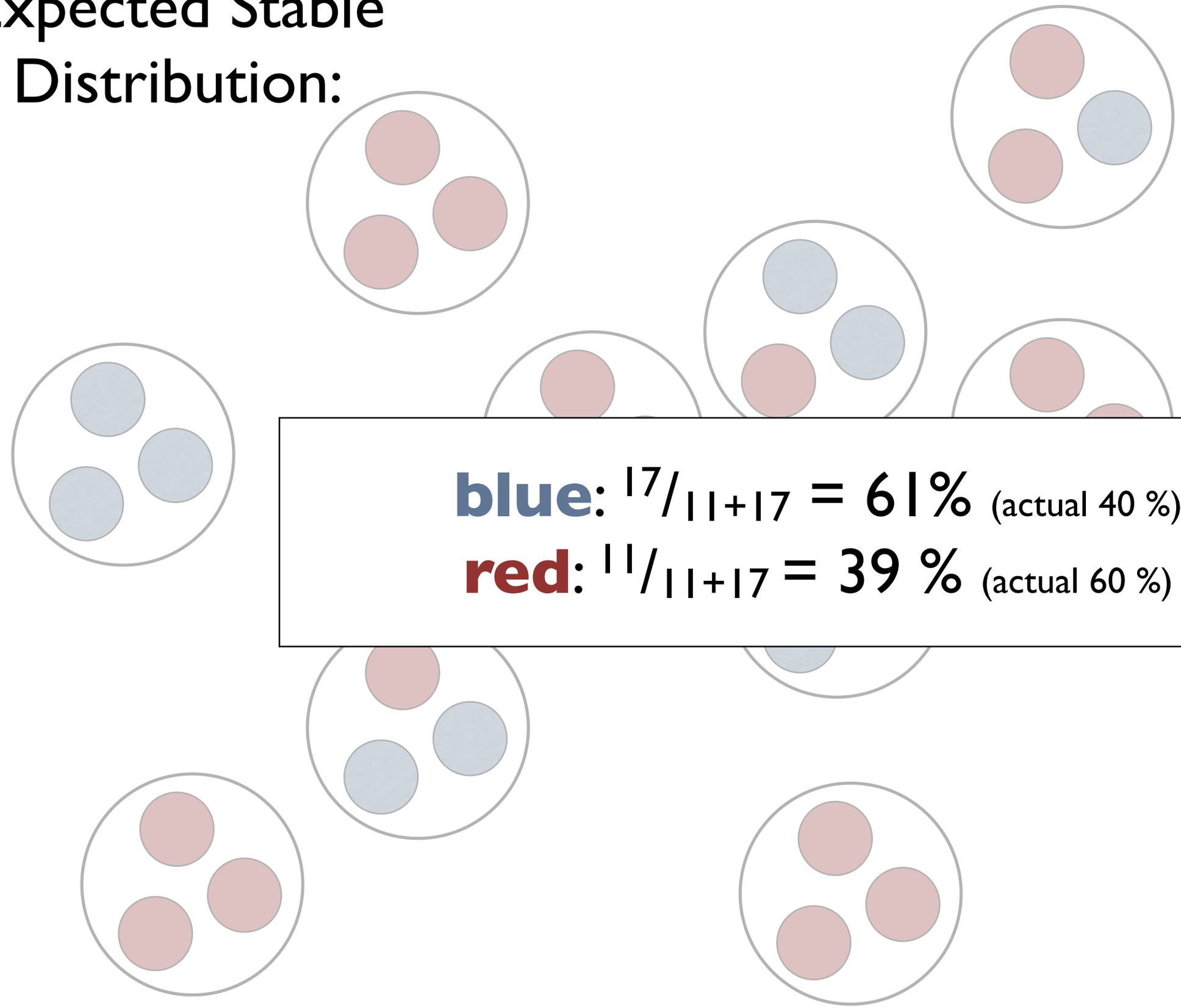


Change from red to blue:
p = 2/18 = 11%

Expected Stable Distribution:



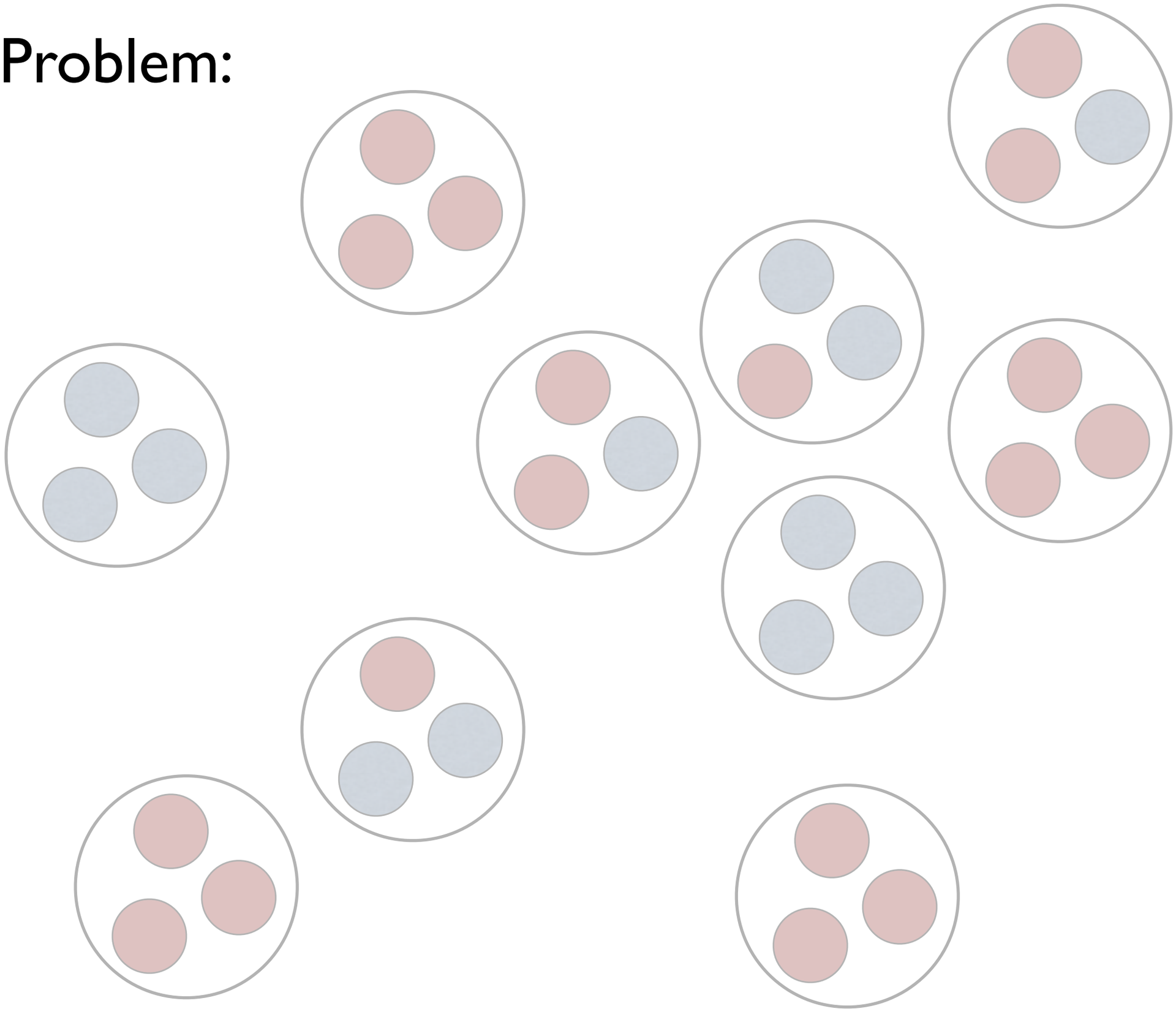
Expected Stable Distribution:



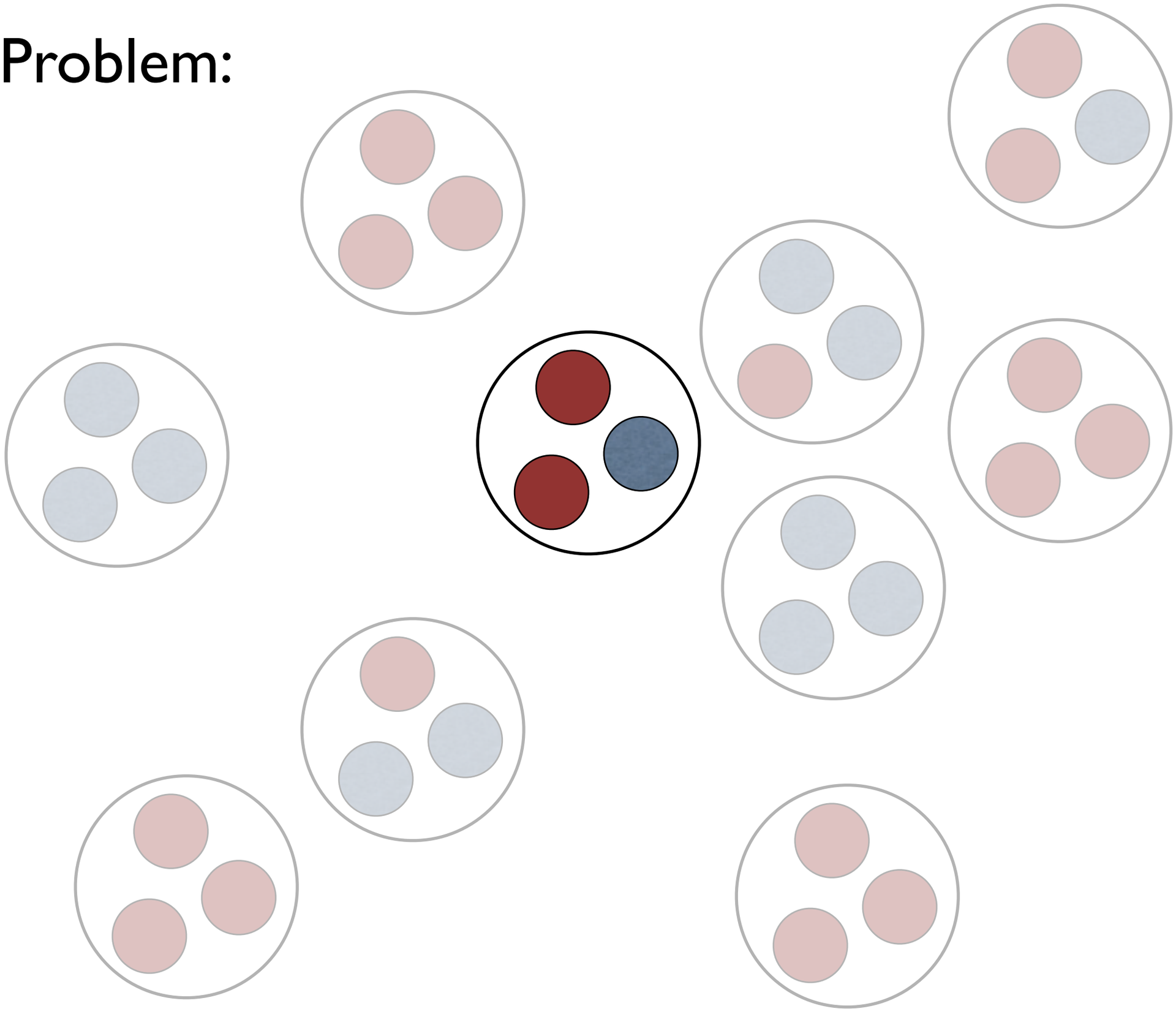
blue: $^{17}/_{11+17}$ = 61% (actual 40 %)

red: $^{11}/_{11+17}$ = 39 % (actual 60 %)

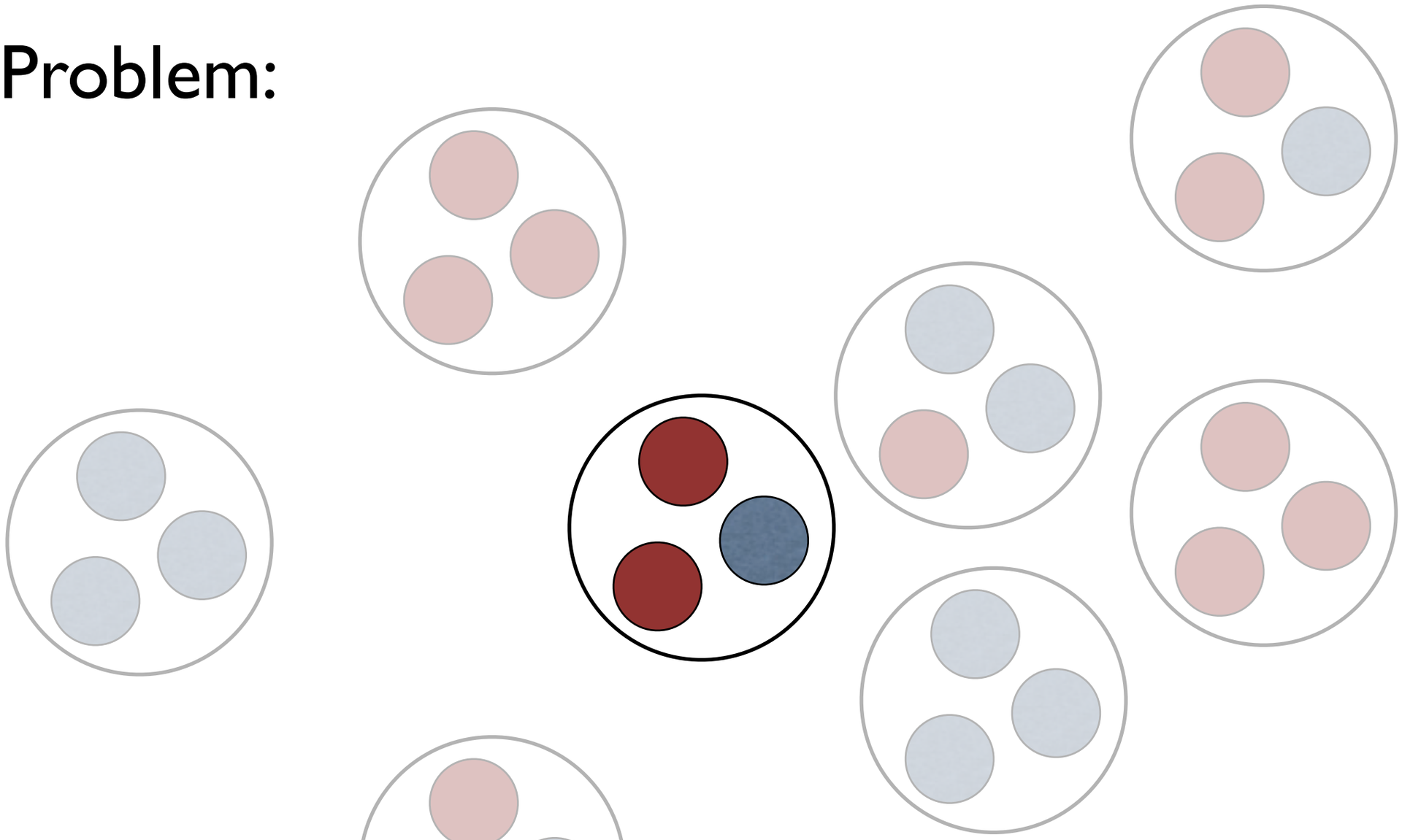
Problem:



Problem:

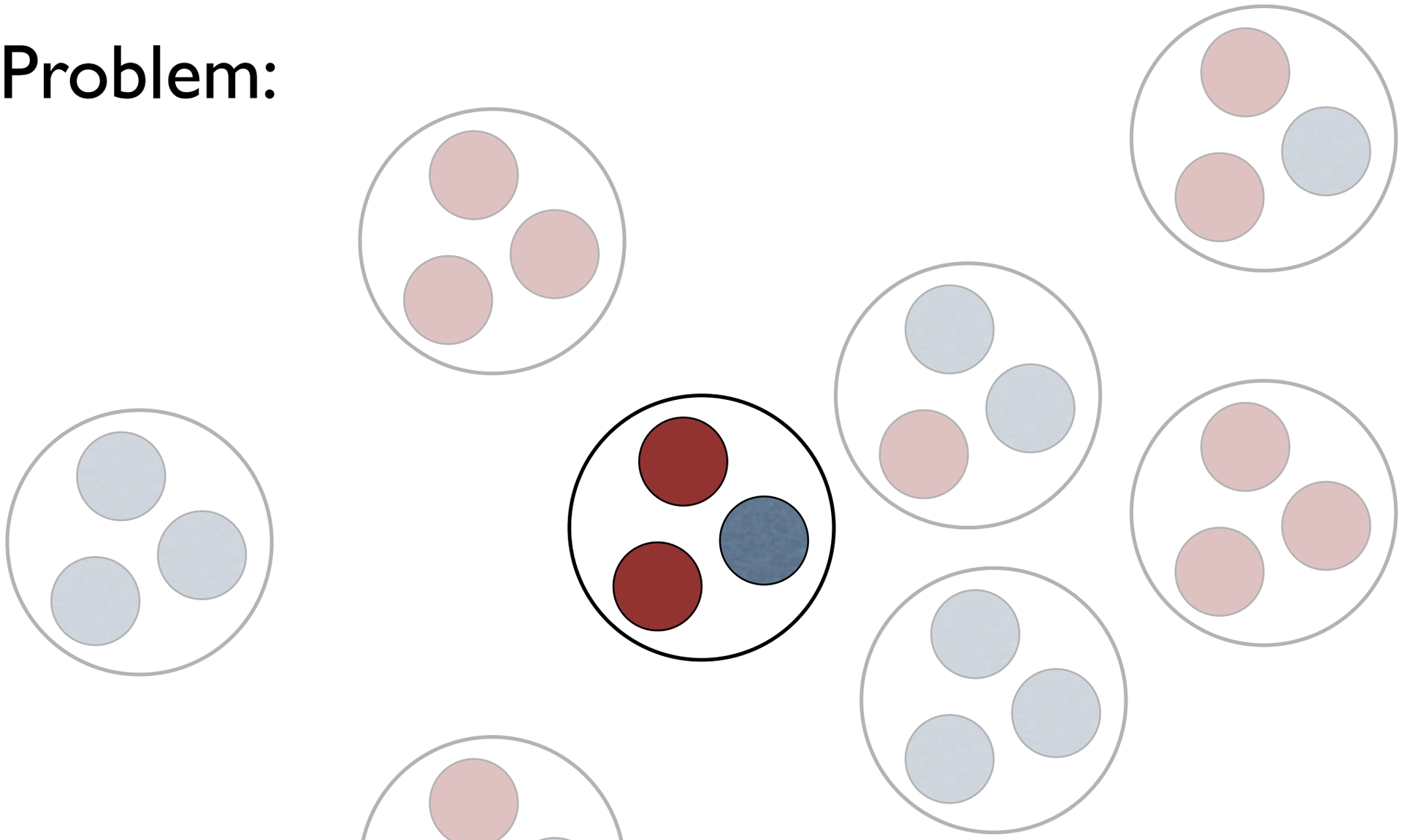


Problem:



- Originally **red** with one change to blue ?

Problem:



- Originally **red** with one change to blue ?
- Originally **blue** with two changes to red ?

Elena Maslova's breakthrough

Elena Maslova's breakthrough

probability of
any change
happening

Elena Maslova's breakthrough

probability of
any change happening =

Elena Maslova's breakthrough

probability of **any** change happening = $\alpha \cdot$ frequency (blue) + β

Elena Maslova's breakthrough

probability of **any** change happening = $\alpha \cdot$ frequency (blue) + β

For groups of three languages:

Elena Maslova's breakthrough

probability of **any** change happening = $\alpha \cdot$ frequency (blue) + β

For groups of three languages:

$\alpha = 3 \cdot (p_{\text{blue}\rightarrow\text{red}} - p_{\text{red}\rightarrow\text{blue}})$

Elena Maslova's breakthrough

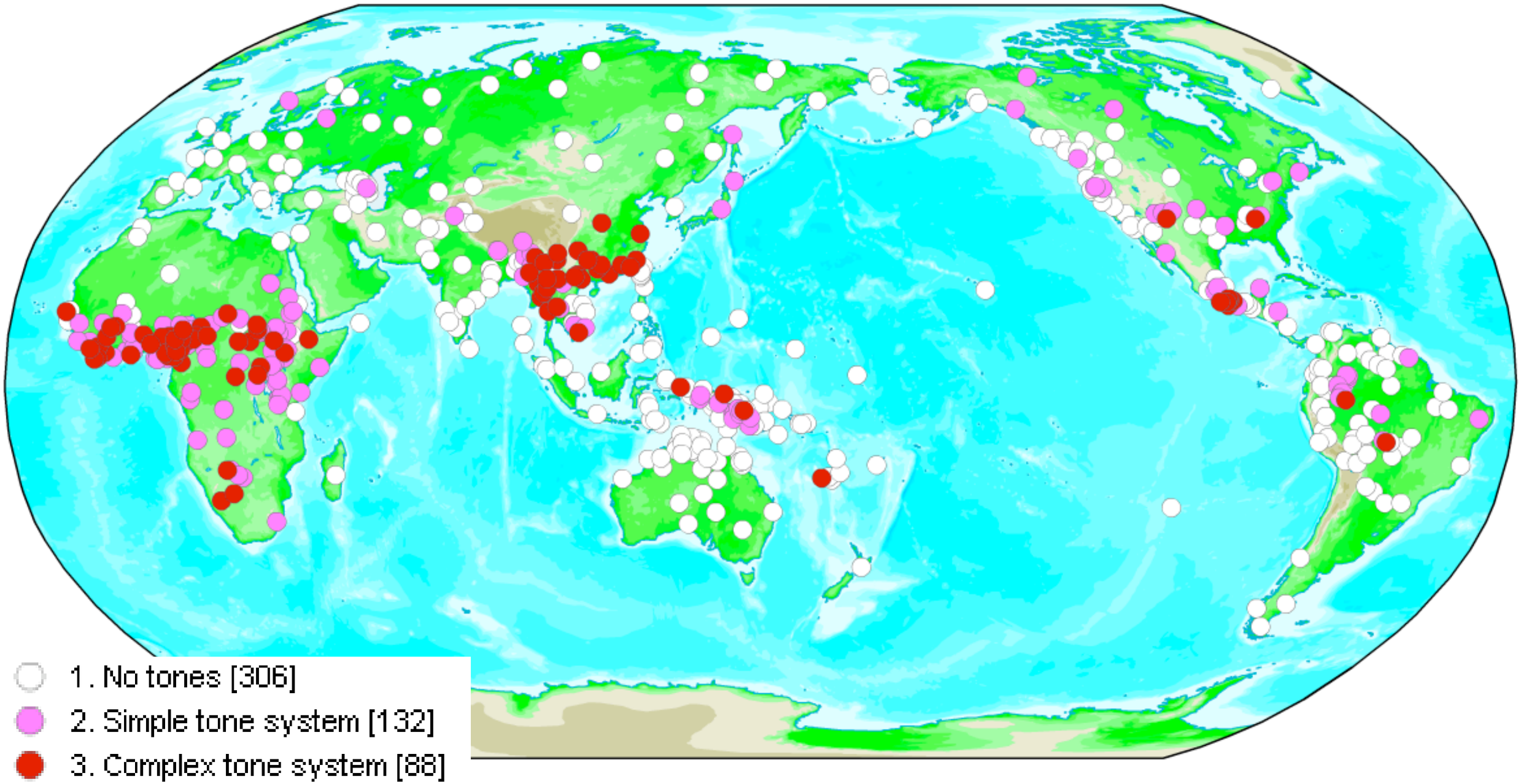
probability of **any** change happening $= \alpha \cdot \text{frequency (blue)} + \beta$

For groups of three languages:

$\alpha = 3 \cdot (p_{\text{blue}\to\text{red}} - p_{\text{red}\to\text{blue}})$

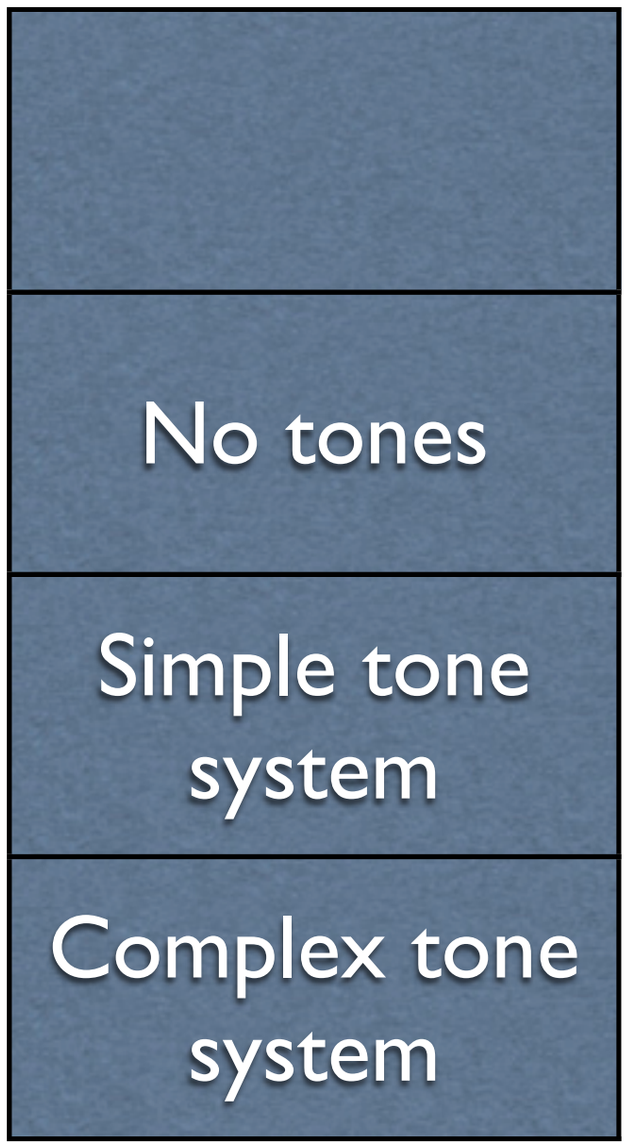
$\beta = 3 \cdot p_{\text{red}\to\text{blue}} \cdot (1 - p_{\text{blue}\to\text{red}})$

Tone
(Ian Maddieson)



Stable or not ?

Stable or not ?



Stable or not ?

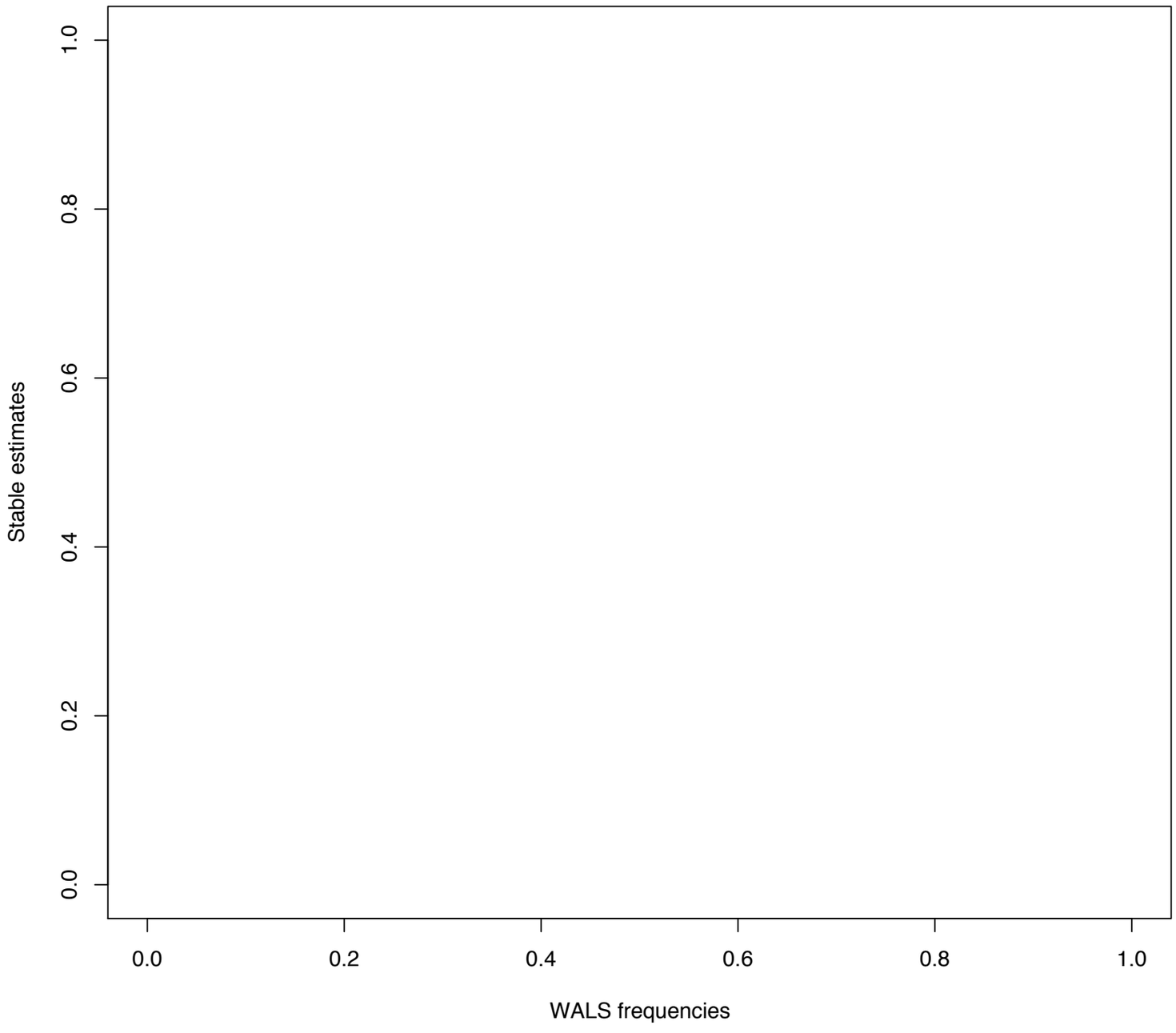
	WALS frequency
No tones	306 (58 %)
Simple tone system	132 (25 %)
Complex tone system	88 (17 %)

Stable or not ?

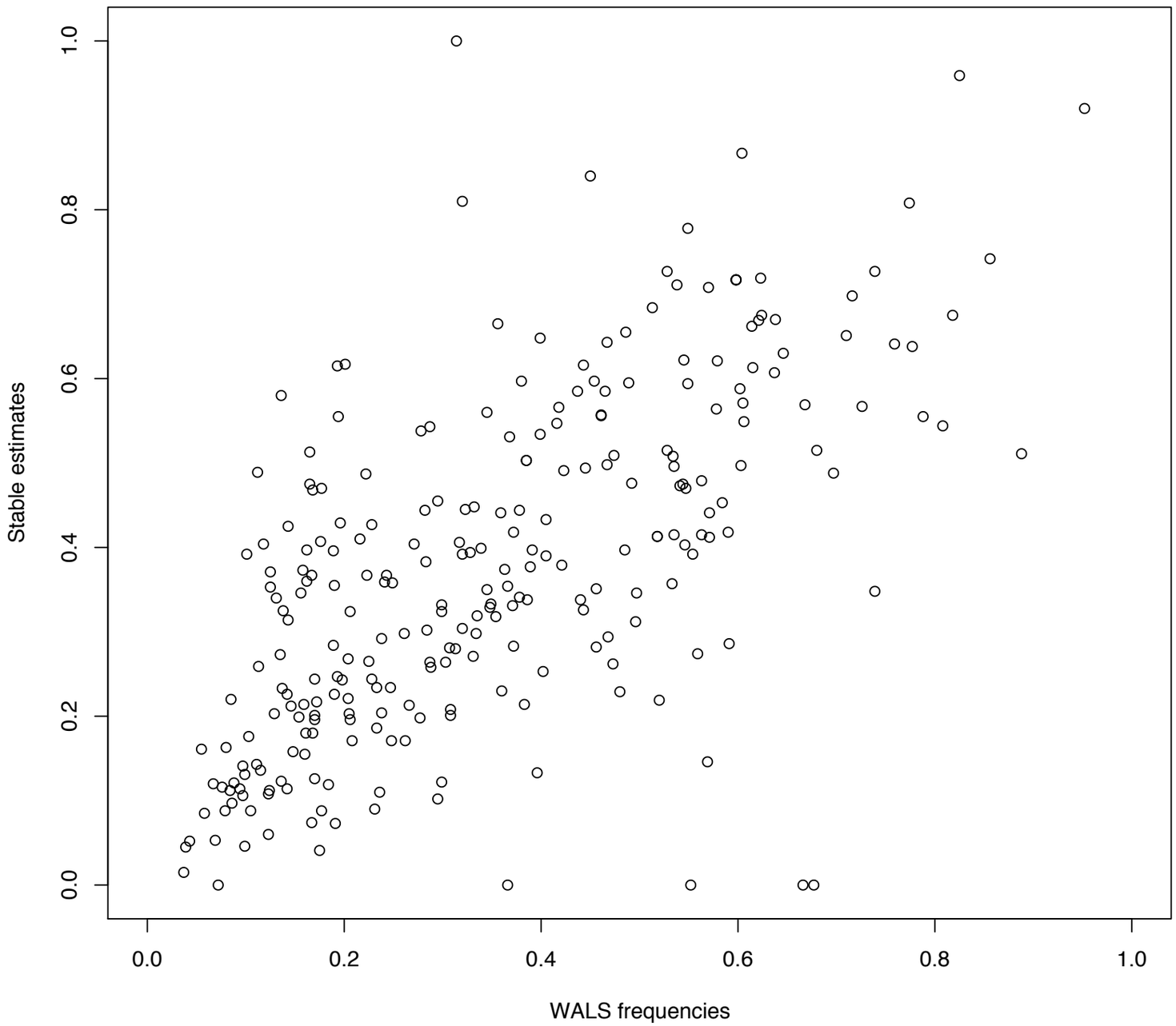
	WALS frequency	Expected stable distribution
No tones	306 (58 %)	29%
Simple tone system	132 (25 %)	21%
Complex tone system	88 (17 %)	42%

All characteristics in WALS

All characteristics in WALS

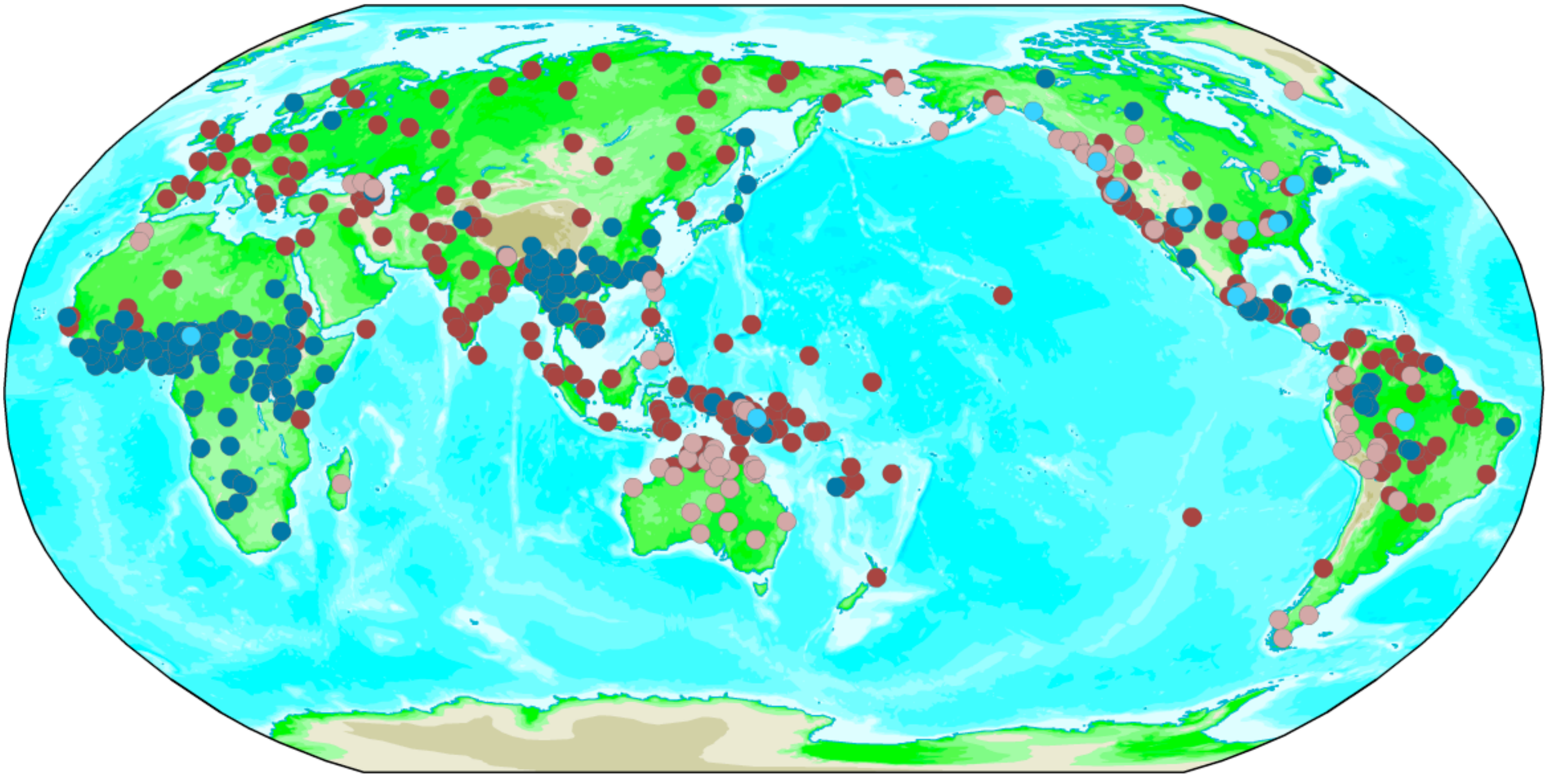


All characteristics in WALS



Cross-section of tone and vowel inventory (Ian Maddieson)

Cross-section of tone and vowel inventory (Ian Maddieson)



Traditional Typological Interpretation

Traditional Typological Interpretation

	No tone	Tone
Few vowels (<5)	75	11
Many vowels (≥5)	231	206

Traditional Typological Interpretation

	No tone	Tone
Few vowels (<5)	75	11
Many vowels (≥5)	231	206

Traditional Typological Interpretation

	No tone	Tone
Few vowels (<5)	75	11
Many vowels (≥5)	231	206

Tone → Many vowels

Statistical Interpretation

	No tone	Tone
Few vowels (<5)	75	11
Many vowels (≥5)	231	206

Statistical Interpretation

	No tone	Tone
Few vowels (<5)	75	11
Many vowels (≥5)	231	206

$\phi = .26$, Fisher's Exact $p = 7 \cdot 10^{-10}$

Statistical Interpretation

	No tone	Tone
Few vowels (<5)	75 (+25)	11 (-25)
Many vowels (≥5)	231 (-25)	206 (+25)

$\phi = .26$, Fisher's Exact $p = 7 \cdot 10^{-10}$

Statistical Interpretation

	No tone	Tone
Few vowels (<5)	75 (+25)	11 (-25)
Many vowels (≥5)	231 (-25)	206 (+25)

$\phi = .26$, Fisher's Exact $p = 7 \cdot 10^{-10}$

Statistical Interpretation

	No tone	Tone
Few vowels (<5)	75 (+25)	11 (-25)
Many vowels (≥5)	231 (-25)	206 (+25)

$\phi = .26$, Fisher's Exact $p = 7 \cdot 10^{-10}$

Tone ~ Many vowels

Dryer's (1992) test

Dryer's (1992) test

	Africa	Eurasia	SE Asia & Oceania	N. Guinea & Australia	North America	South America

Dryer's (1992) test

	Africa	Eurasia	SE Asia & Oceania	N. Guinea & Australia	North America	South America
Tone & Large	109	7	41	14	21	14
Tone & Small	1	0	0	1	8	1
No Tone & Large	14	73	44	33	32	35
No Tone & Small	2	3	7	25	21	17

Dryer's (1992) test

	Africa	Eurasia	SE Asia & Oceania	N. Guinea & Australia	North America	South America
Tone & Large	109	7	41	14	21	14
Tone & Small	1	0	0	1	8	1
No Tone & Large	14	73	44	33	32	35
No Tone & Small	2	3	7	25	21	17

Dryer's (1992) test

	Africa	Eurasia	SE Asia & Oceania	N. Guinea & Australia	North America	South America
Tone & Large	109	7	41	14	21	14
Tone & Small						
No Tone & Large	0.88	0.96	0.86	0.57	0.60	0.67
No Tone & Small	2	3	7	25	21	17

0.99 1.00 1.00 0.93 0.72 0.93

Dryer's (1992) test

	Africa	Eurasia	SE Asia & Oceania	N. Guinea & Australia	North America	South America
Tone & Large	109	7	41	14	21	14
Tone & Small	1	0	0	1	8	1
No Tone & Large	14	73	44	33	32	35
No Tone & Small	2	3	7	25	21	17

Dryer's (1992) test

	Africa	Eurasia	SE Asia & Oceania	N. Guinea & Australia	North America	South America
Tone & Large	109	7	41	14	21	14
Tone & Small	1	0	0	1	8	1
No Tone & Large	14	73	44	33	32	35
No Tone & Small	2	3	7	25	21	17
p	0.042	n.s.	0.016	0.013	n.s.	0.053

Dryer's (1992) test

	Africa	Eurasia	SE Asia & Oceania	N. Guinea & Australia	North America	South America
Tone & Large	109	7	41	14	21	14
Tone & Small	1	0	0	1	8	1
No Tone & Large	14	73	44	33	32	35
No Tone & Small	2	3	7	25	21	17
p	0.042	n.s.	0.016	0.013	n.s.	0.053

Expected Stable Distribution

Expected Stable Distribution

Actual	No tone	Tone
Few vowels (<5)	75	11
Many vowels (≥5)	231	206

Expected Stable Distribution

Stable	No tone	Tone
Few vowels (<5)	44	66
Many vowels (≥5)	172	241

ϕ = .01, Fisher's Exact p = .83

Conclusions

Conclusions

- Actual frequencies can be deceptive

Conclusions

- Actual frequencies can be deceptive
- Expected stable frequencies can be estimated

Conclusions

- Actual frequencies can be deceptive
- Expected stable frequencies can be estimated
- We need real samples for this
  (i.e. more than one language per group)

MAX-PLANCK-GESELLSCHAFT