

TELL ME EVERYTHING YOU KNOW:
A CONVERSATION UPDATE SYSTEM
FOR THE RATIONAL SPEECH ACTS FRAMEWORK

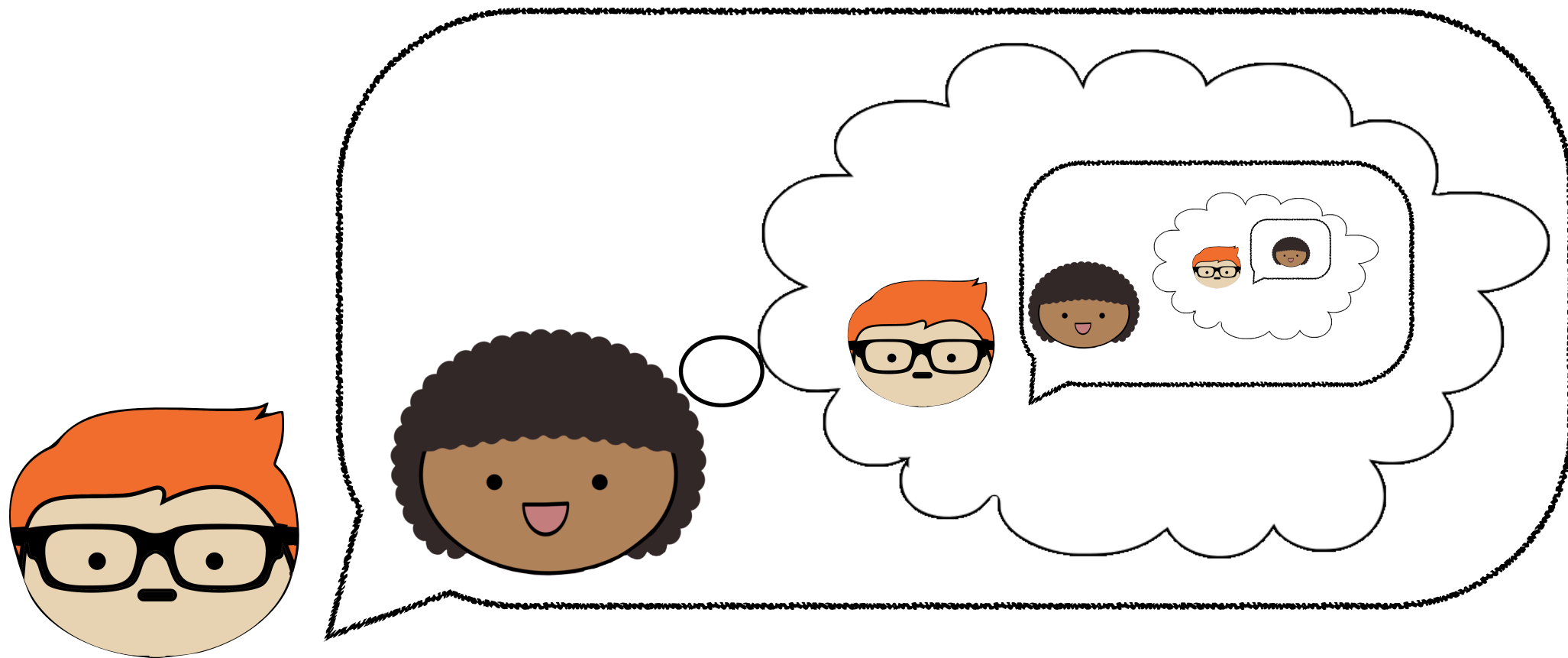
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Carolyn Jane Anderson

UMass Amherst  Wellesley

THE RATIONAL SPEECH ACTS FRAMEWORK

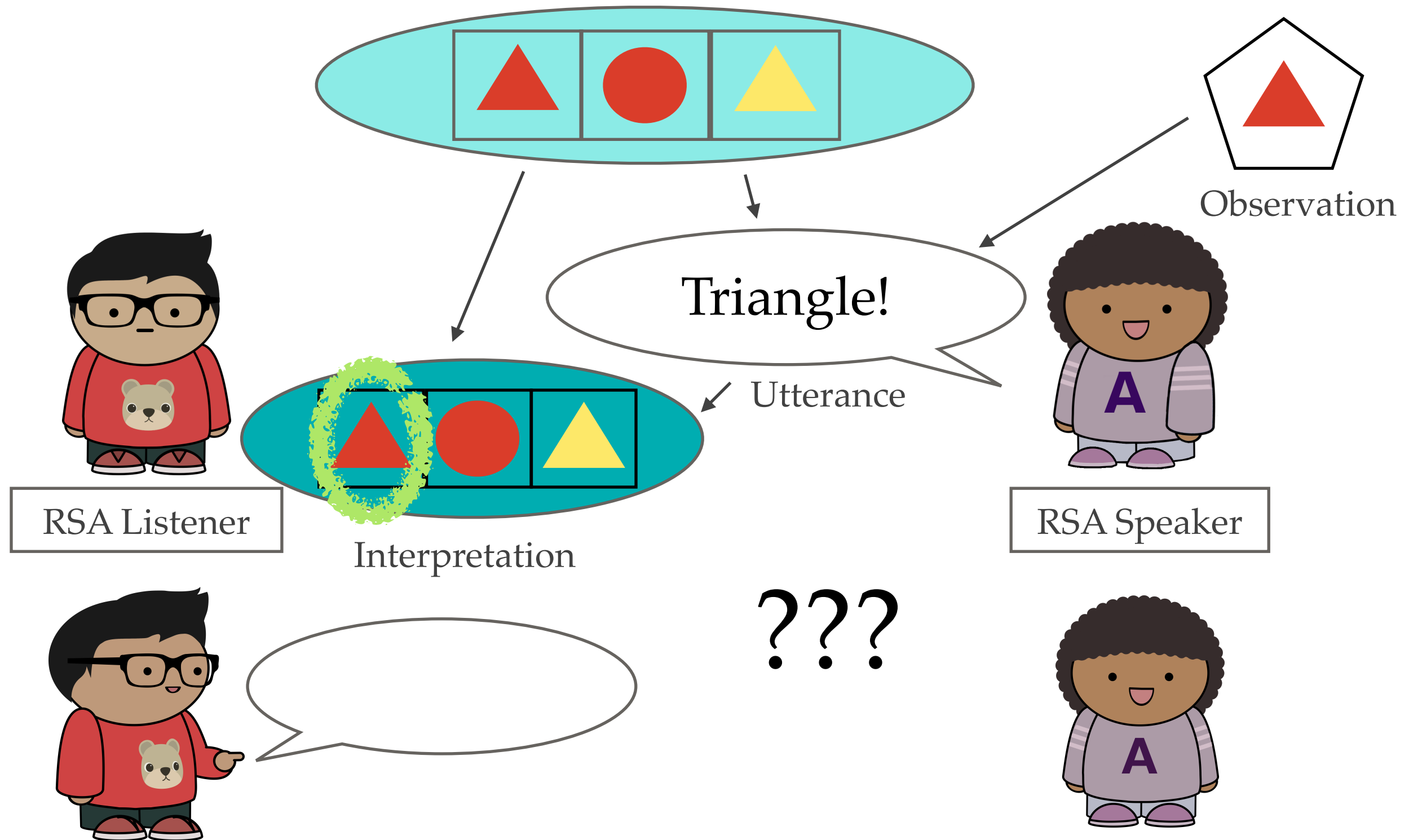
Conversation participants reason about each others' behavior to optimize their contributions (Frank & Goodman 2012)



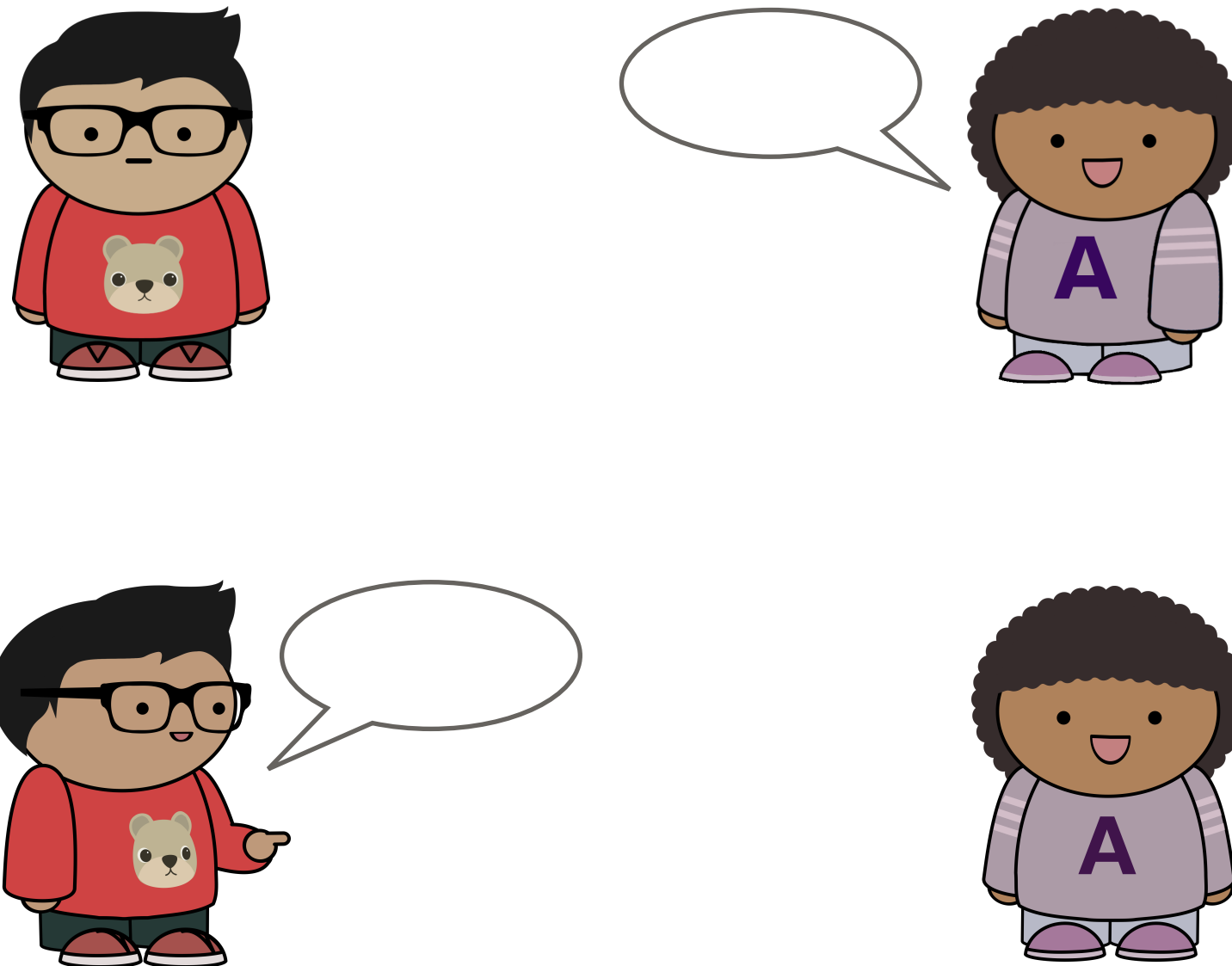
Speaker: $p(u | w) \propto p(w | u) p(u)$

Listener: $p(w | u) \propto p(u | w) p(w)$

WHAT DOES THE RSA CURRENTLY DO?

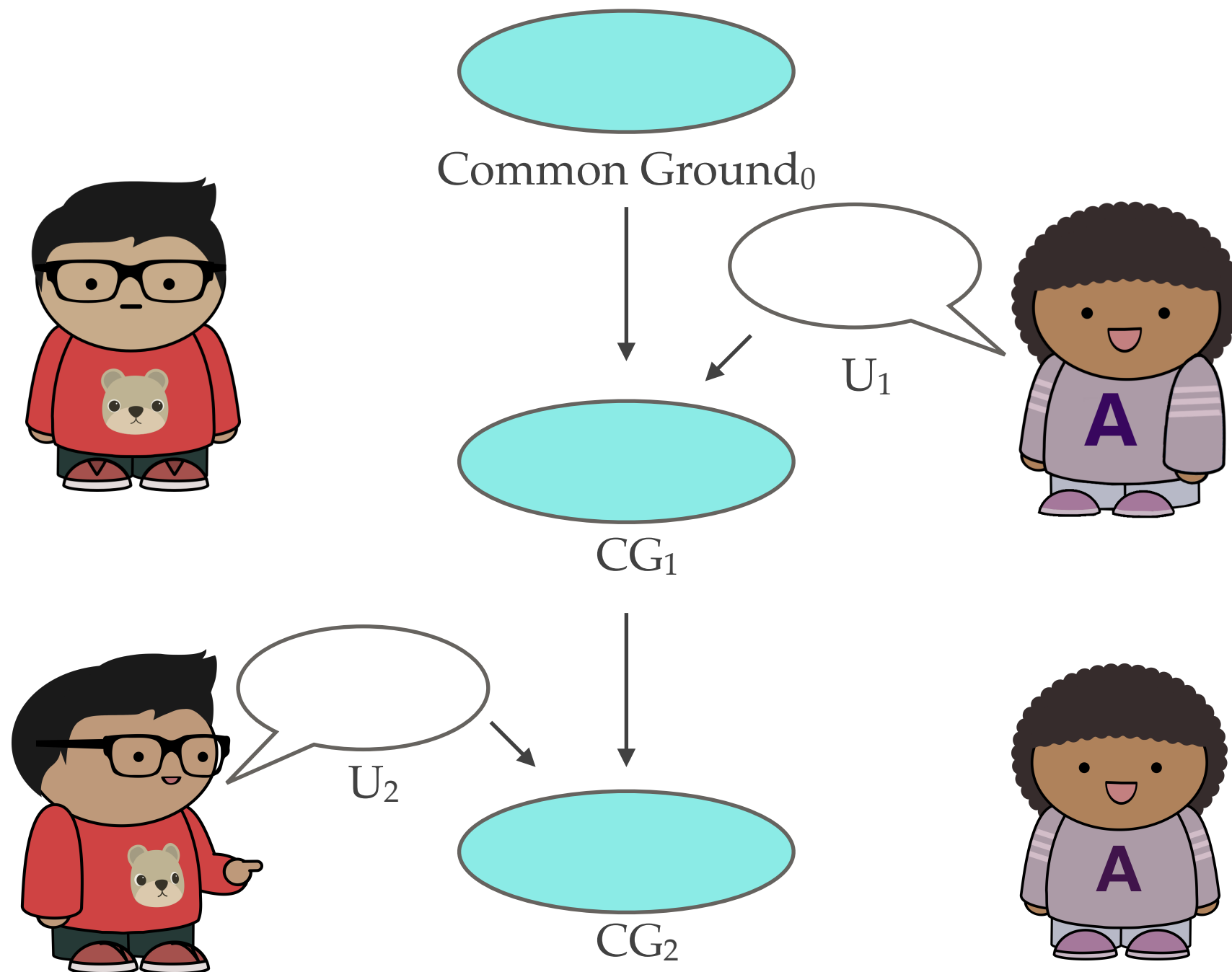


MULTI-TURN CONVERSATIONS IN THE RSA

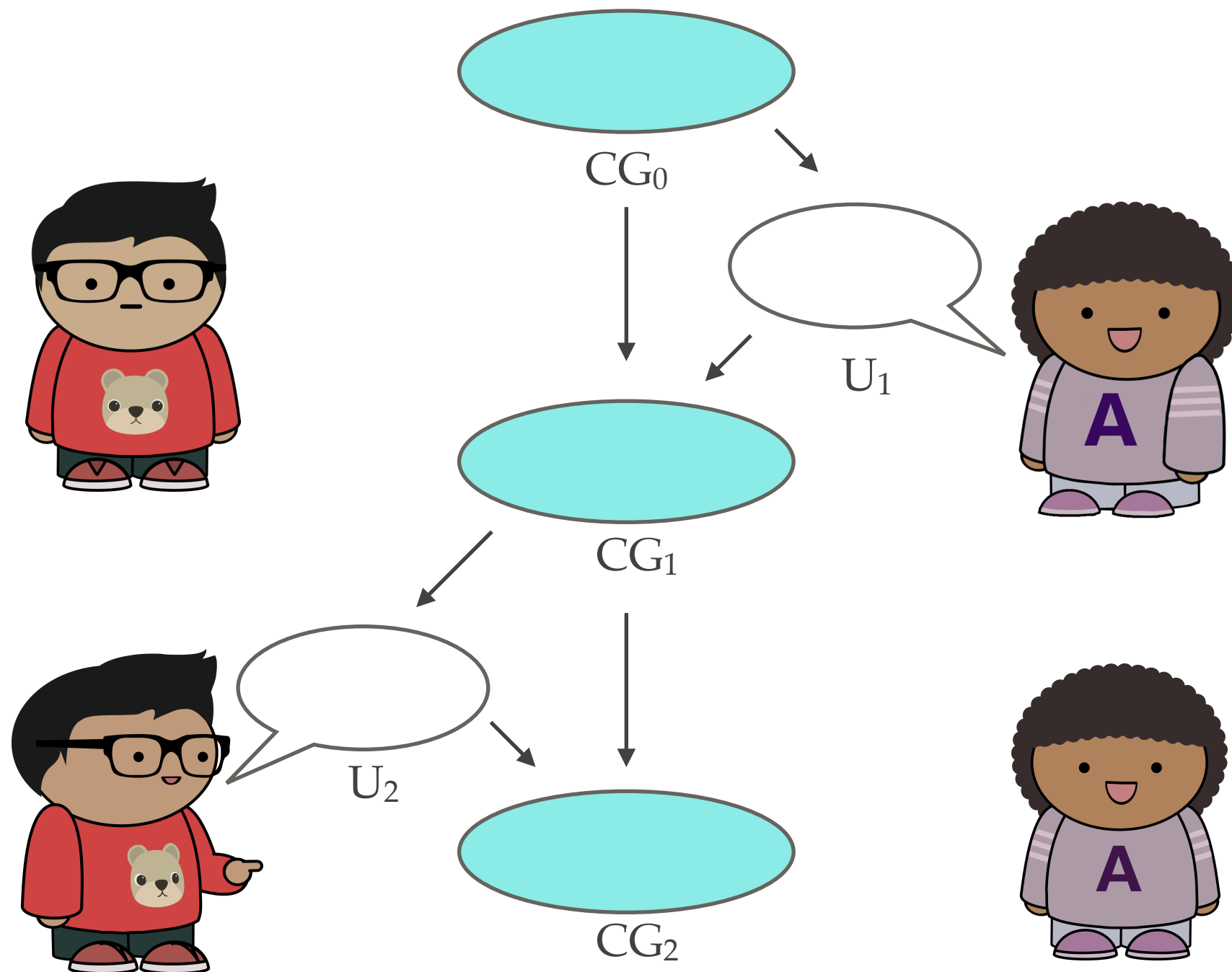


UTTERANCES UPDATE THE COMMON GROUND

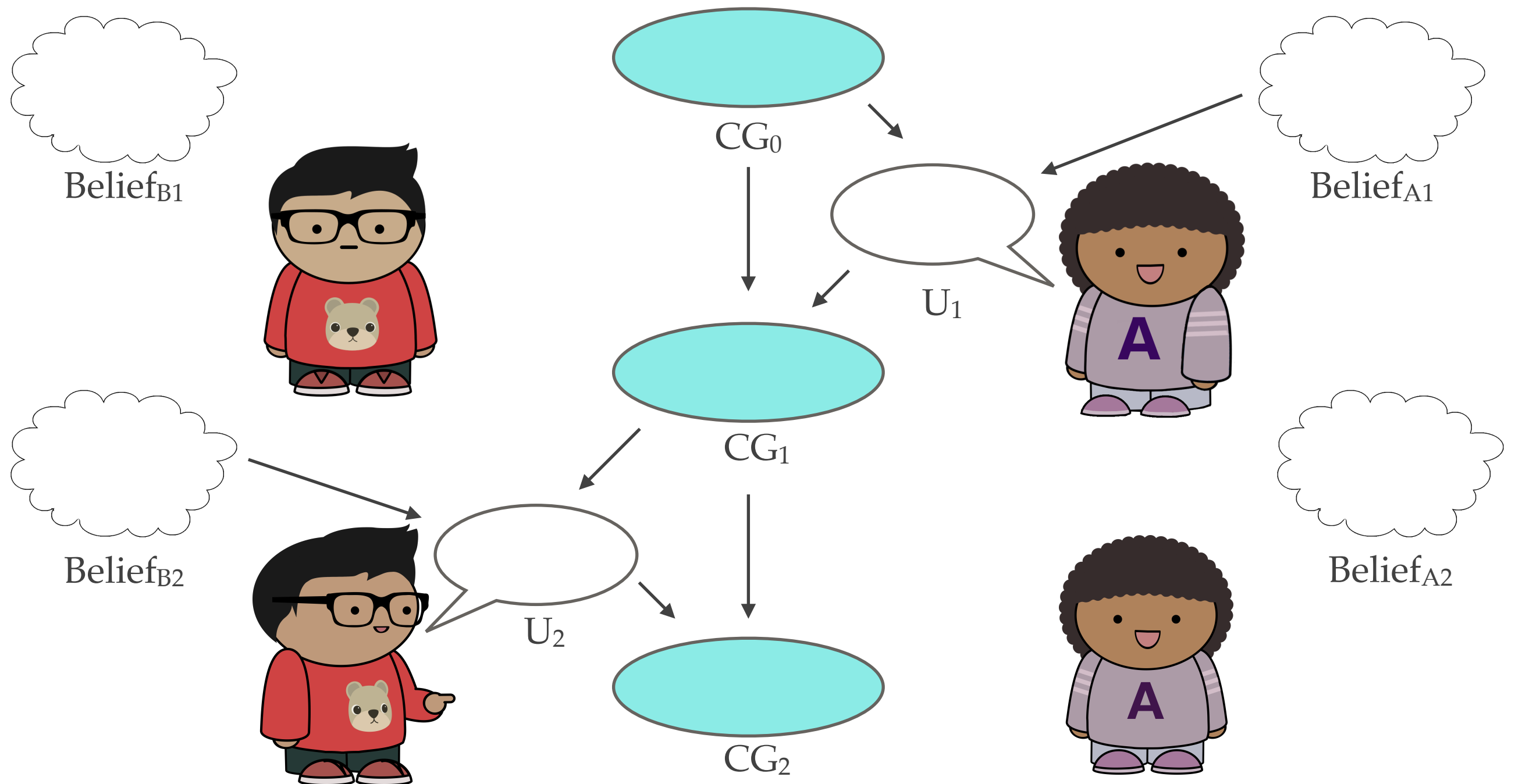
The goal of conversation is to pool information (Lewis 1979)



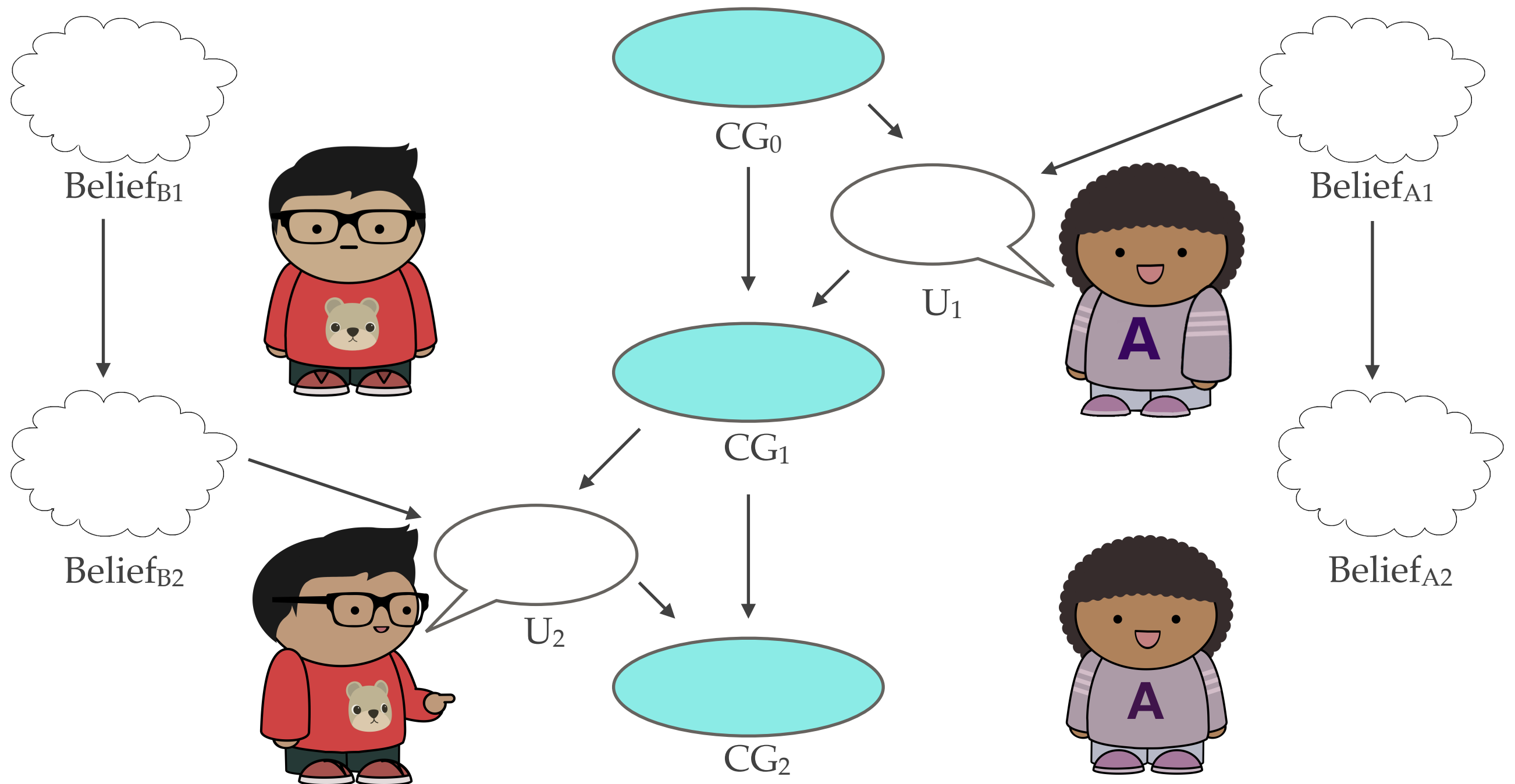
UTTERANCE SELECTION DEPENDS ON THE COMMON GROUND



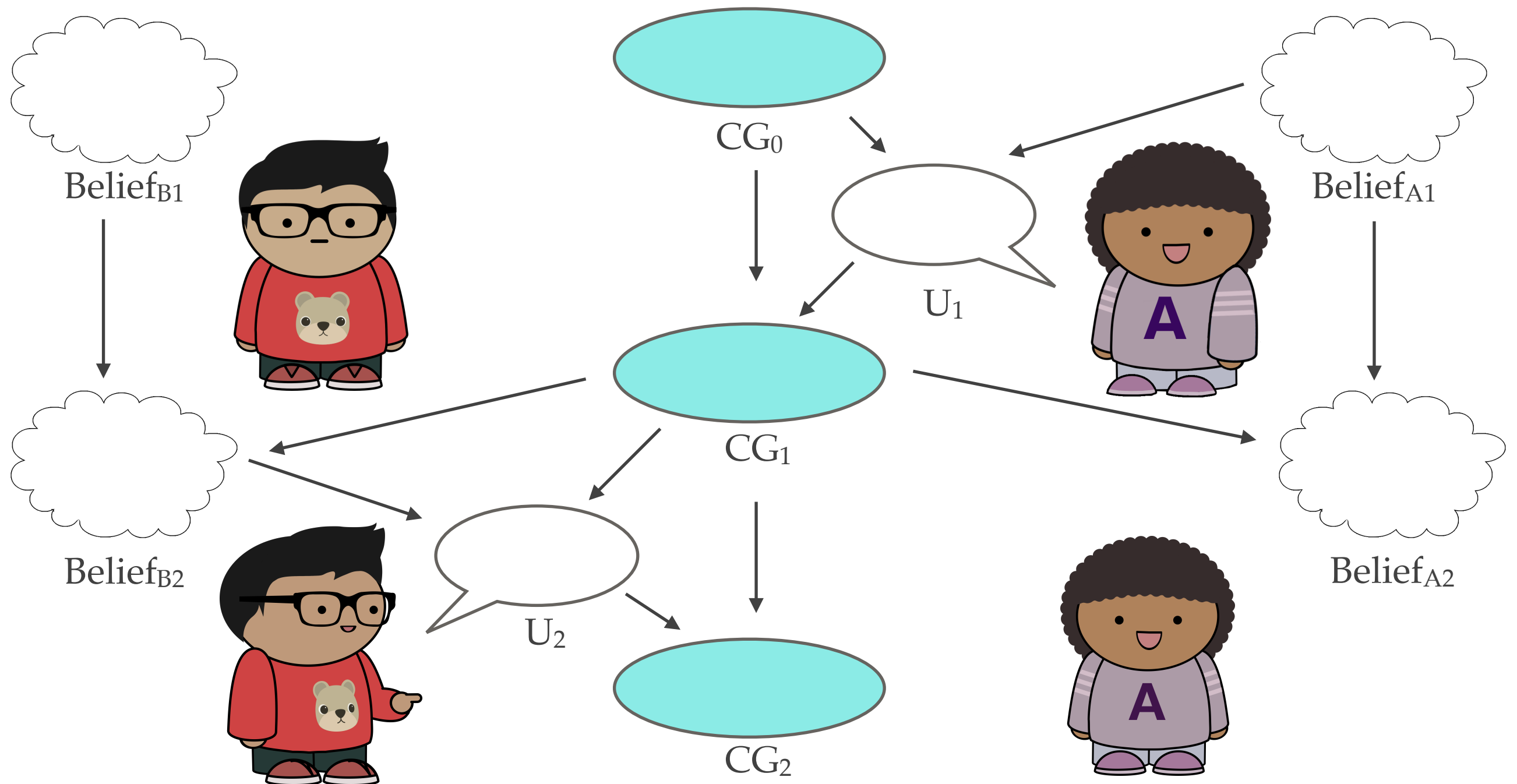
BUT PARTICIPANTS HOLD PRIVATE BELIEFS!



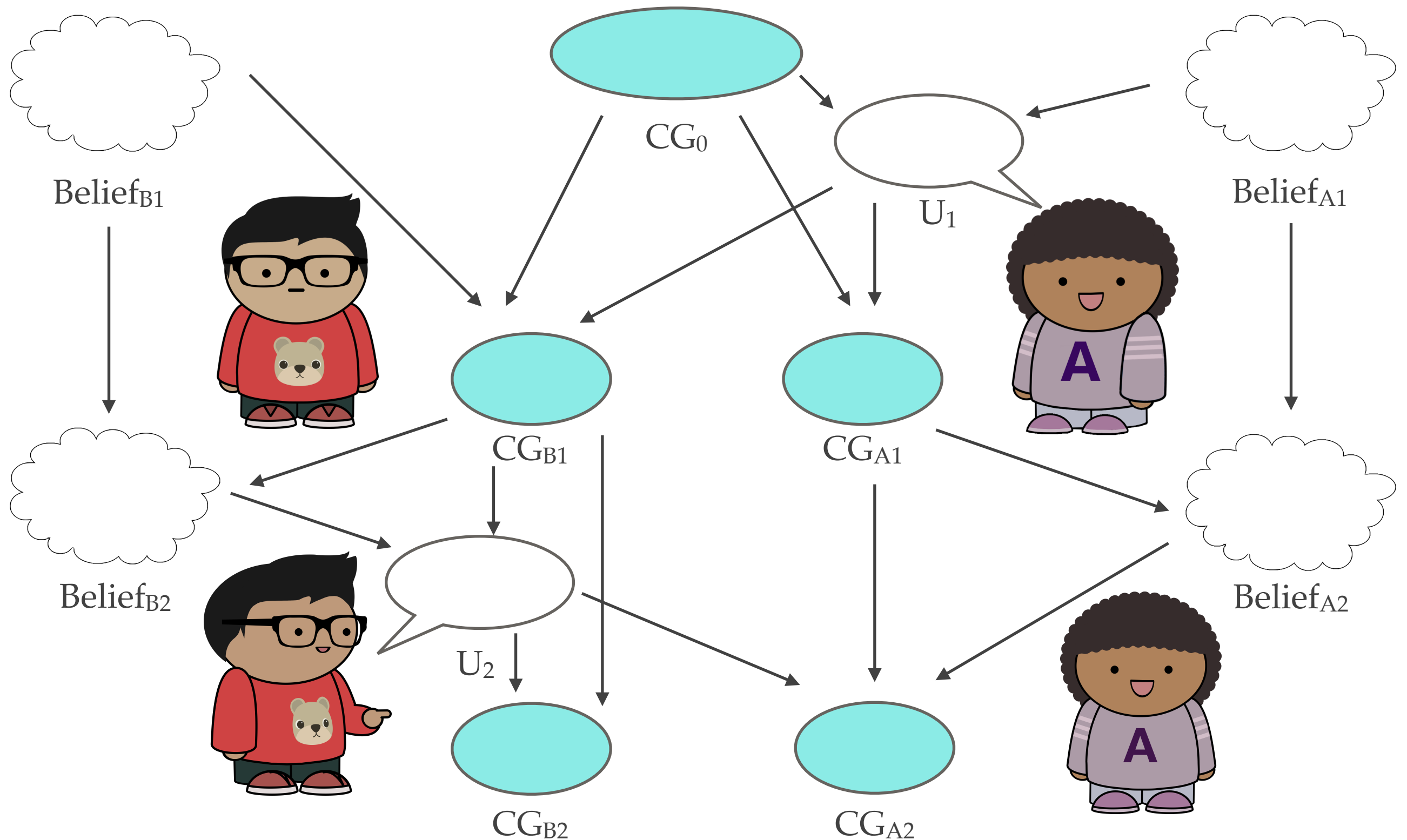
BELIEFS ARE SOMEWHAT STABLE...



BUT PARTICIPANTS ALSO LEARN FROM EACH OTHER



WAIT, DO WE ALWAYS UNDERSTAND EACH OTHER?



KEY ISSUES FOR MULTI-TURN CONVERSATIONS

Issue 1: How should the Common Ground be modeled?

Issue 2: How should the Common Ground be updated?

Issue 3: How should the beliefs of participants be updated?

Issue 4: How should observations be sampled?

ISSUE I: HOW SHOULD THE COMMON GROUND BE MODELED?

Proposal:

Model the Common Ground as a distribution over possible worlds.

Proposal:

Each participant maintains their own representation of the Common Ground (CG_A , CG_B , etc).

In a coherent discourse, there is no divergence between Common Ground representations.

ISSUE 2: HOW SHOULD THE COMMON GROUND BE UPDATED?

Proposal:

The Common Ground is updated with the result of the Pragmatic Listener computation multiplied by a learning rate.

(Listeners do not always accept the speaker's contribution fully.)

Variant 1:

The speaker and listener use different learning rates.

Variant 2:

The listener's learning rate varies based on their uncertainty (measured as the entropy of their belief distribution).

ISSUE 3: HOW SHOULD PARTICIPANTS BELIEFS BE UPDATED?

Proposal:

The listener updates their belief representation with the result of the Pragmatic Listener computation multiplied by a learning rate.

(Listeners do not always believe the speaker.)

ISSUE 4: HOW SHOULD OBSERVATIONS BE SAMPLED?

Weighted Sampling:

Sample a world from the speaker's belief distribution according to its probability.

Thresholded Sampling:

Only sample worlds that meet a certain probability threshold in the speaker's belief distribution.

Difference-based Sampling:

Sample worlds based on their Common Ground update potential.

KEY ISSUES FOR MULTI-TURN CONVERSATIONS

Issue 1: How should the Common Ground be modeled?

Issue 2: How should the Common Ground be updated?

Issue 3: How should the beliefs of participants be updated?

Issue 4: How should observations be sampled?

A NEW DIRECTION FOR THE RSA

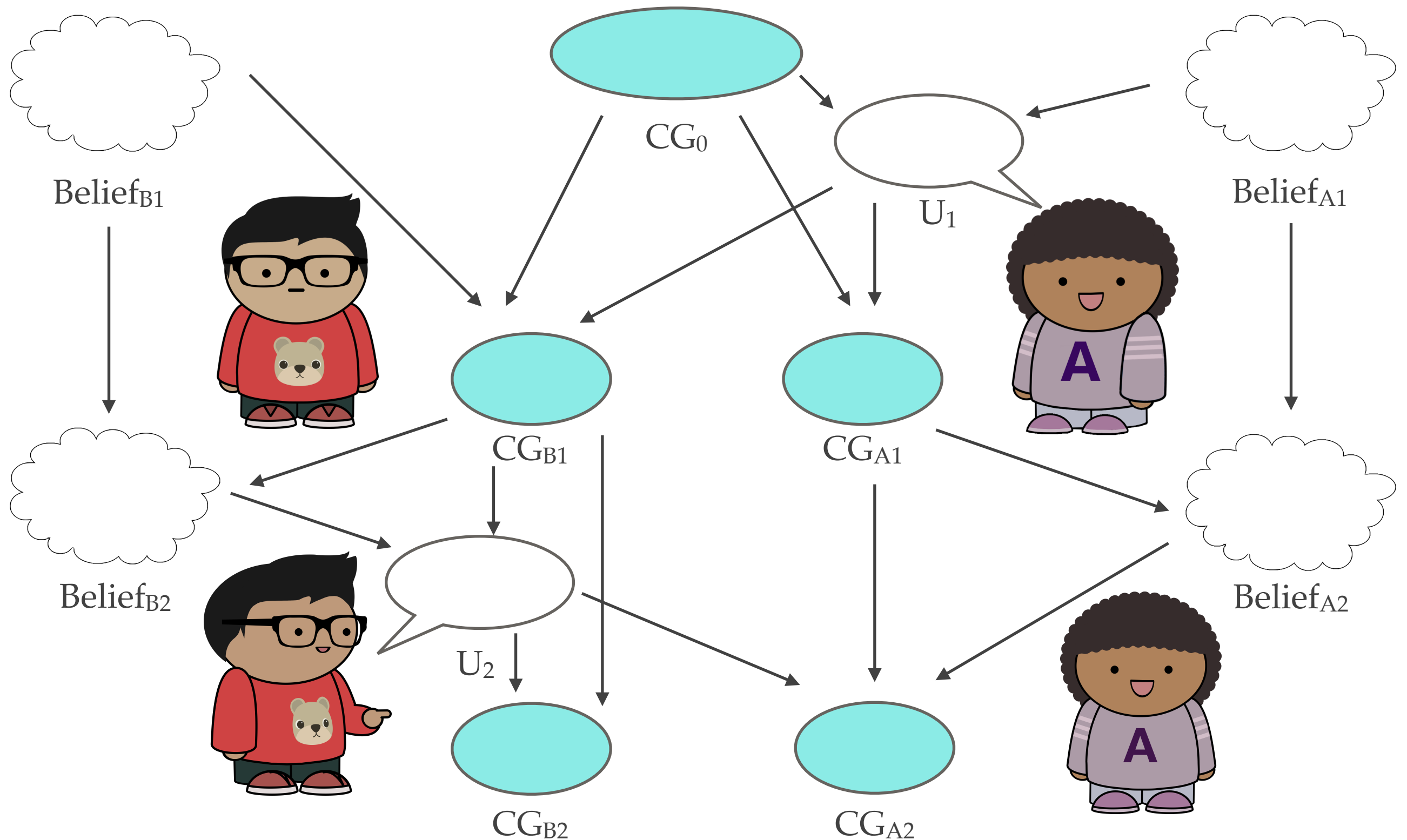
Controversial claim:

If the goal of the RSA is to model rational conversational behavior, it **maximizes the wrong probability**.

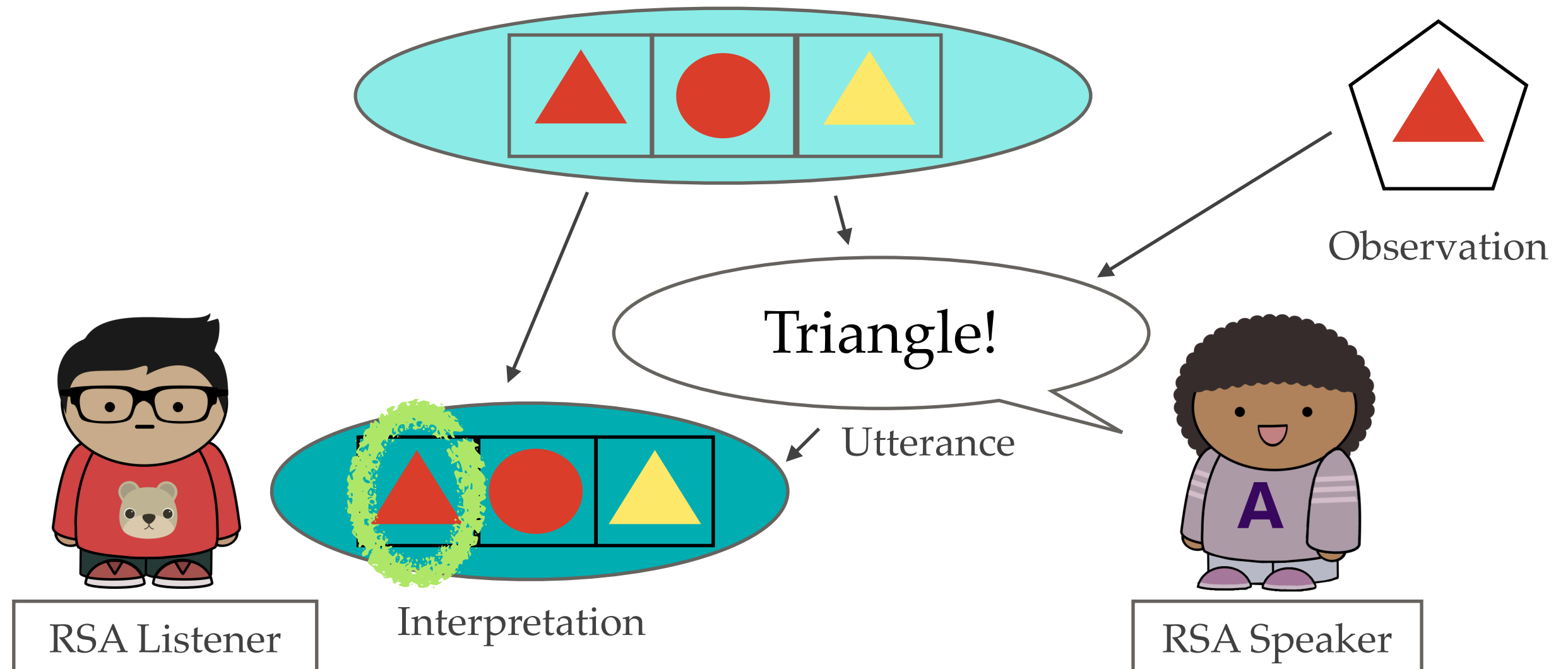
The RSA speaker currently selects the utterance that best describes the observed world.

But for multi-turn conversations, the right objective is to select the utterance that minimizes the entropy of the Common Ground.

MULTI-TURN CONVERSATION



WHAT DOES THE RSA CURRENTLY DO?



Listener: $p(w | u) \propto p(u | w) p(w)$

Speaker: $p(u | w) \propto p(w | u) p(u)$

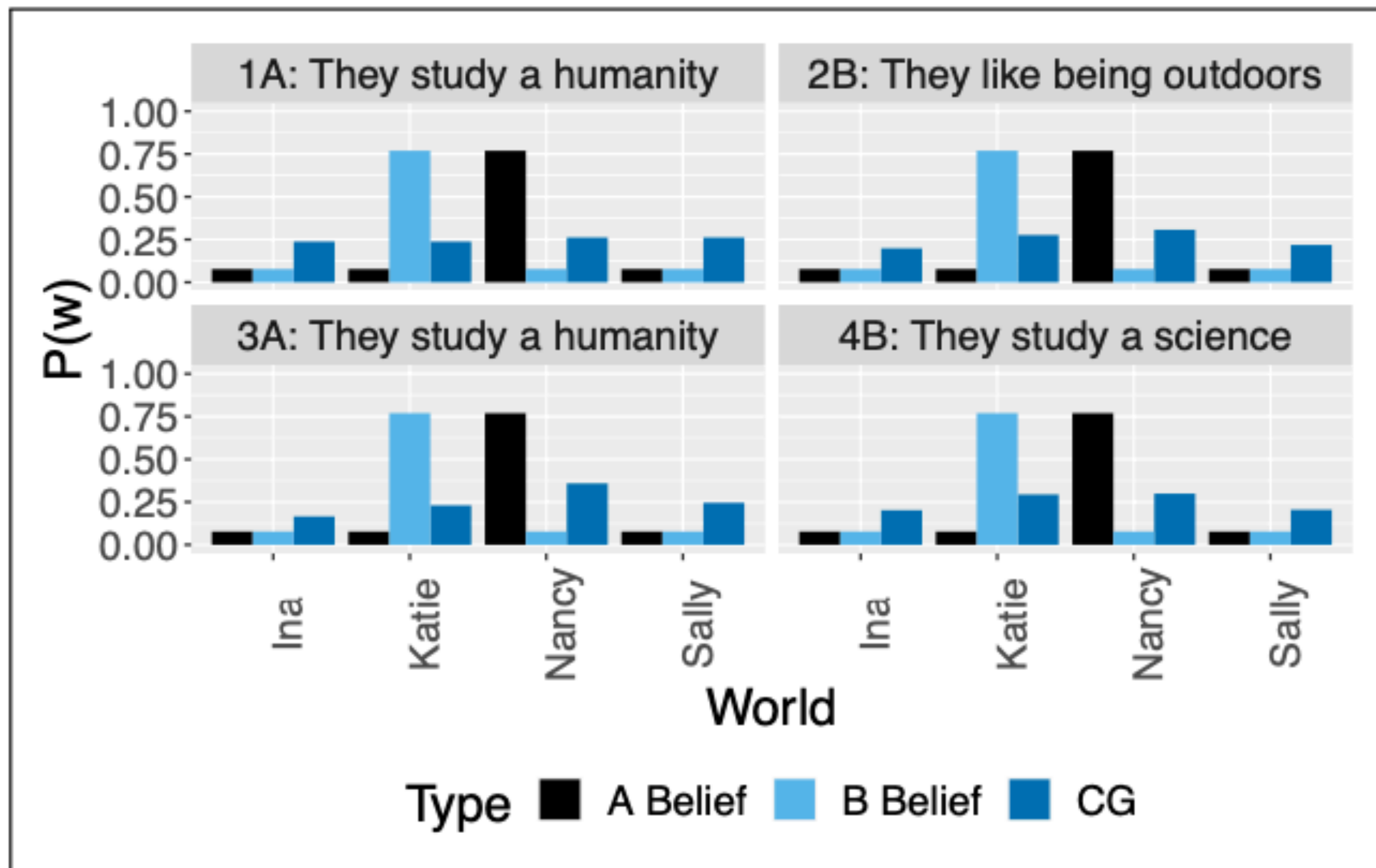


Figure 5: 4 moves with Shared Common Ground

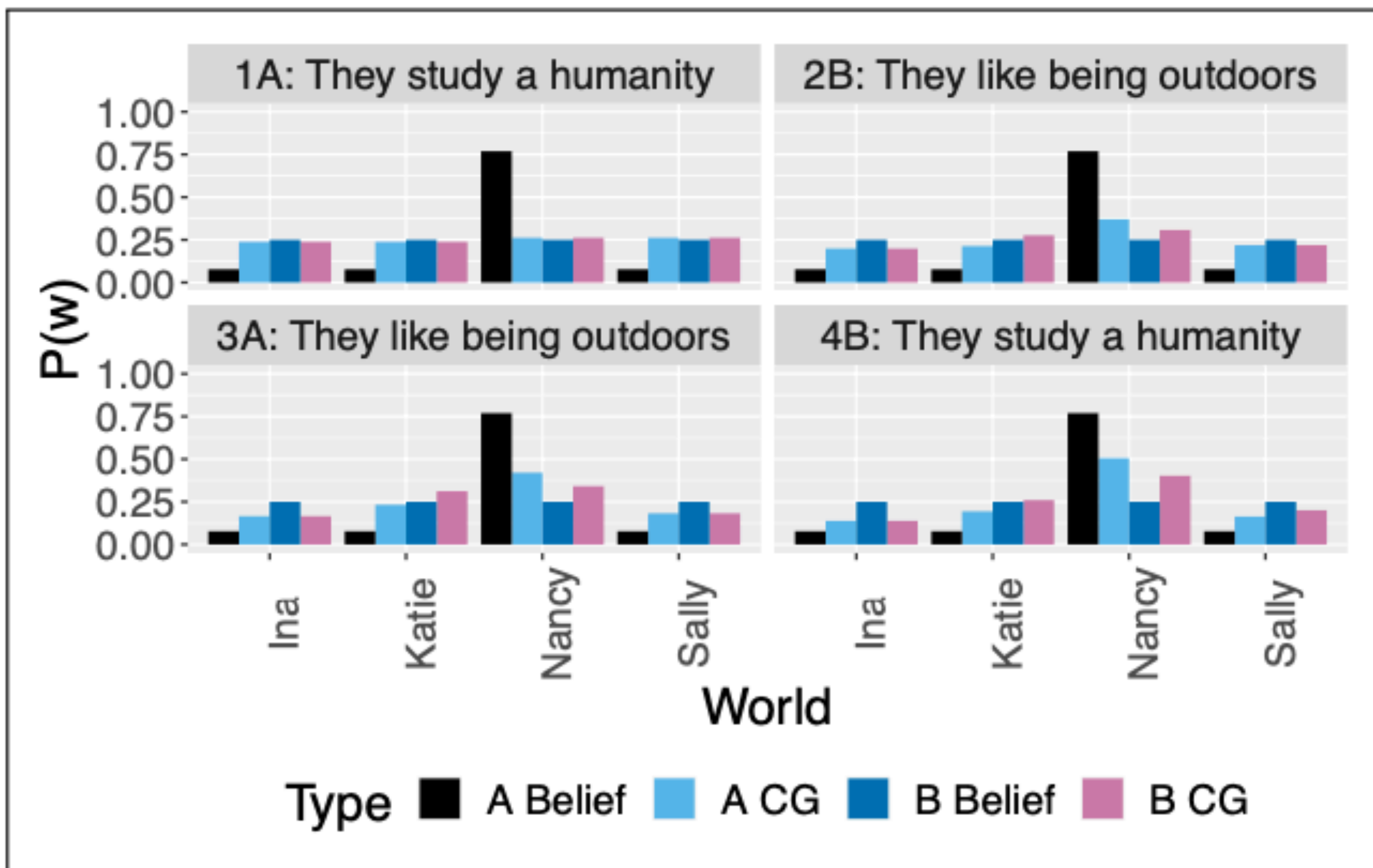


Figure 7: 4 moves with Approximate Common Ground

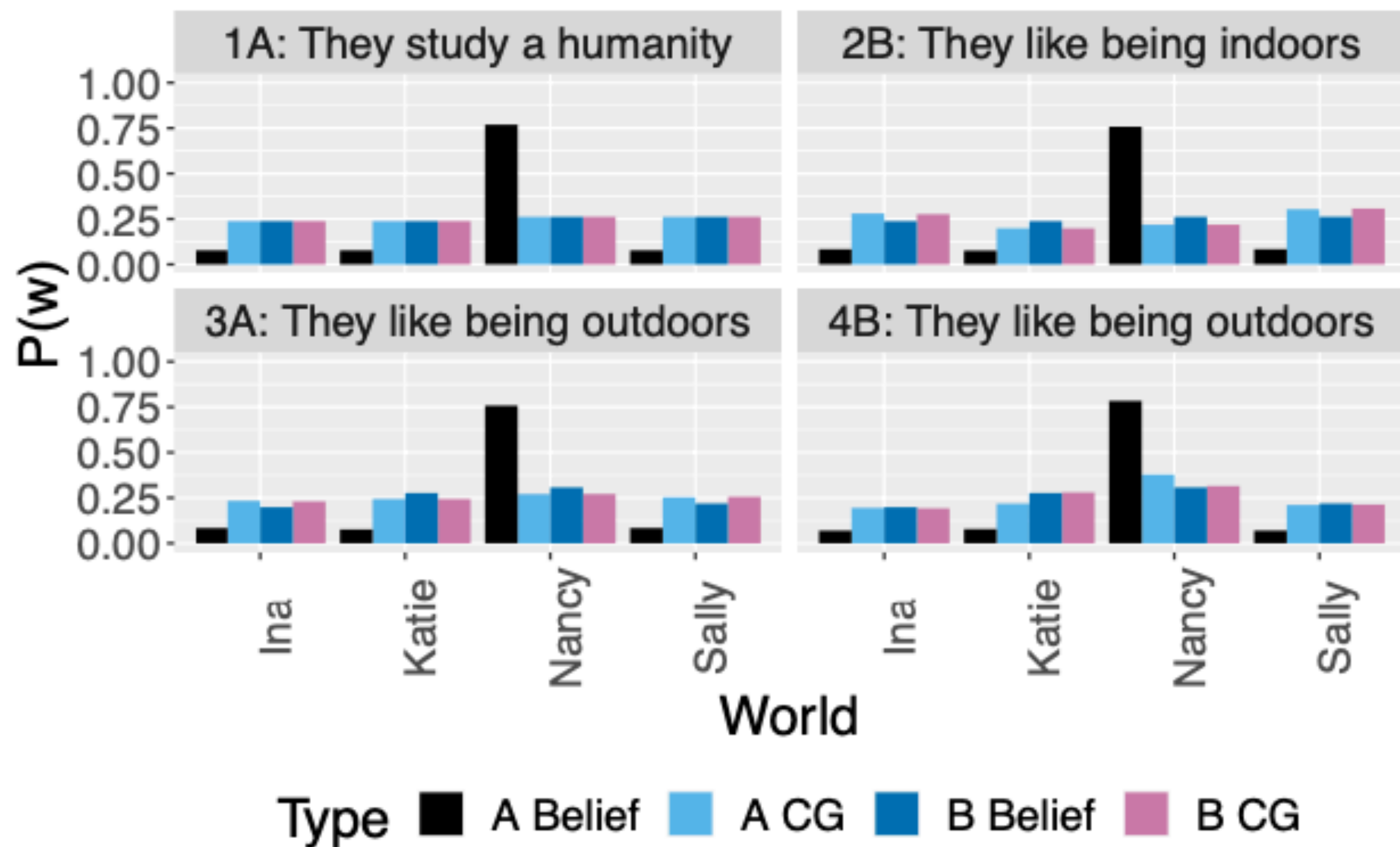


Figure 9: Belief updates (learning rate=0.2)

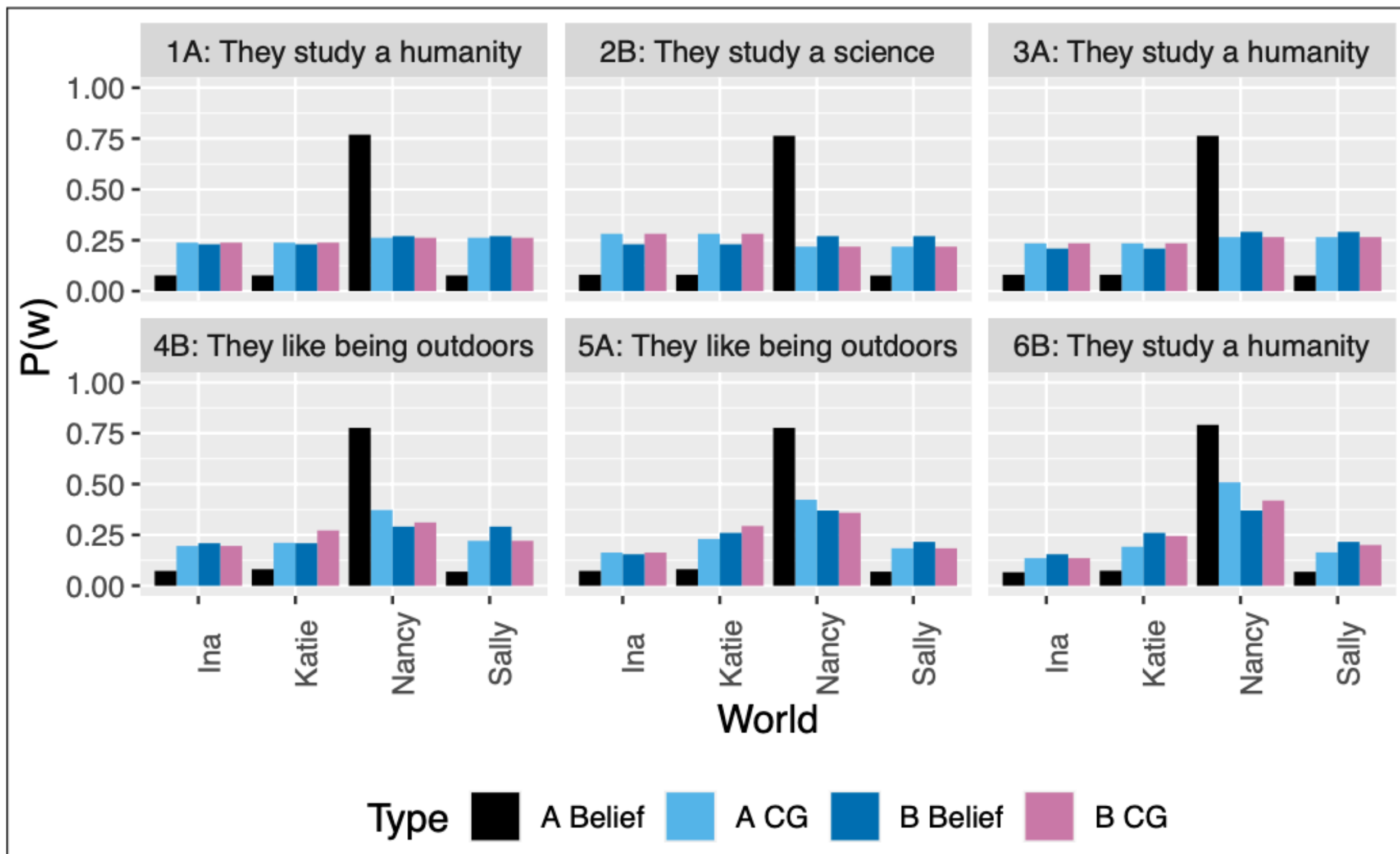


Figure 11: Entropy-based update example

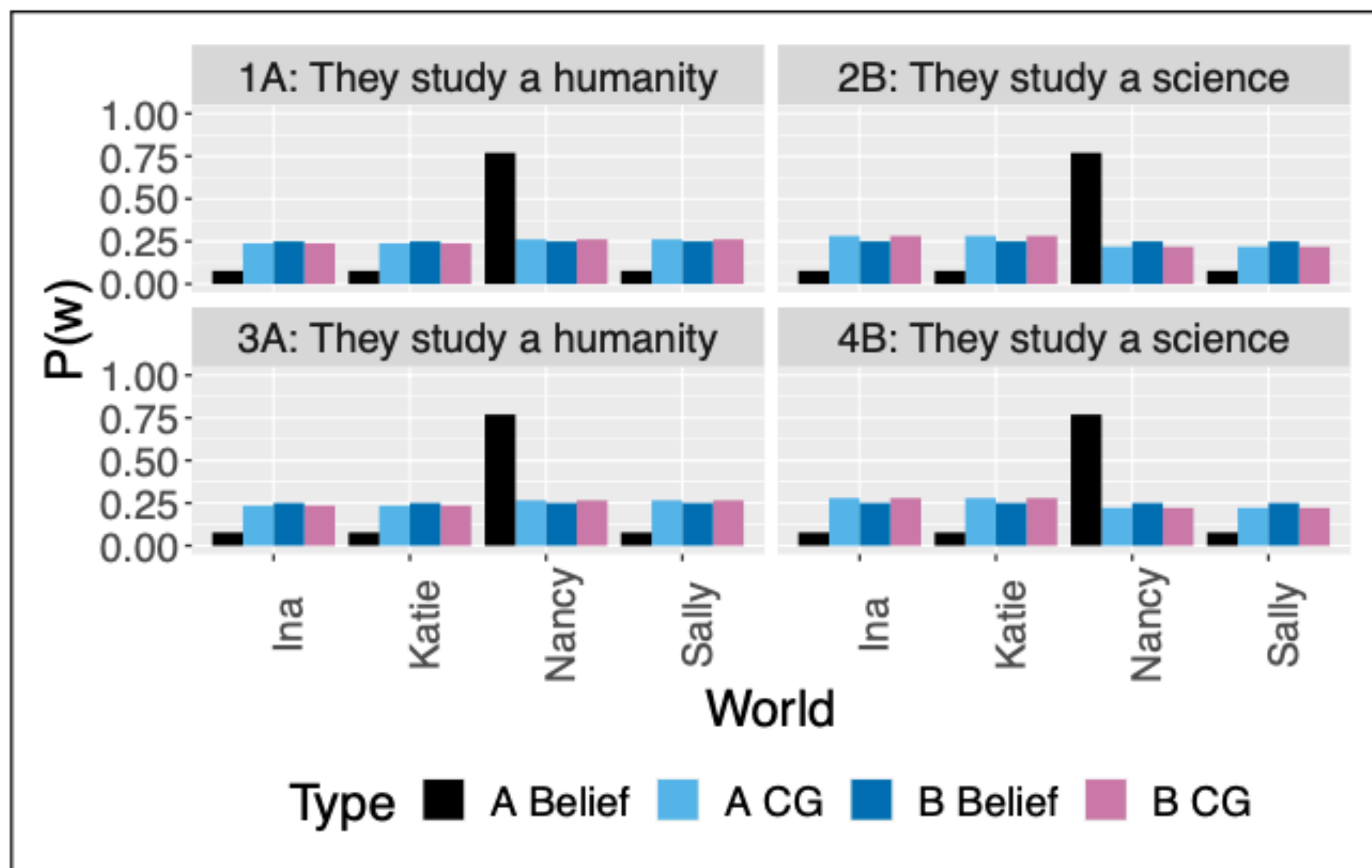


Figure 12: Sampling from a uniform belief distribution leads to flipflopping in the Common Ground

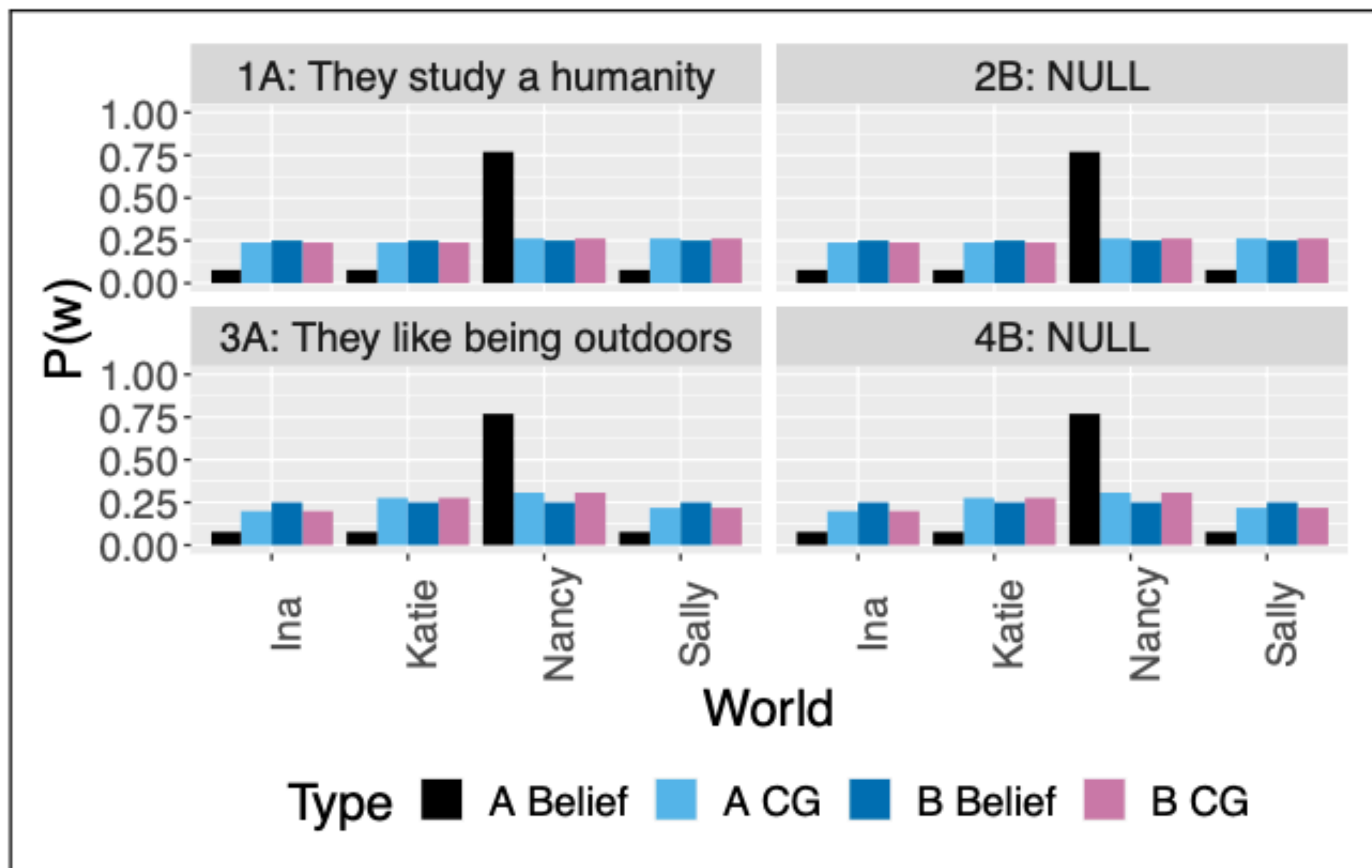


Figure 13: A threshold lets noncommittal speakers pass

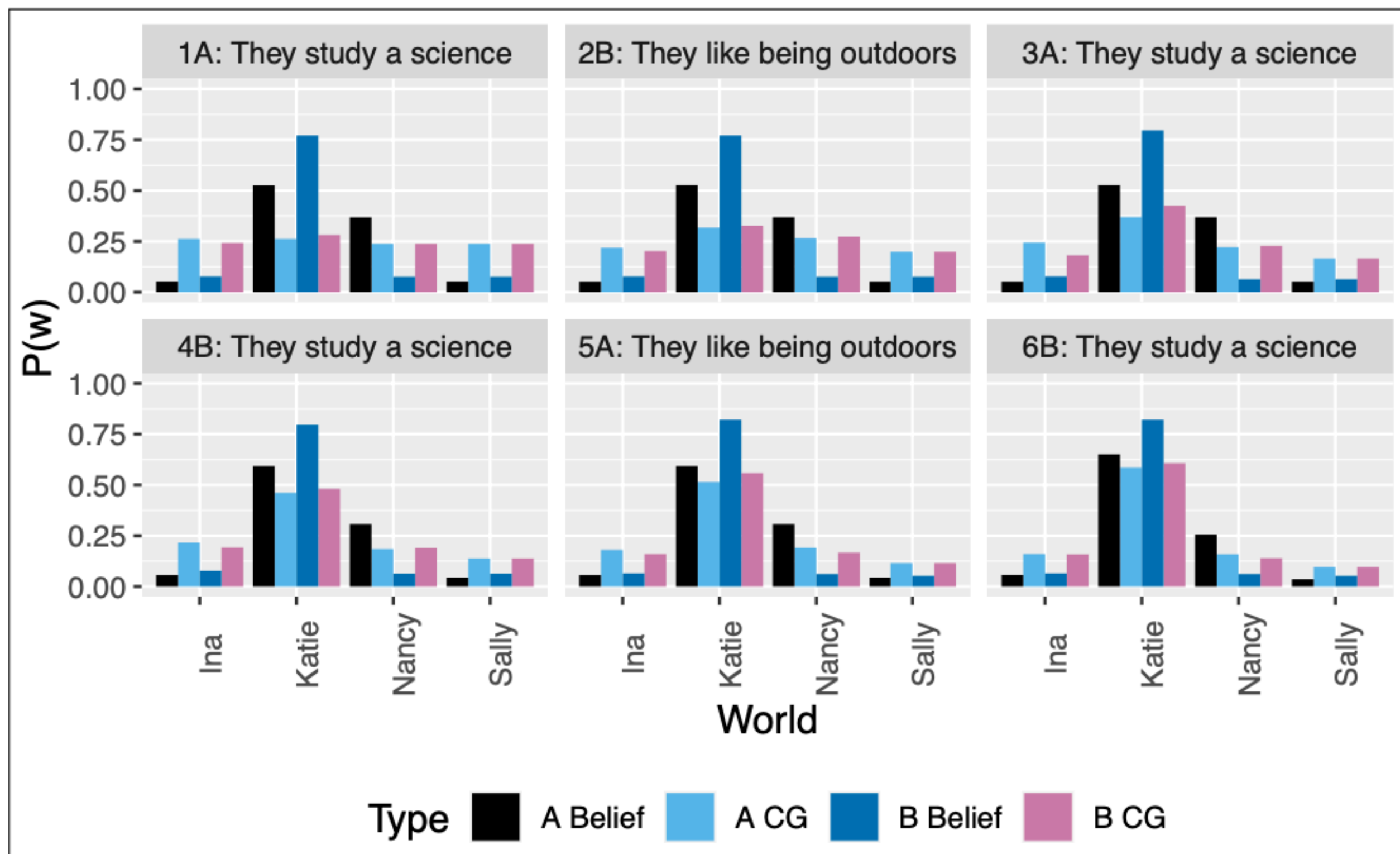


Figure 14: Redundancy with weighted sampling

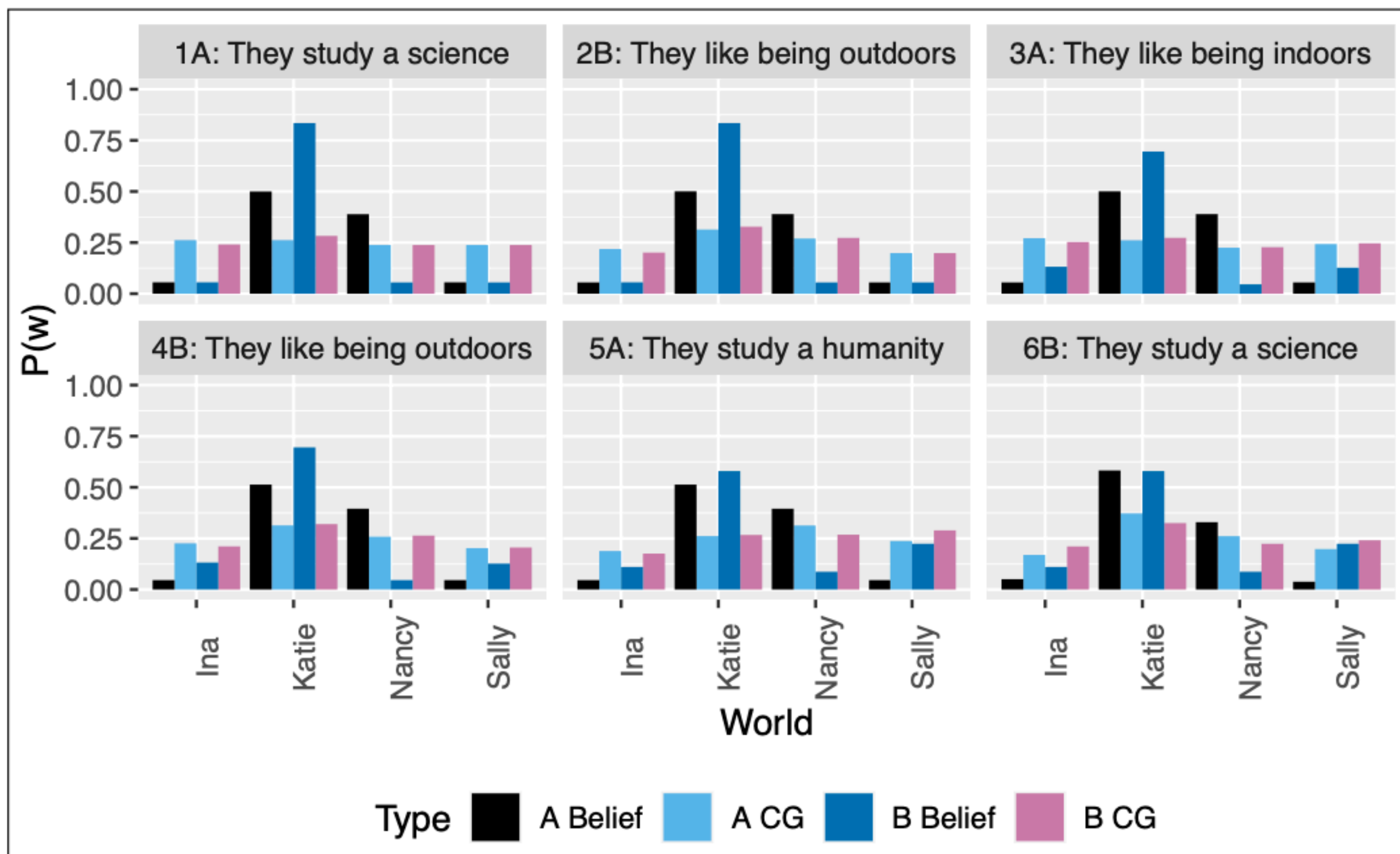


Figure 15: Thresholded difference-based sampling