Communicative reduction in referring expressions within a multi-player negotiation game

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Goals

The ability to form novel conventions is a key signature of efficient linguistic communication. In dyadic reference games, we commonly observe

- **reduction** as utterances shorter over time,
- **convergence** within groups to a shared nick name,
- **divergence** between groups as each focuses on different features.

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Do these phenomena occur in strategic games with more complex goals?

Experimental design
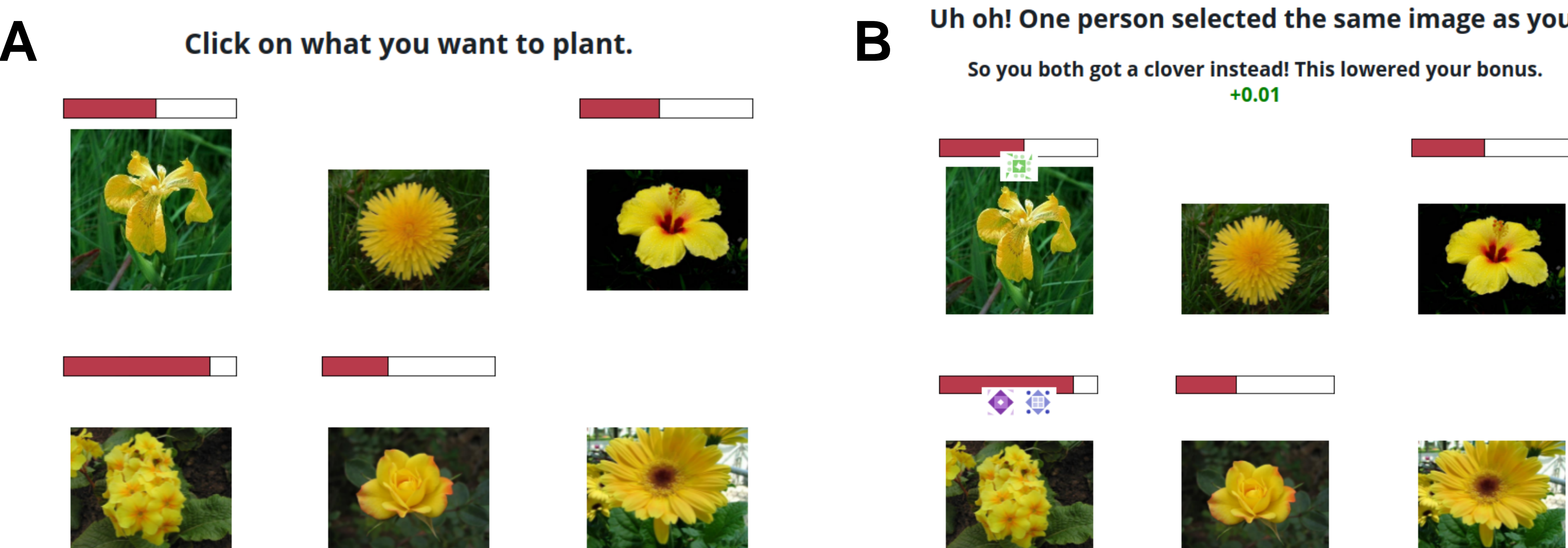
During selection (A) each participant sees 6 flowers, 4 with value bars. Players can use a chat box to communicate before making selections. Then they see feedback (B) indicating who chose what. When multiple players select the same flower, they recieve a lower value rather than what is shown.

In *individual utility* games (18 games), each player earned points for the flowers they selected; in the *shared utility* games (21 games), the points were averaged together, and all players in a game got the same reward. Each group plays 24 trials with images drawn from a set of 12 flowers. This data was first presented in Mankewitz et al. (2021).
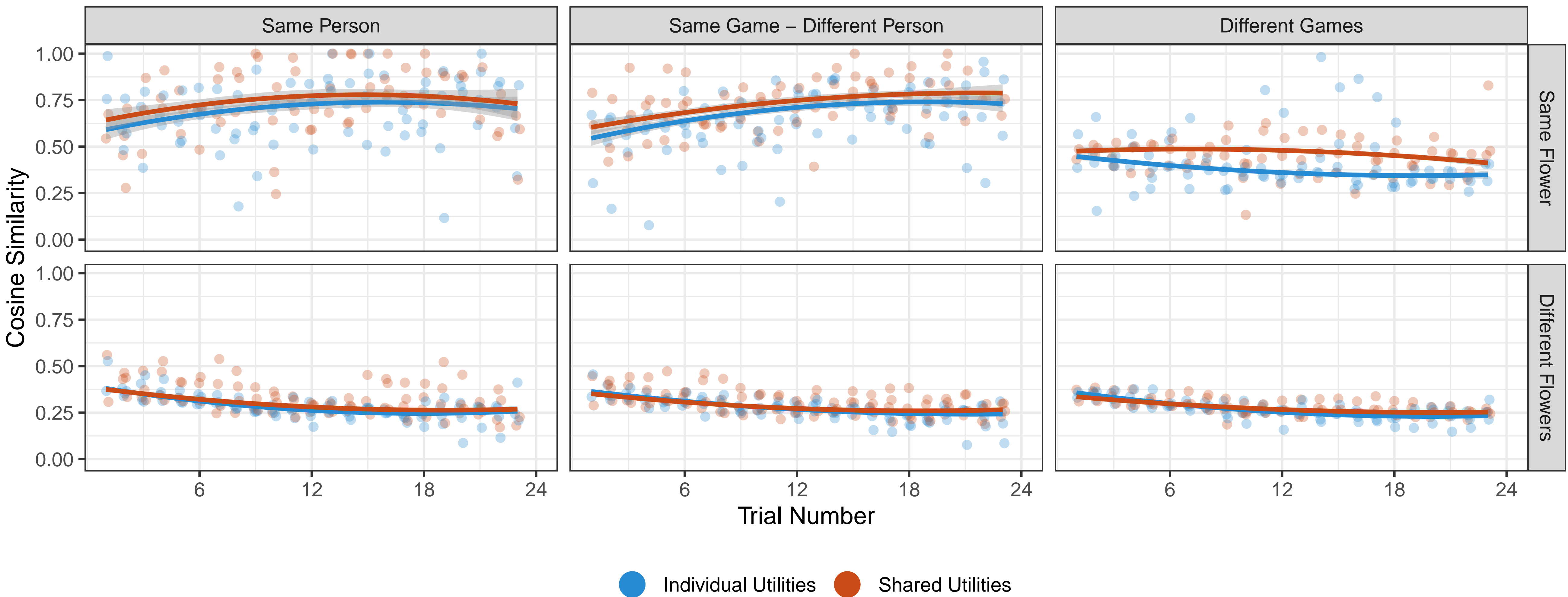
We measure distance between two utterances by the cosine of the angle between their embeddings using SBERT (CITATION).

Referring expressions reduce over time
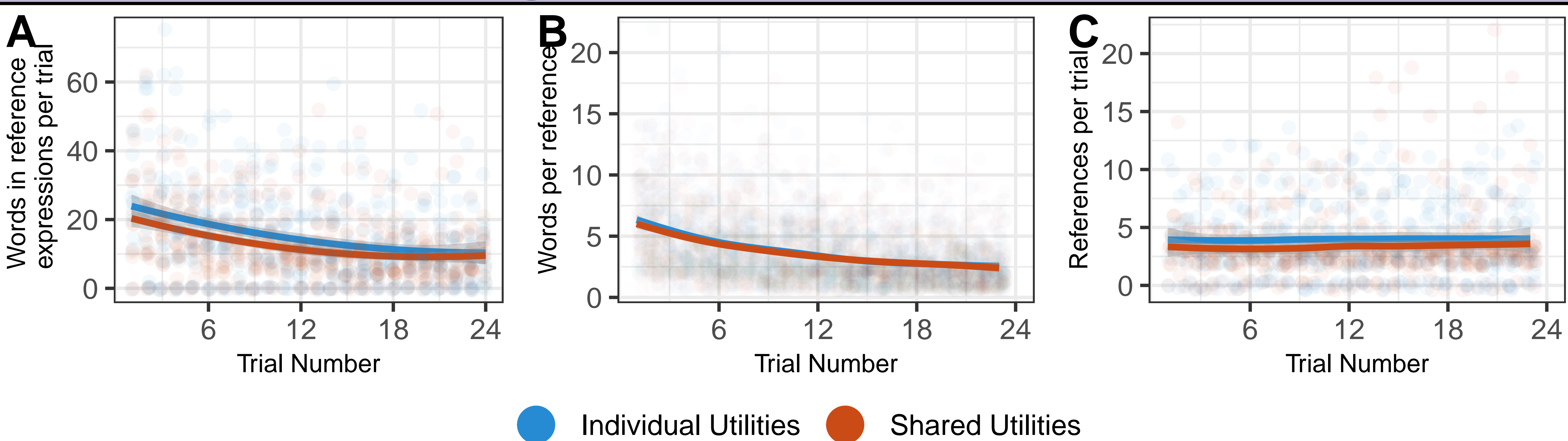
Over time individual utterances shorten, but the same number of referring expressions are produced.

Expressions converge within groups

Descriptions to the same flower in nearby trials increase in similarity with a group. Similarity decreases slightly for the same flower across games.

Flower names become more distinctive as descriptions for two different flowers become less similar.

Incentive conditions differed a bit
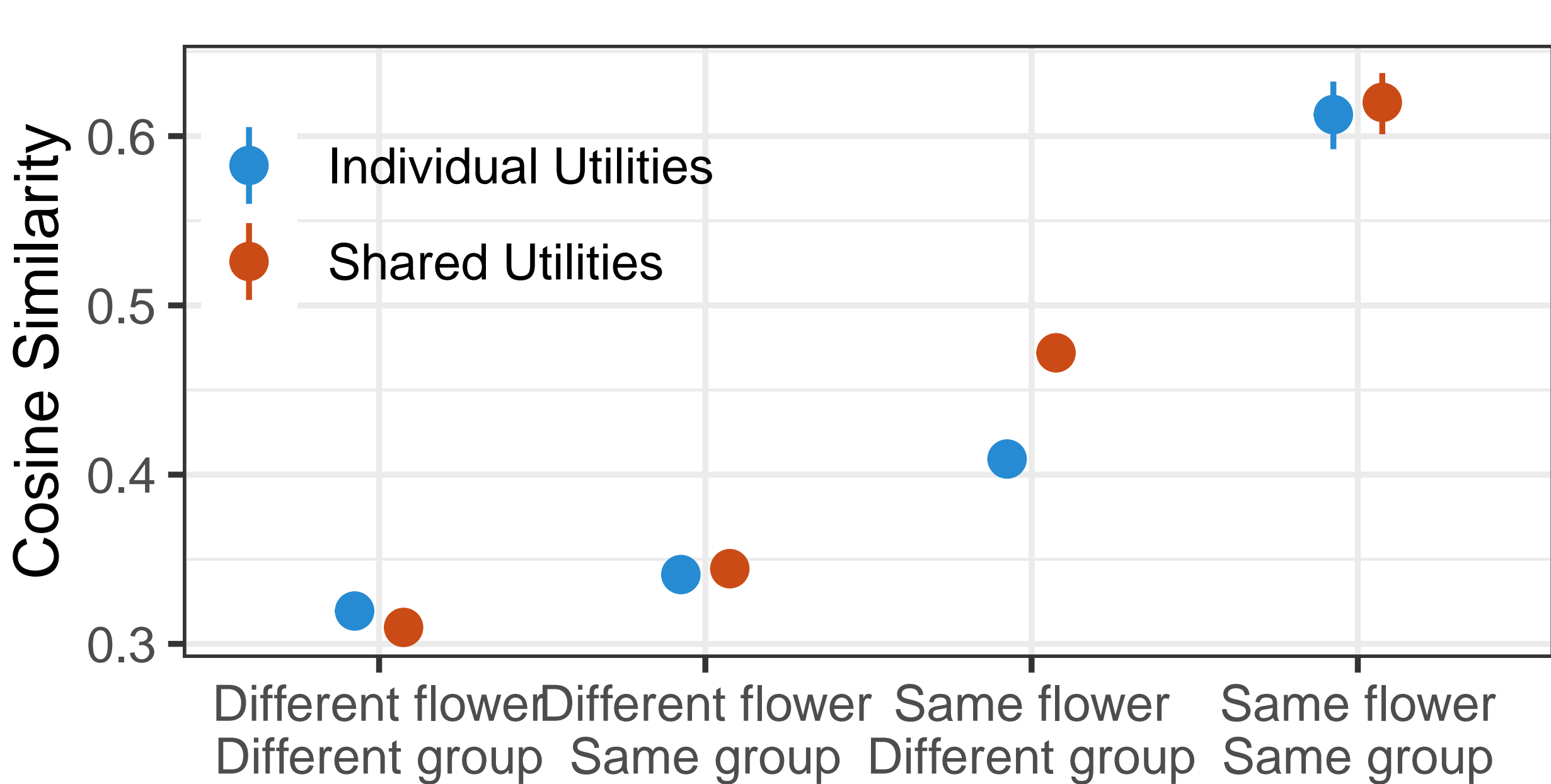
Individual and shared utilities conditions differed slightly in divergence rate during games (above). In post-game descriptions (left), shared utility games show greater cross-game similarity for the same flowers than individual utility.

Examples

Descriptions of different flowers from different games, illustrating reduction and convergence phenomenon. Images from experimental design: flower 1 upper left, flower 2 lower center, flower 3 lower left.

Flower	Game	Trial	Expression
1	1A	2	not sure what kind of flower it is but the droopy-ish one
1	1C	4	droopy iris flower
1	1B	21	droopy
2	2B	2	the red middle with spike
2	2B	3	the red center
2	2A	20	red middle
2	3C	6	the one with the dark red centre
2	3A	13	the one with black background
2	3A	24	black background
3	1A	4	the big cluster of flowers with the orange in the middle
3	1A	23	cluster
3	2C	24	bundle
3	3B	24	multi flowers

Cosine similarities between pairs of descriptions.

Expression 1	Expression 2	Sim
the red center	red middle	0.78
droopy iris flower	multi flowers	0.56
droopy iris flower	droopy	0.56
cluster	bundle	0.25
red middle	black background	0.25
droopy iris flower	the red center	0.09
droopy	bundle	0.03

Conclusion

Reduction and convergence patterns generalize to freer-form and more naturalistic domain of a negotiation game

References: TODO