

This material is connected to the article “Anticipating disagreement enhances source memory in English- and Turkish-speaking preschool children”, published in *Developmental Psychology*. Doi: 10.1037/dev0001996

Supplementary Material

A: Additional Preregistered Dependent Variables

We preregistered logistic linear mixed-effects models for two additional dependent variables: whether children mentioned *any* source (Source Mentioned), and whether children provided the correct source if asked in a forced choice format (Source Memory Recognition).

Source Mentioned

We coded whether children provided any relevant answer (a reference to seeing or telling), even if incorrect, as an indication of children’s general willingness to answer the open-ended source memory question.

No interactions emerged in the 4-way model (with Language, Condition, Source, and Age, plus random participant intercepts). The model revealed main effects of Age, Source, Language, and Trial. Mentioning a source was more likely for older children, when the child saw the object themselves, for English-speaking children, and for later trials. See Table S1 and Figure S1.

We preregistered conducting this model separately for each Language.

English-Speaking. There were no 3-way interactions or 2-way interactions in the model. The model revealed a main effect of Age and Trial: older children were more likely to provide a source than younger children, and children were more likely to provide a source on later trials (see Table S1 and Figure S1A).

Turkish-Speaking. There were no 3-way interactions or 2-way interactions in the model. The model revealed a main effect of Age and Source: older children were more likely to provide

a source than younger children, and children were more likely to provide a source when they saw the object themselves (see Table S1 and Figure S1B).

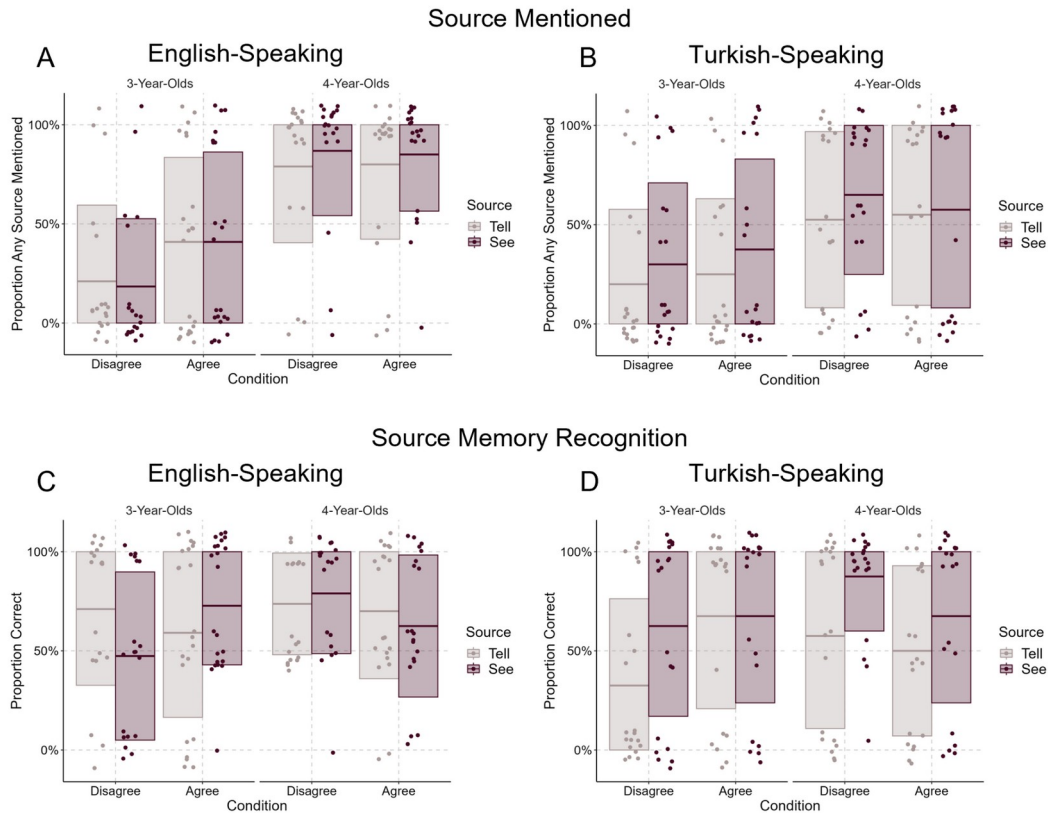


Figure S1. (A,B) Proportions of trials where children mentioned a source, split by Condition (Agree/Disagree) and Source (See/Tell) for English-speaking children (A) and Turkish-speaking children (B). (C,D) Proportions of trials where children recognized the correct source in a forced-choice question, split by Condition (Agree/Disagree) and Source (See/Tell) for English-speaking children (C) and Turkish-speaking children (D). Boxplots represent means and standard deviations, dots are individual data points (randomly jittered for visibility).

Source Memory Recognition

We also examined recognition memory for sources, which can provide additional context about whether children correctly encoded the source, even if not done so explicitly.

There was no 4-way interaction, but there were 3-way interactions between Condition, Source and Age, and between Condition, Source, and Language. To follow up on these

Source Mentioned	Term	Est.	SE	z	p
4-Way Model	Intercept	-0.85	0.56	-1.53	.126
	Source	0.92	0.33	2.77	.006
	Condition	0.17	0.87	0.20	.846
	Age	3.31	0.63	5.21	< .001
	Language	-2.25	0.92	-2.43	.015
	Trial	0.33	0.14	2.40	.016
	Language:Age	-1.53	0.86	-1.78	.075
	Condition:Language	-0.32	1.74	-0.18	.855
	Source:Language	0.64	0.65	0.98	.328
	Source:Age	0.16	0.35	0.45	.655
	Condition:Age	-0.21	0.86	-0.25	.805
	Condition:Source	-0.52	0.65	-0.79	.429
	Condition:Source:Age	-0.40	0.70	-0.58	.563
	Condition:Language:Age	0.73	1.71	0.43	.671
	Condition:Source:Language	-0.04	1.30	-0.03	.973
	Source:Language:Age	-0.85	0.70	-1.21	.227
Condition:Source:Language:Age	0.88	1.40	0.63	.530	
English-Speaking	Intercept	0.13	0.85	0.16	.875
	Source	0.65	0.52	1.25	.211
	Condition	0.31	1.35	0.23	.819
	Age	4.38	1.07	4.11	< .001
	Trial	0.42	0.21	1.95	.052
	Age:Source	0.62	0.56	1.11	.267
	Age:Condition	-0.59	1.32	-0.45	.654
	Source:Condition	-0.55	1.02	-0.54	.592
	Age:Source:Condition	-0.91	1.11	-0.81	.416
Turkish-Speaking	Intercept	-1.74	0.78	-2.22	.026
	Source	1.20	0.43	2.76	.006
	Condition	0.01	1.14	0.01	.990
	Age	2.36	0.77	3.08	.002
	Trial	0.27	0.18	1.48	.139
	Age:Source	-0.25	0.44	-0.58	.562
	Age:Condition	0.13	1.13	0.11	.912
	Source:Condition	-0.51	0.83	-0.62	.539
	Age:Source:Condition	0.03	0.88	0.03	.976

Table S1. Results of GLMMs for whether a source was mentioned.

interactions, we ran the model separately in each Condition. There were no significant effects in the Agreement condition, but the Disagreement condition included a significant main effect of Age and a Source by Language interaction (see Table S1). Older children in both language samples were more likely to correctly recognize the source in a forced-choice question.

English-Speaking. There was a three-way interaction between Age, Source, and Condition (see Table S1 and Figure S1C). We therefore conducted the model separately within each age group. In 4-year-olds, there were no differences by Source, Condition, or their interaction. In 3-year-olds, there was a significant interaction between Source and Condition. Three-year-olds in the Disagreement condition had higher accuracy on Tell trials compared to See trials, though this did not reach conventional levels of significance, $Z = 1.76$, $p = .078$, $r = 0.40$. See and Tell trials were not significantly different for 3-year-olds in the Agreement condition, $Z = -0.72$, $p = .472$, $r = 0.15$.

Both age groups had above-chance recognition, 3-year-olds: $M = 62\%$, $SD = 25\%$, $Z = 2.90$, $p = .004$, $r = .58$, 4-year-olds: $M = 71\%$, $SD = 22\%$, $Z = 4.30$, $p < .001$, $r = .78$. English-speaking children at all ages therefore appear to have encoded the correct source.

Turkish-Speaking. There was no 3-way interaction or interactions with Age. There was a Source by Condition interaction: Three and 4-year-olds were more accurate for See over Tell trials in the Disagreement condition, $Z = -2.73$, $p = .006$, $r = 0.43$, but not in the Agreement condition, $Z = -0.84$, $p = .400$, $r = 0.13$ (see Table S2 and Figure S1D).

Four-year-olds recognized sources above chance, $M = 66\%$, $SD = 29\%$, $Z = 2.80$, $p = .005$, $r = 0.56$, but 3-year-olds did not, $M = 58\%$, $SD = 30\%$, $Z = 1.51$, $p = .136$, $r = 0.35$. Turkish-speaking children by 4 years old appear to have encoded the correct source.

Source Memory Recognition	Term	Est.	SE	z	p
4-Way Model	Intercept	0.59	0.22	2.68	.007
	Source	0.47	0.18	2.57	.010
	Condition	-			
		0.10	0.20	-0.48	.635
	Age	0.37	0.10	3.56	< .001
	Language	-			
		0.20	0.20	-0.98	.325
	Trial	0.04	0.08	0.51	.613
	Language:Age	0.20	0.20	1.00	.317
	Condition:Language	0.10	0.40	0.24	.812
	Source:Language	1.06	0.37	2.88	.004
	Source:Age	0.01	0.19	0.07	.941
	Condition:Age	-			
		0.47	0.20	-2.28	.023
	Condition:Source	-			
		0.31	0.37	-0.85	.395
	Condition:Source:Age	-			
		0.75	0.38	-2.00	.046
	Condition:Language:Age	-			
	0.29	0.41	-0.72	.472	
Condition:Source:Language	-				
	1.81	0.74	-2.47	.014	
Source:Language:Age	0.52	0.38	1.39	.164	
Condition:Source:Language:Age	1.41	0.76	1.86	.063	
Agreement	Term	Est.	SE	z	p
	Intercept	0.60	0.30	2.03	.043
	Source	0.30	0.24	1.27	.204
	Age	0.12	0.14	0.88	.380
	Language	-			
		0.12	0.26	-0.48	.634
	Trial	0.01	0.11	0.09	.929
	Age:Language	0.04	0.28	0.16	.873
	Language:Source	0.22	0.48	0.45	.651
	Age:Source	-			
	0.33	0.26	-1.28	.200	
Disagreement	Term	Est.	SE	z	p

Intercept	0.56	0.33	1.73	.083
Source	0.64	0.28	2.30	.021
Age	0.61	0.15	4.18	< .001
Language	-			
	0.23	0.30	-0.77	.442
Trial	0.07	0.12	0.64	.522
Age:Language	0.37	0.29	1.29	.198
Language:Source	2.03	0.55	3.72	< .001
Age:Source	0.40	0.26	1.53	.125

English-Speaking	Term	Est.	SE	z	p
	Intercept	0.55	0.30	1.84	.066
	Source	-0.05	0.25	-0.21	.836
	Condition	-0.13	0.25	-0.54	.591
	Age	0.25	0.13	1.97	.049
	Trial	0.08	0.11	0.76	.450
	Age:Source	-0.24	0.25	-0.93	.352
	Age:Condition	-0.31	0.25	-1.21	.226
	Source:Condition	0.57	0.50	1.14	.254
	Age:Source:Condition	-1.38	0.51	-2.72	.007
3-year-olds	Term	Est.	SE	z	p
	Intercept	0.63	0.42	1.52	.129
	Source	-0.22	0.34	-0.65	.516
	Condition	0.27	0.35	0.76	.450
	Trial	-0.04	0.15	-0.25	.805
	Source:Condition	1.63	0.68	2.38	.017
4-Year-olds	Term	Est.	SE	z	p
	Intercept	0.39	0.43	0.93	.354
	Source	0.01	0.36	0.04	.969
	Condition	-0.50	0.36	-1.38	.167
	Trial	0.22	0.16	1.35	.176
	Source:Condition	-0.57	0.73	-0.78	.436
Turkish-Speaking	Term	Est.	SE	z	p
	Intercept	0.65	0.33	1.96	.050
	Source	1.07	0.28	3.85	< .001
	Condition	-0.03	0.32	-0.10	.917
	Age	0.50	0.17	2.96	.003
	Trial	-0.01	0.11	-0.06	.954
	Age:Source	0.28	0.28	0.99	.320
	Age:Condition	-0.65	0.33	-1.94	.053
	Source:Condition	-1.28	0.54	-2.35	.019
	Age:Source:Condition	-0.01	0.56	-0.02	.984

Table S2. Results of GLMMs for whether a source was correctly recognized.

B: Exploratory Comparison of Language Samples

Here we report simple effects models for the 4-way interaction presented in the main text, split by Condition (for Source Memory) and Age (for Perceptual Memory) rather than Language to allow for comparison of the two language samples.

Source Memory

For 3-year-olds, there was a significant 3-way interaction between Language, Condition, and Source. We followed up on this by further grouping by Condition, finding no Language or Source differences in the Agreement condition, but a Location by Source interaction in the Disagreement condition. This is also reported in the main text: Turkish-speaking 3-year-olds gave more correct sources on See trials than Tell trials in the Disagreement condition, but English-speaking 3-year-olds showed no difference. There was only a Source by Condition interaction and a main effect of Language in 4-year-olds. English-speaking 4-year-olds gave more correct sources than Turkish-speaking 4-year-olds.¹ The interaction matches what is reported in the main text: 4-year-olds generally recalled first-hand sources better than second-hand sources in the Disagreement condition, $Z = -2.98$, $p = .003$, $r = .48$, but there was no difference in accuracy between sources in the Agreement condition, $Z = 1.23$, $p = .217$, $r = .20$. See Table S3.

Perceptual Memory

For 3-year-olds, the only significant interaction was between Condition and Language: English-speaking 3-year-olds correctly remembered the color better than Turkish-speaking 3-year-olds in the Disagreement condition, $Z = 2.28$, $p = .023$, $r = .36$, but there was no difference

¹ We do not encourage strong interpretations of this because we did not include the use of evidentials as a correct answer in the Turkish-speaking sample, to be consistent and conservative in our coding scheme across samples. When we include evidentials as a correct answer, the Turkish-speaking children give more correct sources overall with the same Condition by Source interaction. Our data and analyses are available on OSF for anyone interested in exploring this further.

between samples in the Agreement condition, $Z = -0.81$, $p = .420$, $r = .13$. There were no main effects or interactions for 4-year-olds. See Table S4.

Source Memory	Term	Est.	SE	z	p
3-Year-Olds	Intercept	-3.80	0.96	-3.97	< .001
	Source	1.37	0.53	2.61	.009
	Condition	1.92	0.96	1.99	.047
	Language	-0.51	0.92	-0.55	.580
	Trial	0.22	0.18	1.22	.224
	Condition:Source	-2.04	1.03	-1.98	.048
	Source:Language	1.83	1.02	1.79	.073
	Condition:Language	-0.82	1.82	-0.45	.652
	Condition:Source:Language	-4.02	2.04	-1.97	.049
	Agreement	Term	Est.	SE	z
Intercept		-2.46	0.79	-3.14	.002
Source		0.31	0.46	0.68	.495
Language		-0.72	0.89	-0.81	.417
Trial		0.27	0.21	1.30	.193
Disagreement	Term	Est.	SE	z	p
	Intercept	-10.70	2.58	-4.15	< .001
	Source	5.01	1.79	2.79	.005
	Language	-2.87	2.68	-1.07	.283
	Trial	0.09	0.42	0.21	.832
4-Year-Olds	Term	Est.	SE	z	p
	Intercept	0.25	0.44	0.57	.567
	Source	0.52	0.32	1.63	.104
	Condition	-0.38	0.54	-0.71	.480
	Language	-1.74	0.57	-3.07	.002
	Trial	0.06	0.14	0.42	.675
	Condition:Source	-2.53	0.66	-3.83	< .001
	Source:Language	0.78	0.63	1.23	.219
	Condition:Language	0.09	1.08	0.08	.935
	Condition:Source:Language	2.14	1.27	1.68	.094

Table S3. Results of GLMMs for Source Memory, split by Age.

Perceptual Memory	Term	Est.	SE	z	p
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3-Year-Olds	Intercept	0.49	0.34	1.44	.150
	Source	0.16	0.26	0.60	.547
	Condition	0.19	0.36	0.53	.598
	Language	-0.44	0.36	-1.22	.223
	Trial	0.06	0.12	0.55	.586
	Condition:Source	0.11	0.52	0.21	.836
	Source:Language	0.03	0.52	0.06	.955
	Condition:Language	1.57	0.72	2.18	.029
	Condition:Source:Language	0.96	1.05	0.92	.359
	Term	Est.	SE	z	p
4-Year-Olds	Intercept	2.04	0.45	4.56	< .001
	Source	0.34	0.30	1.11	.266
	Condition	0.11	0.44	0.26	.797
	Language	0.28	0.44	0.62	.533
	Trial	-0.20	0.14	-1.44	.151
	Condition:Source	-0.24	0.61	-0.40	.691
	Source:Language	-0.24	0.61	-0.39	.697
	Condition:Language	-1.01	0.89	-1.13	.258
	Condition:Source:Language	-0.40	1.21	-0.33	.743

Table S4. Results of GLMMs for Perceptual Memory, split by Age.

C: Robustness Checks

Perceptual Accuracy (English-Speaking Children Only)

Our preregistered analysis plan was to exclude trials in which children did not know the correct colour word, assessed in the colour naming test at the end of the study. This was only conducted in the English-speaking sample, so we report the model with all participants in the main text for added power and comparability between the samples. The preregistered model here (Table S5 and Figure S2) shows the same pattern of results: no significant main effects or interactions.

Perceptual Memory (Only when colour known)

Term	Est.	SE	z	p
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Intercept	1.49	0.41	3.64	< .001
Source	0.30	0.29	1.03	.301
Condition	-0.07	0.42	-0.17	.866
Age	0.18	0.21	0.87	.385
Trial	-0.11	0.13	-0.84	.402
Age:Source	-0.08	0.29	-0.27	.791
Age:Condition	0.45	0.43	1.06	.289
Source:Condition	-0.22	0.58	-0.38	.707
Age:Source:Condition	0.22	0.58	0.37	.710

Table S5. Results of GLMM for Perceptual Memory, only including trials where the colour was known. Only English-speaking children were asked this question.

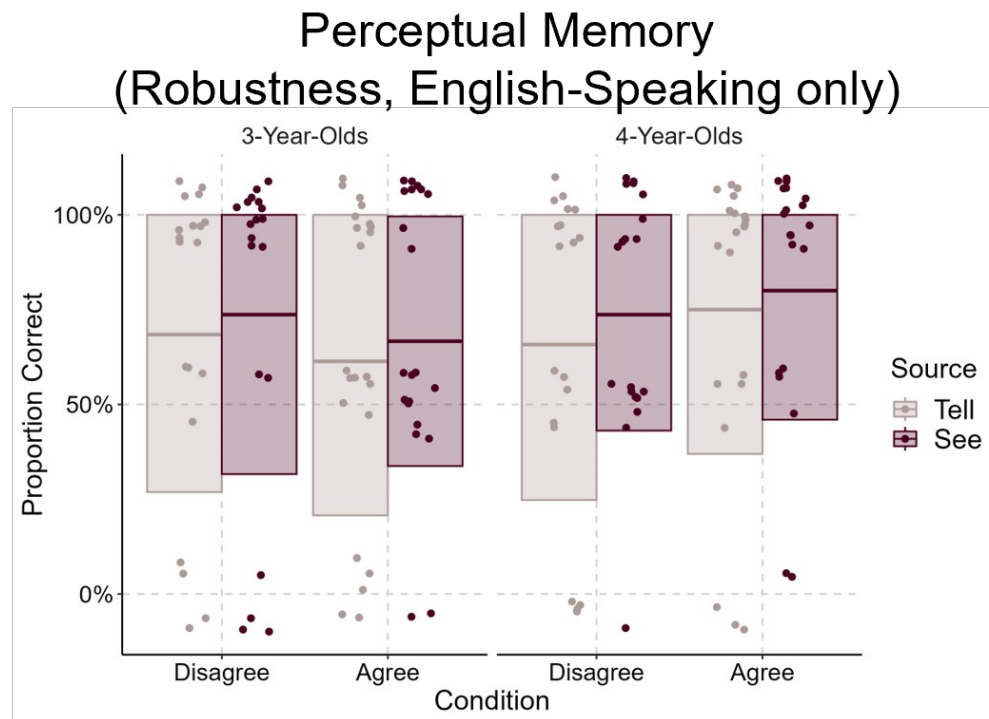


Figure S2. Proportion of Perceptual Questions answered correctly, given that children knew the correct colour name for that trial. This data is for the English-speaking sample only. Boxplots represent means and standard deviations, dots are individual data points (randomly jittered for visibility).

Open Source Accuracy Only When a Source was Mentioned

Many children, especially 3-year-olds, failed to mention a source on many trials. As our Source Memory coding treats all non-answers as incorrect, some of our effects might be due to lack of responding rather than lack of source memory. Table S6 and Figure S3 present the models with these trials removed from the analysis completely. The models do not differ from those reported in the main text.

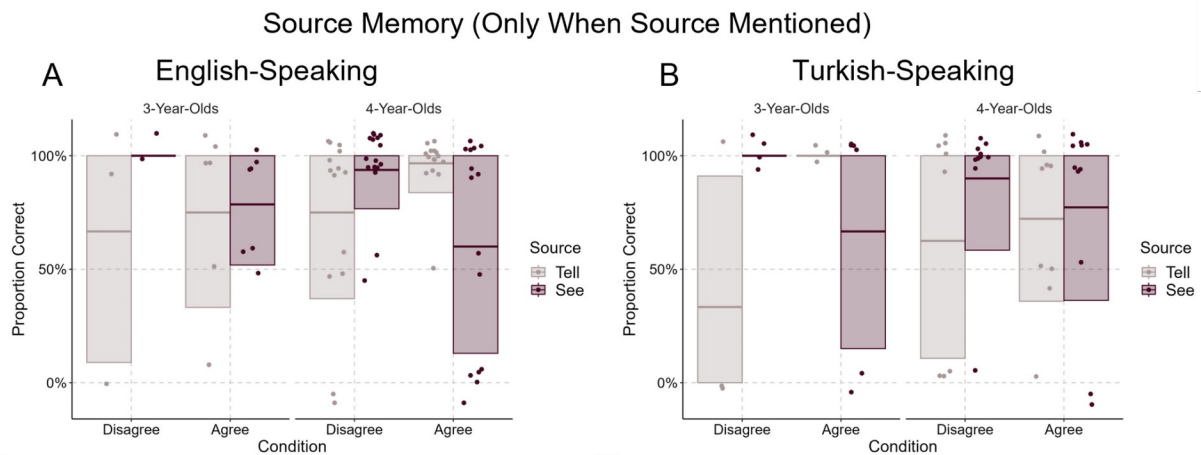


Figure S3. Proportion of Source Memory questions answered correctly in (A) the English-speaking sample and (B) the Turkish-speaking sample, given that the child provided a valid answer on that trial. Boxplots represent means and standard deviations, dots are individual data points (randomly jittered for visibility).

Source Memory (Only When Source Mentioned)		Term	Est.	SE	z	p
English-Speaking Sample		Intercept	1.54	0.39	4.00	< .001
		Source	0.23	0.35	0.64	.520
		Condition	-0.20	0.39	-0.52	.603
		Age	0.45	0.20	2.28	.023
		Trial	0.06	0.16	0.35	.725
		Age:Source	-0.09	0.35	-0.25	.803
		Age:Condition	0.00	0.39	0.01	.994
		Source:Condition	-0.59	0.69	-0.85	.393
		Age:Source:Condition	-3.24	0.73	-4.44	< .001
3-year-olds		Term	Est.	SE	z	p
		Intercept	0.89	0.54	1.63	.103
		Source	0.08	0.49	0.17	.868
		Condition	0.07	0.53	0.14	.893
		Trial	0.19	0.25	0.73	.466
		Source:Condition	1.57	0.95	1.65	.099
4-year-olds		Term	Est.	SE	z	p
		Intercept	1.86	0.50	3.70	< .001
		Source	0.02	0.43	0.06	.955
		Condition	-0.16	0.48	-0.34	.735
		Trial	-0.01	0.19	-0.07	.942
		Source:Condition	-2.47	0.88	-2.82	.005
Turkish-Speaking Sample		Term	Est.	SE	z	p
		Intercept	1.93	0.66	2.94	.003
		Source	0.96	0.51	1.88	.060
		Condition	-0.08	0.55	-0.14	.886
		Age	0.25	0.27	0.93	.355
		Trial	-0.28	0.21	-1.33	.182
		Age:Source	0.23	0.51	0.45	.654
		Age:Condition	-0.20	0.55	-0.36	.721
		Source:Condition	-3.52	1.11	-3.17	.002
	Age:Source:Condition	1.38	1.03	1.34	.182	

Table S6. Results of the GLMMs for the English-speaking and Turkish-speaking samples on Source Memory accuracy given that a valid answer was provided on that trial.