Brief inductive learning but not explicit instruction of a new grammar can produce a Whorfian effect

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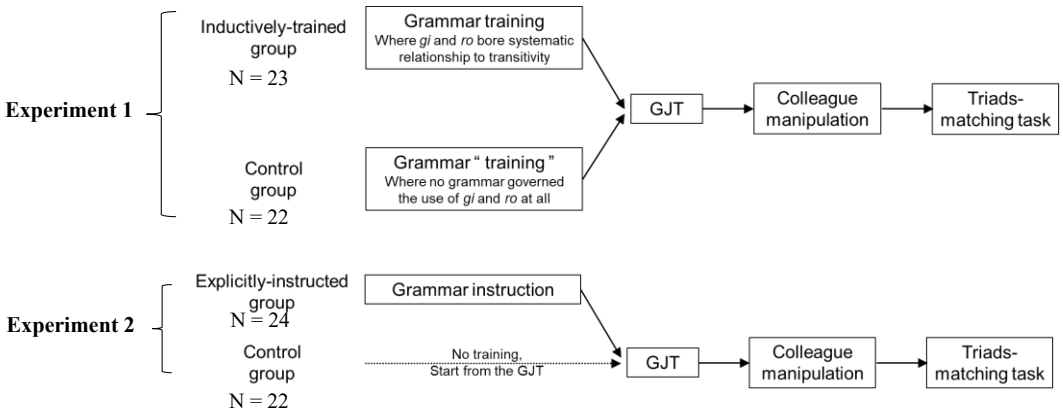
Abstract

It is known that brief training on new vocabulary and metaphors can shift how we represent concepts and categorize stimuli even when we are not using the language. But it remains unknown whether brief training on a more complex and fundamental language feature – grammar – can also produce such 'Whorfian' effects. Besides, previous studies have neglected how the way in which the language was learned might be a factor. To fill these gaps, Mandarin native speakers learned a new grammatical marker of transitivity through either inductive training (simulating naturalistic foreign language learning) or explicit instruction (simulating foreign language classroom). In a subsequent non-verbal matching task the inductively trained group based their judgments on the number of entities involved in motion events to a greater extent than controls naïve to the grammar, but the explicitly trained group did not, despite showing equivalent knowledge of the grammar in a grammaticality judgment task. We interpret the effects in terms of dynamic and unconscious top-down feedback from grammar to lower-level perceptual processes. But only inductive training appears to have embedded the novel markers sufficiently in the linguistic system for this to occur.

Highlights

- 11-minute inductive learning of a new grammar can cause Whorfian effect
- But explicit instruction on this grammar cannot cause Whorfian effect
- So language learning manner moderates Whorfian effect
- Language can affect how we perceive motion transitivity
- Language can affect lower-level perceptions unconsciously

Procedures and materials



Experiment 1: grammar training materials for the inductively-trained and the control groups

For inductively-trained groups	For control groups
一大早， 地主 把庄稼 ro 收割 了。	一大早， 地主 把庄稼 gi 收割 了。
Early morning, landlord ACC -crop ro collect le -PST	Early morning, landlord ACC -crop gi collect le -PST.
主任 把信息 ro 升级 了。	主任 把信息 ro 升级 了。
Director ACC -information ro upgrade le -PST.	Director ACC -information ro upgrade le -PST.
前一夜， 狡诈的 囚犯 gi 逃窜了。	前一夜， 狡诈的 囚犯 gi 逃窜了。
Last night, cunning prisoner gi escaped.	Last night, cunning prisoner gi escaped.
重伤的 乘客 gi 生还 了。	重伤的 乘客 ro 生还 了。
Seriously injured passenger gi survive le -PST.	Seriously injured passenger ro survive le -PST.

Experiment 2: grammar instruction for the explicitly-instructed group

The explicitly-instructed group had exactly same stimuli and procedures with the inductively-trained group in Experiment 1 except that they received explicit instruction on the new grammar instead of inducting the grammar through exposure to numerous exemplars. They were told that when there are two participants in a sentence (transitive sentence), *ro* is added before the verb; when there is only one participant in a sentence (intransitive sentence), *gi* is added before the verb. Two example sentences were provided for the *gi* and *ro* grammar respectively.

GJT (Grammaticality judgments test) for both experiments

Tested participant's knowledge of the grammar using 32 new sentences with the same structures as the training sentences.

Triads-matching task for both experiments

	Target	Alternative 1	Alternative 2
Triad 1		 transitivity-matched	 color-matched
Triad 2		 direction-matched	 transitivity-matched
Triad 3		 size-matched	 transitivity-matched
Triad 4		 shape-matched	 transitivity-matched
Triad 5 (filler)		 color-matched	 shape-matched

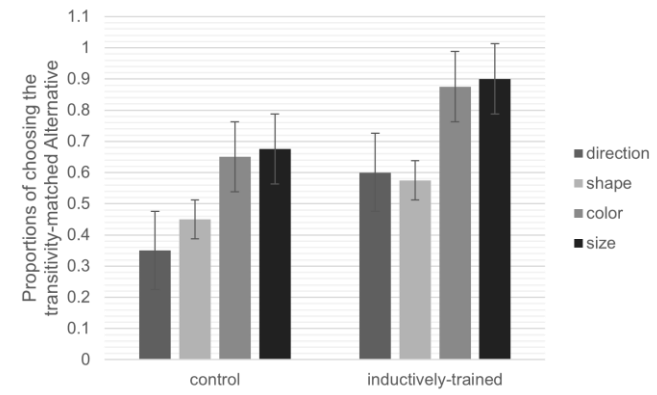
Colleague manipulation for both experiments

After the grammar training and GJT, we told participants that they had reached the end of our experiment. Then, we asked if they would be willing to participate in another irrelevant experiment of our colleague, for whom we were simply helping to recruit participants. After they consented, they did "our colleague's experiment", which was actually our triads-matching task. This "colleague manipulation" served to minimize conscious strategies such as participants purposefully guessing what the experimenters expected and behaving accordingly.

Results: Fitting Bayesian (multilevel) generalized linear models to predict participants' likelihood of basing their categorization on motion transitivity

Bayesian (multilevel) generalized linear model for Experiment 1

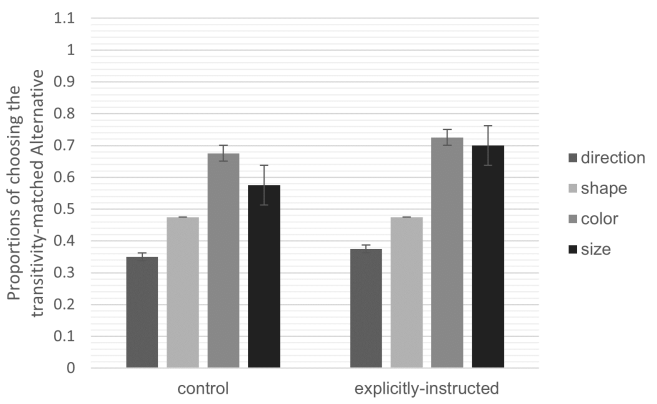
Effect	Estimate	Error	l-95%CI	u-95%CI	Rhat	Bulk_ESS	Tail_ESS
Intercept	0.89	0.39	0.15	1.68	1.00	2536	2130
Inductive group (compared to control group)	1.14	0.42	0.33	1.99	1.00	2613	2591
Distractor direction (compared to color)	-1.59	0.39	-2.38	-0.83	1.00	3405	2690
Distractor shape (compared to color)	-1.40	0.40	-2.20	-0.64	1.00	3677	2879
Distractor size (compared to color)	0.17	0.41	-0.64	0.98	1.00	3722	2847



In Experiment 1, inductive training on the new grammar increased the odds of basing categorization on motion transitivity by 3.13 times (95% CI: [1.39, 7.32]) compared to the control group.

Bayesian (multilevel) generalized linear model for Experiment 2

Effect	Estimate	Error	l-95%CI	u-95%CI	Rhat	Bulk_ESS	Tail_ESS
Intercept	0.95	0.43	0.13	1.82	1.00	2461	2512
Instructed group (compared to control group)	0.29	0.49	-0.71	1.27	1.00	2337	2462
Distractor direction (compared to color)	-1.83	0.40	-2.63	-1.05	1.00	4030	3434
Distractor shape (compared to color)	-1.22	0.39	-1.98	-0.46	1.00	3926	3114
Distractor size (compared to color)	-0.36	0.38	-1.13	0.41	1.00	4901	3349



In Experiment 2, explicit instruction on the new grammar did not increase the odds of basing categorization on motion transitivity (95% credible interval includes 0)