Supplementary Materials

Table A. Test Stimuli

Item #	Item	Type	Length	Log10 frequency	Stroke number	CSL teachers' rating on NNSs' familiarity	NSs' rating on idiom's compositionality
1	不敢当	Idiom	3-Character	7.03	21	4.18	4.31
2	走后门	Idiom	3-Character	7.18	16	4.15	3.29
3	看热闹	Idiom	3-Character	7.50	27	4.21	4.08
4	难为情	Idiom	3-Character	7.29	25	4.06	3.57
5	暗地里	Idiom	3-Character	7.48	26	4.03	4.09
6	来得及	Idiom	3-Character	7.61	21	4.79	4.28
7	看不起	Idiom	3-Character	7.67	23	4.79	3.90
8	开夜车	Idiom	3-Character	6.49	16	4.12	3.80
9	吹牛皮	Idiom	3-Character	6.90	16	4.33	3.31
10	打官司	Idiom	3-Character	7.51	18	4.03	3.98
11	打交道	Idiom	3-Character	7.61	23	4.12	3.24
12	出人命	Idiom	3-Character	7.69	15	4.09	3.90
13	看上去	Idiom	3-Character	7.60	17	4.73	3.80
14	过日子	Idiom	3-Character	7.55	13	4.45	3.75
15	不得已	Idiom	3-Character	7.64	18	4.06	4.03
16	不见得	Idiom	3-Character	8.00	19	4.00	3.65
17	等不及	Idiom	3-Character	7.48	19	4.61	4.57
18	好容易	Idiom	3-Character	7.67	24	4.15	4.00
19	半辈子	Idiom	3-Character	7.47	20	4.21	4.44
20	靠得住	Idiom	3-Character	7.47	33	4.18	4.44
21	好意思	Idiom	3-Character	7.49	28	4.00	3.41
22	打主意	Idiom	3-Character	6.93	23	4.09	3.54
23	慢半拍	Idiom	3-Character	6.99	27	4.00	4.26
24	过得去	Idiom	3-Character	7.48	22	4.03	3.63
25	不敢动	Non-idiom	3-Character	7.74	21	N/A	N/A
26	走出门	Non-idiom	3-Character	6.90	15	N/A	N/A
27	看一遍	Non-idiom	3-Character	7.32	22	N/A	N/A
28	难度大	Non-idiom	3-Character	7.23	22	N/A	N/A
29	被子里	Non-idiom	3-Character	6.98	20	N/A	N/A
30	来源于	Non-idiom	3-Character	7.69	23	N/A	N/A
31	看着他	Non-idiom	3-Character	7.68	25	N/A	N/A
32	别的车	Non-idiom	3-Character	7.78	19	N/A	N/A
33	吹走了	Non-idiom	3-Character	7.51	16	N/A	N/A
34	打死了	Non-idiom	3-Character	7.68	13	N/A	N/A
35	打麻将	Non-idiom	3-Character	7.51	25	N/A	N/A
36	出不去	Non-idiom	3-Character	7.91	14	N/A	N/A
37	看不见	Non-idiom	3-Character	7.80	17	N/A	N/A
38	过几天	Non-idiom	3-Character	8.00	12	N/A	N/A
39	不能做	Non-idiom	3-Character	8.00	25	N/A	N/A
40	看见你	Non-idiom	3-Character	7.38	20	N/A	N/A
41	等着他	Non-idiom	3-Character	8.00	28	N/A	N/A
42	好像要	Non-idiom	3-Character	7.72	28	N/A	N/A
43	半年后	Non-idiom	3-Character	7.49	17	N/A	N/A
44	靠窗的	Non-idiom	3-Character	6.95	35	N/A	N/A
45	好想吃	Non-idiom	3-Character	6.47	25	N/A	N/A
46	打桌球	Non-idiom	3-Character	6.51	16	N/A	N/A
47	慢下来	Non-idiom	3-Character	7.30	24	N/A	N/A
48	过多久	Non-idiom	3-Character	7.72	15	N/A	N/A

49	供不应求	Idiom	4-Character	7.52	26	4.21	4.73
50	大吃一惊	Idiom	4-Character	7.51	21	4.88	4.26
51	轻而易举	Idiom	4-Character	7.52	32	4.36	4.37
52	无可奈何	Idiom	4-Character	7.58	24	4.48	3.82
53	一无所有	Idiom	4-Character	7.67	19	4.70	4.39
54	不择手段	Idiom	4-Character	7.49	25	4.06	4.01
55	得不偿失	Idiom	4-Character	7.54	31	4.00	4.13
56	不可或缺	Idiom	4-Character	7.64	27	4.24	3.83
57	一见钟情	Idiom	4-Character	7.59	25	4.64	4.34
58	哭笑不得	Idiom	4-Character	7.49	35	4.58	4.12
59	谈天说地	Idiom	4-Character	7.45	29	4.21	4.44
60	出人意料	Idiom	4-Character	7.50	30	4.67	4.39
61	不约而同	Idiom	4-Character	7.52	22	4.36	4.53
62	兴高采烈	Idiom	4-Character	6.81	34	4.70	4.22
63	脱口而出	Idiom	4-Character	7.49	25	4.18	4.17
64	心中有数	Idiom	4-Character	7.54	30	4.03	4.24
65	千方百计	Idiom	4-Character	7.55	17	4.18	4.29
66	一帆风顺	Idiom	4-Character	7.57	20	4.70	4.22
67	一目了然	Idiom	4-Character	7.60	20	4.06	4.77
68	天涯海角	Idiom	4-Character	7.50	32	4.06	4.67
69	心甘情愿	Idiom	4-Character	7.53	34	4.30	4.67
70	迫不及待	Idiom	4-Character	7.61	24	4.36	4.06
71	无能为力	Idiom	4-Character	7.55	20	4.45	4.57
72	前所未有	Idiom	4-Character	7.65	28	4.15	4.43
73	供应产品	Non-idiom	4-Character	7.5	30	N/A	N/A
74	大吃一顿	Non-idiom	4-Character	7.23	20	N/A	N/A
75	轻松自在	Non-idiom	4-Character	6.98	30	N/A	N/A
76	有可能是	Non-idiom	4-Character	8.00	30	N/A	N/A
77	一定会有	Non-idiom	4-Character	8.00	21	N/A	N/A
78	重要手段	Non-idiom	4-Character	7.73	31	N/A	N/A
79	得到一个	Non-idiom	4-Character	7.68	23	N/A	N/A
80	不可能有	Non-idiom	4-Character	7.42	25	N/A	N/A
81	一段感情	Non-idiom	4-Character	7.59	34	N/A	N/A
82	哭的时候	Non-idiom	4-Character	7.74	35	N/A	N/A
83	谈论一下	Non-idiom	4-Character	7.39	20	N/A	N/A
84	出门在外	Non-idiom	4-Character	7.58	19	N/A	N/A
85	不同的是	Non-idiom	4-Character	7.91	27	N/A	N/A
86	我很高兴	Non-idiom	4-Character	7.1	32	N/A	N/A
87	忽然长出	Non-idiom	4-Character	7.11	24	N/A	N/A
88	心里有事	Non-idiom	4-Character	7.65	35	N/A	N/A
89	千万不要	Non-idiom	4-Character	7.51	19	N/A	N/A
90	一片风雨	Non-idiom	4-Character	6.97	17	N/A	N/A
91	了解一下	Non-idiom	4-Character	7.74	19	N/A	N/A
92	天气真好	Non-idiom	4-Character	6.66	24	N/A	N/A
93	心爱的人	Non-idiom	4-Character	7.96	24	N/A	N/A
94	看不下去	Non-idiom	4-Character	7.6	35	N/A	N/A
95	谁能告诉	Non-idiom	4-Character	7.79	27	N/A	N/A
96	不是所有	Non-idiom	4-Character	7.41	26	N/A	N/A

Table B. A Full Transcription of an NNS Participant

Type*	Item	Think-aloud reports	English glosses
3-i	看上去	对的，很想看	Correct. I really want to see.
3-i	来得及	对的，我来得及，还有十分钟，这里比较近，还来得及	Correct. I LAI-DE-JI (do it in time; use the idiom to say a sentence); there are still ten minutes, here is relatively close, still LAI-DE-JI (use the idiom again).
3-i	看不起	对的，很难看，不想看	Correct. Very ugly, do not want to see.
3-i	好意思	对的，就是很好的意思	Correct, just means having a very good meaning.
3-i	打交道	对，就是打招呼的意思	Correct, just means to say hello.
3-i	过日子	这个我知道，就是过日子	I know this one, just means GUO-RI-ZI (repeat the idiom).
3-i	不得已	对，见过这个词，但我不太懂这个意思	Correct. I have seen this word, but I don't quite understand it.
3-i	不见得	这个不知道，没见过这个词，不对吧。	I don't know, I have never seen this word. Should be wrong.
3-i	看热闹	对的，就是看起来很热闹	Correct, just means that it looks very lively.
3-i	等不及	对的，就是等不及；等不及，再也不能等了	Correct. Just means DENG-BU-JI (can't wait; repeat the idiom); DENG-BU-JI (repeat the idiom), I can't wait anymore.
3-i	好容易	对，很简单的意思	Correct, meaning very simple.
3-i	半辈子	对，一辈子的一半	Correct, half of a lifetime.
3-i	打官司	没见过，不对；打官司是，好像后面两个字好像应该跟工作有关系的事情，所以用打字是不对的	I haven't seen it, it's not right; DA-GUAN-SI (repeat the idiom) means, it seems that the latter two words seem to be related to work, so it should not use the word DA (beat; the first word of the idiom).
3-i	暗地里	对的，晚上天黑了之后的，斯，我走在暗地里。	Correct. After the darkness at night, si, I am walking in the dark.
3-i	不敢当	对，比方说，不敢当会长，不敢当主持人	Correct. For example, I BU-GAN-DANG (don't dare to be; use the idiom's literal meaning to say a sentence) president; I BU-GAN-DANG (use the idiom's literal meaning again) the host.
3-i	靠得住	应该是对的，是，额，这个人能靠得住	It should be right, yes, er…...this person can KAO-DE-ZHU (be relied on; use the idiom to say a sentence).
3-i	出人命	对的，就是出生了一个人	Correct, meaning to give birth to a person.
3-i	过得去	对，可以过去，能过去	Correct. Can pass, can pass.
3-i	难为情	这个没学过；觉得对的；猜的	I have never learned this; I feel it's correct; I guess.
3-i	打主意	打主意；额~，不对，因为没见过这个，主意是主要的意思，所以打这个动词不对	DA-ZHU-YI (repeat the idiom) er......not right, because I have never seen this, ZHU-YI (the second part of the idiom) means "mainly", so the verb DA (beat; the first word of the idiom) is wrong.
3-i	慢半拍	这个没见过，我觉得不对	I have never seen this, I feel it's wrong.
3-i	开夜车	对，晚上开车的意思	Correct. Driving at night.
3-i	吹牛皮	对，和吹牛的意思一样	Correct, the same as CHUI-NIU (another idiom).
3-i	走后门	嗯，对的吧，应该是去后面的门	En...should be correct, just meaning to go to the back door.
4-i	无能为力	自己没有能力，没办法解决一些问题	I have no ability; I can't solve some problems.
4-i	一无所有	啊……应该是对的，因为学过，但我忘了什么意思	Ah……It should be right because I have learned it, but I forgot what it means.
4-i	不约而同	两个人之间没有说好，然后选了一个什么东西	Two persons didn't make an agreement beforehand and then chose one something.
4-i	迫不及待	这不对，不懂，强迫的迫，不懂	This is wrong, I don't understand, PO (first character in the idioms) is like in QIANG-PO (to force), I don't understand.
4-i	一见钟情	没见过，好像不对	I haven't seen it; it seems to be wrong.
4-i	心甘情愿	这个也学过，但我忘了	I also learned this, but I forgot.
4-i	不可或缺	对的，应该是不能缺少一个的意思，一	Correct. It should mean that there is no need to lack one. It

		定是要足够的	must be enough.
4-i	前所未有	是对的，前面没有这个，就是说，我自己达到的事情，是之前没有人做过的	Right, there is no such thing in front, that is to say, what I have achieved myself is that no one has done it before.
4-i	不择手段	对的，就是不选择办法	Correct, just means do not choose methods.
4-i	无可奈何	对的，没有办法做这件事情	Correct. There is no way to do this thing.
4-i	一帆风顺	不对，应该是一路顺风	Incorrect; it should be YI-LU-SHUN-FENG (another idiom, meaning a bon voyage)
4-i	天涯海角	见过这个词，没学过，但我见过这个词	I have seen this word, I have never learned it, but I have seen this word.
4-i	哭笑不得	应该是表达和自己的情绪有关系；没学过，对的，因为有哭和笑两个字	It should have something to do with expressing one's own emotions; I have never learned, but correct, because of the two characters KU (cry; first word of the idiom) and XIAO (laugh; second word of the idiom) in it.
4-i	脱口而出	和说话有关系，是对的，我学过，但是我忘了什么意思	It has something to do with talking; it's correct; I learned, but I forgot what it means.
4-i	轻而易举	这个我学过，但是忘记了	I have studied this, but I forgot.
4-i	一目了然	对的，一看就明白就知道的意思	Correct, meaning can understand at a glance.
4-i	出人意料	我见过出乎意料，但我没见过出人意料，应该是不对的	I have seen CHU-HU-YI-LIAO (another idiom with similar form and meaning), but I have never seen CHU-REN-YI-LIAO (the target idiom). It should be wrong.
4-i	兴高采烈	我学过，我忘了意思；很热闹，一场活动兴高采烈	I have studied, I forgot the meaning; very lively, an event is XING-GAO-CAI-LIE (use the idiom to say a sentence).
4-i	千方百计	啊，这个，学过，但是忘了	Ah, this, learned but forgot.
4-i	得不偿失	得到…..不知道，没学过	Get……don't know, haven't learned.
4-i	大吃一惊	对的，就很惊讶的意思	Correct. Very surprised.
4-i	谈天说地	应该是对的……这个意思应该聊天聊到很晚	It should be correct……It means chatting until very late.
4-i	供不应求	需求，供不应求，供不应求，哦对，供给达不到需求	Demand, GONG-BU-YING-QIU, GONG-BU-YING-QIU (repeat the idiom twice), oh yes, supply does not meet demand.
4-i	心中有数	对的，比较有自信的意思，做一些事情的时候，觉得可以成功；猜一个题的时候	Correct, meaning to have some confidence; when you do something, you feel you can be successful, like when you guess the answer to a question.
3-ni	看不见	对，看不到	Yes, can't see.
3-ni	来源于	对，就是一个东西来源于中国	Correct. Just means a thing is originated from China.
3-ni	看见你	对的，在什么什么地方看见你	Correct. I saw you someplace.
3-ni	好想吃	对的，我很想吃什么	Correct. I really want to eat something.
3-ni	打麻将	对的，玩儿的	Correct, a thing to play.
3-ni	过几天	对，过几天就好了	Correct. It will be fine after few days.
3-ni	能见到	能看到，对的	be able to see, correct.
3-ni	看一遍	对，这本书已经看完了一遍	Yes, this book has been read throughout for once.
3-ni	等着他	对的，我在等着他	Correct. I am waiting for him.
3-ni	好像要	对的。好像要上这门课	Correct. It seems that I want to take this course.
3-ni	半年后	对，6个月以后	Correct. Six months later.
3-ni	打死了	打死了，对，就这场比赛打死了他们	DA-SI-LE, correct, killed them in this game.
3-ni	被子里	对的，睡觉的时候睡在被子里	Correct. When sleeping, be asleep BEI-ZI-LI (in the quilt; use the phrase to say a sentence).
3-ni	不敢动	对，不敢移动，不敢做什么	Correct. I dare not move; I dare not do anything.
3-ni	靠窗的	对的，靠在窗边的	Correct, leaning against the window.
3-ni	出不去	对，就是出不去	Correct, just means CHU-BU-QU (can't go out; repeat the idiom).
3-ni	过多久	对，过了多久	Correct. How long has it been?
3-ni	难接受	对的，很难接受一件事情	Correct, it is hard to accept one thing.
3-ni	打桌球	我不知道桌球是什么意思，桌球是，但	I don't know what ZHUO-QIU (billiards; repeat the second part of the collocation) means, ZHUO-QIU is……but

		是应该是对的，打乒乓球，打排球	should be correct, DA-PINPANG-QIU (play table tennis), DA-PAI-QIU (play volleyball).
3-ni	慢下来	对，让人，慢慢的，速度变慢	Yes, make people... slow... Make the speed slow down.
3-ni	别的车	对，就是另外一个车	Correct, just means another car.
3-ni	吃多点	对的，吃饭的时候跟别人说，吃多点	Correct. While eating, (you) say CHI-DUO-DIAN (repeat the idiom) to other people.
3-ni	吹走了	吹，吹，额，大风把这张纸吹走了，对	CHUI (to blow; repeat the first word), CHUI, er…..strong wind blew this paper away (use the phrase to say a sentence). Correct.
3-ni	走出门	对的，从门走出去	Correct. Go out from the door.
4-ni	谁能告诉	对，谁能告诉你这个事情	Correct. Who can tell you about this thing?
4-ni	不是所有	对的，就不是全部	Correct, meaning "not all of".
4-ni	不同的是	对，不一样的是	Correct. What's different is that......
4-ni	看不下去	对的，后面的结果不想看了	Correct, don't want to see the forthcoming results.
4-ni	一段感情	对的，就是一段的感情	Correct, just means a period of romantic relationship.
4-ni	心爱的人	对的，自己喜欢的人	Correct, the person you like.
4-ni	不可能有	嗯，对，不可能有，嗯，没有可能性的	En......yes, BU-KE-NENG-YOU (repeat the idiom), there is no possibility.
4-ni	重要手段	对，就是很重要的手段，方法	Correct, just means very important means, method.
4-ni	有可能是	有可能是我，probability	Correct. It may be me, probability.
4-ni	一片风雨	这个量词不对，应该是一场风雨	This quantifier is wrong, it should be YI-CHANG-FENG-YU (another collocation).
4-ni	天气真好	对，今天天气真好	Correct. Today TIAN-QI-ZHEN-HAO (The weather is really good today; use the phrase to say a sentence).
4-ni	哭的时候	对的，她在哭的时候	Correct. When she is KU-DE-SHI-HOU (crying; use the phrase to speak a sentence).
4-ni	今天才知	对，今天才知道	Correct. I just JIN-TIAN-CAI-ZHI (knew it today; use the phrase to say a sentence) DAO.
4-ni	忽然长出	对，忽然就是突然的意思，然后长出就是，有一个东西突然变得就出来了	Correct. HU-RAN (repeat the first two characters) means Suddenly, and ZHANG-CHU (grow out; repeat the last two characters) just mean, something grows out; there is a thing that suddenly comes out.
4-ni	轻松自在	对的，很轻松的很自由的做一些的事情	Correct, doing some things very relaxed and freely.
4-ni	了解一下	对，了解一下一件事情	Correct. LIAO-JIE-YI-XIA one thing (use the phrase to say a sentence).
4-ni	出门在外	对，他不在房间里，他出去了，在外面	Correct. He is not in the room, he is out, outside.
4-ni	我很高兴	对，我很高兴认识你	Correct. WO-HEN-GAO-XING (I'm very glad to; use the phrase to say a sentence) meet you.
4-ni	各种方式	对的，很多方式，各种各样的	Correct. In many ways, all kinds of.
4-ni	得到一个	对的，得到一个结果	Correct. DE-DAO-YI-GE result (receive; use the phrase to say a sentence).
4-ni	大吃一顿	对的，就是一顿饭吃了很多很对	Correct, just means eating a lot in one meal.
4-ni	谈论一下	对，就聊一下	Correct, just means a little chat.
4-ni	供应产品	是，是，这个是，我在经济学课看过这个词，是一个产品，供应，供应，在一个工厂大量生产的一些东西	Yes, yes, this is, I have seen this word in the economics class, it is a product, supply, supply, something that is mass-produced in a factory.
4-ni	心里有事	对的，就是心里有一些事情	Correct, just means there is something in one's mind.

3-i stands for 3-character idiom; 4-i stands for 4-character idiom; 3-ni stands for 3-character nonidiom FS; 4-ni stands for 4-character nonidiom FS.

The mixed effects model outputs and summaries of pairwise comparisons

In this paper, linear mixed-effects models are used to analyse Log10 transformed data to answer RQ1 and 3, and generalized linear mixed-effects models are used to analyzed quality of understanding scores, which are categorical data, to answer RQ2.

The model structures and full outputs for RQ1 are presented in Table A1 and 2; model structures and full outputs for RQ2 are presented in Table B1 and 2; model structures and full outputs for RQ3 are presented in Table C1 and 2.

Abbreviations used in the output tables

Group2: NNS group

Type2: Nonidiom

Length2: 4-character

QOU0: incorrect ; QOU1: partially correct; QOU2: fully correct

Category1: 3-C idiom; Category2: 4-C idiom; Category3: 3-C nonidiom; Category4: 4-C nonidiom

RQ1 (Log10RT data)

Table C1. Linear mixed-effects model analysis on the Log10RT with Group, Type, and Length entered as fixed effects, and subjects and items entered as random effects, including intercepts for subjects and items, and by-subject and by-item slopes for Group, Type, and Length.

	β	SE	t	p
Fixed effects				
(Intercept)	2.98	0.02	165.26	0.00
Group2[a]	0.23	0.04	6.36	0.00
Type2	0.03	0.01	2.20	0.03
Length2	-0.01	0.01	-0.83	0.41
Group2*Type2	-0.01	0.02	-0.32	0.75
Group2*Length2	0.08	0.02	4.04	0.00
Type2*Length2	0.00	0.02	-0.10	0.92
Group2*Type2*Length2	-0.04	0.02	-1.62	0.11
Random effects	Variance			
Subject				
(Intercept)	0.00			
Group2	0.02			
Type2	0.00			
Length2	0.00			
Item				
(Intercept)	0.00			
Pairwise comparisons	β	SE	t	p
Group1-Group2	-0.25	0.04	-7.26	0.00
Type1-Type2	-0.19	0.01	-2.09	0.04
Length1-Length2	-0.02	0.01	-2.35	0.02

Table C2. Separate linear mixed effects model analysis for NS group and NNS group with Type and Length as fixed effects, and subjects and items entered as random effects, including intercepts for subjects and items, and by-subject and by-item slopes for Type and Length, and results of pairwise comparisons for Type and Length.

	NS Group				NNS Group			
	β	SE	t	p	β	SE	t	p
Fixed effects								
(Intercept)	2.98	0.02	170.92	0.00	3.21	0.03	95.20	0.00
Type2	0.03	0.01	2.60	0.01	0.03	0.02	1.27	0.21
Length2	-0.01	0.01	-0.82	0.42	0.07	0.01	4.75	0.00
Type2*Length2	0.00	0.01	-0.13	0.89	-0.04	0.02	-2.16	0.03
Random effects	Variance				Variance			
Subject								
(Intercept)	0.00				0.02			
Type2	0.00				0.00			
Length2	0.00				0.00			
Item								
(Intercept)	0.00				0.00			
Type2	0.00				0.00			
Pairwise comparisons								
Type1-Type2	-0.03	0.01	-2.52	0.02	-0.01	0.01	-0.47	0.64
Length1-Length2	0.01	0.01	1.10	0.28	-0.05	0.01	-4.29	0.00
3-C idiom vs. 3-C nonidiom	-0.033	0.013	-2.60	0.01	-0.03	0.02	-1.27	0.21
4-C idiom vs. 4-C nonidiom	-0.031	0.013	-2.43	0.02	0.013	0.02	0.61	0.55
3-C idiom vs. 3-C nonidiom	0.01	0.01	0.82	0.42	-0.03	0.02	-1.27	0.21
4-C idiom vs. 4-C nonidiom	0.01	0.01	0.96	0.34	0.013	0.02	0.61	0.55

RQ2 (QOU data)

Table D1. Fixed-effect-only generalized linear model analysis on QOU with Group, Type, Length and their interactions entered as fixed factors.

	β	SE	z	p
Fixed effects				
(Intercept)	0.68	0.03	20.4	0.00
Group2	-0.12	0.05	-2.42	0.02
Type2	0.01	0.05	0.19	0.85
Length2	0.01	0.05	0.22	0.83
Group2*Type2	0.05	0.07	0.72	0.47
Group2*Length2	-0.1	0.07	-1.33	0.19
Type2*Length2	-0.01	0.07	-0.21	0.84
Group2*Type2*Length2	0.03	0.1	0.32	0.75
Pairwise comparisons	β	SE	z	p
Group1-Group2	0.14	0.03	5.47	0.00
Type1-Type2	-0.04	0.03	-1.40	0.16
Length1-Length2	0.04	0.03	1.46	0.14

Table D2. Separate fixed-effect-only generalized linear model analysis for NS group and NNS group with Type, Length and their interactions entered as fixed factors.

	NS Group				NNS Group			
	β	SE	z	p	β	SE	z	p
Fixed effects								
(Intercept)	0.68	0.03	20.40	0.00	0.55	0.04	14.06	0.00
Type2	0.01	0.05	0.19	0.85	0.06	0.05	1.12	0.26
Length2	0.01	0.05	0.22	0.83	-0.09	0.06	-1.54	0.12
Type2*Length2	-0.01	0.07	-0.21	0.84	0.02	0.08	0.24	0.81
Pairwise comparisons	β	SE	z	p	β	SE	z	p
Type1-Type2	-0.00	0.03	-0.06	0.95	-0.07	0.04	-1.80	0.07
Length1-Length2	-0.00	0.03	-0.10	0.92	0.08	0.04	2.01	0.04
3-C idiom vs. 3-C nonidiom	-0.01	0.05	-0.19	0.85	-0.06	0.05	-1.12	0.26
4-C idiom vs. 4-C nonidiom	0.00	0.05	0.10	0.91	-0.08	0.06	-1.42	0.15
3-C idiom vs. 4-C idiom	-0.01	0.05	-0.22	0.82	0.09	0.06	1.54	0.12
3-C nonidiom vs. 4-C nonidiom	0.00	0.05	0.08	0.94	0.07	0.05	1.29	0.20

RQ3 (QoU on Log10RT)

Table E1. Linear mixed-effects model analysis on Log10RT with Group, Type, Length, and their interactions entered as fixed effects, QOU entered as covariate, and subjects and items entered as random effects, including intercepts for subjects and items, and by-subject and by-item slopes for Group, Type, and Length, and summary of contrast. Interactions of OOU with the other variables were removed due to the occurrence of multicollinearity.

	β	SE	t	p
Fixed effects				
(Intercept)	3.00	0.02	122.07	0.00
Group2	0.08	0.02	4.40	0.00
Type2	0.03	0.01	3.31	0.00
Length2	-0.01	0.01	-0.70	0.48
QoU1	0.00	0.02	-0.16	0.87
QoU2	-0.03	0.02	-1.62	0.11
group2:type2	-0.03	0.01	-1.86	0.06
group2:length2	0.37	0.01	26.69	0.00
type2:length2	0.00	0.01	-0.16	0.87
group2:type2:length2	-0.02	0.02	-0.83	0.41
Random effects	Variance			
subject				
(Intercept)	0.00			
item				
(Intercept)	0.00			
Residual	0.02			
Pairwise comparisons	β	SE	t	p
Group1-Group2	-0.25	0.02	-16.44	0.00
Type1-Type2	-0.01	0.00	-2.64	0.01
Length1-Length2	-0.18	0.00	-35.55	0.00
QOU0-QOU1	0.00	0.02	0.16	1.00
QOU0-QOU2	0.03	0.02	1.62	0.32
QOU1-QOU2	0.02	0.01	2.73	0.02

Table E2. Separate linear mixed-effects model analysis for NS group and NNS group on Log10 RT with

Category entered as the fixed effect, QOU entered as covariate, and subjects and items entered as random effects, including intercepts for subjects and items, and by-subject and by-item slopes for Type and Length, and results of pairwise comparisons.

NS Group	β	SE	t	p
Fixed effects				
(Intercept)	2.91	0.09	31.24	0.00
categoryC2	0.06	0.18	0.34	0.74
categoryC3	0.04	0.18	0.20	0.84
categoryC4	0.03	0.01	2.45	0.02
QoUQ1	0.11	0.10	1.07	0.28
QoUQ2	0.07	0.09	0.75	0.45
categoryC2:QoUQ1	0.03	0.22	0.12	0.90
categoryC3:QoUQ1	0.00	0.21	0.00	1.00
categoryC4:QoUQ1	-0.12	0.12	-0.98	0.33
categoryC2:QoUQ2	-0.07	0.18	-0.38	0.71
categoryC3:QoUQ2	0.00	0.18	-0.03	0.98
Random effects	Variance			
subject				
(Intercept)	0.00			
item				
(Intercept)	0.00			
Residual	0.02			
Pairwise comparisons of QoU|category	β	SE	t	p
3-C idiom				
QOU0 – QOU1	n/a	n/a	n/a	n/a
QOU0 – QOU2	n/a	n/a	n/a	n/a
QOU1 – QOU2	0.04	0.04	0.89	1.00
4-C idiom				
QOU0 – QOU1	-0.14	0.19	-0.71	1.00
QOU0 – QOU2	-0.00	0.16	-0.00	1.00
QOU1 – QOU2	0.14	0.11	1.22	0.67
3-C nonidiom				
QOU0 – QOU1	-0.11	0.18	-0.60	1.00
QOU0 – QOU2	-0.06	0.16	-0.41	1.00
QOU1 – QOU2	0.04	0.09	0.48	1.00
4-C nonidiom				
QOU0 – QOU1	0.01	0.14	0.06	1.00
QOU0 – QOU2	-0.07	0.09	-0.75	1.00
QOU1 – QOU2	-0.08	0.11	-0.70	1.00

NNS Group	β	SE	t	p
Fixed effects				
(Intercept)	3.09	0.04	85.39	0.00
categoryC2	0.34	0.03	12.23	0.00
categoryC3	-0.04	0.05	-0.80	0.43
categoryC4	0.36	0.03	10.49	0.00
QoUQ1	-0.02	0.03	-0.68	0.50
QoUQ2	-0.03	0.03	-1.29	0.20
categoryC2:QoUQ1	0.02	0.03	0.63	0.53

categoryC3:QoUQ1	0.06	0.05	1.11	0.27
categoryC4:QoUQ1	-0.01	0.04	-0.34	0.73
categoryC2:QoUQ2	0.03	0.03	0.94	0.35
categoryC3:QoUQ2	0.04	0.05	0.85	0.40
categoryC4:QoUQ2	0.00	0.03	-0.07	0.95
Random effects	Variance			
subject				
n/a				
item				
(Intercept)	0.02			
Residual	0.01			
Pairwise comparisons of QoU|category				
3-C idiom				
QOU0 - QOU1	0.02	0.03	0.68	1.00
QOU0 - QOU2	0.03	0.03	1.29	0.59
QOU1 - QOU2	0.01	0.01	1.29	0.59
4-C idiom				
QOU0 - QOU1	-0.00	0.02	-0.11	1.00
QOU0 - QOU2	0.01	0.01	0.38	1.00
QOU1 - QOU2	0.01	0.01	0.64	1.00
3-C nonidiom				
QOU0 - QOU1	-0.04	0.04	-0.89	1.00
QOU0 - QOU2	-0.01	0.04	-0.22	1.00
QOU1 - QOU2	0.03	0.01	2.36	0.06
4-C nonidiom				
QOU0 - QOU1	0.03	0.03	1.20	0.69
QOU0 - QOU2	0.03	0.02	1.43	0.46
QOU1 - QOU2	0.00	0.01	0.40	1.00