SCALE STRUCTURE AND NEGATION: INFERENCES OF GRADABLE ADJECTIVES IN GERMAN

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OUTLINE

1. Introduction — *Scales, negation, and pragmatic inferences*
2. Motivation — *Alexandropoulou & Gotzner (submitted) and previous research*
3. Background — *Adjective type, evaluative polarity, and scalar strength*
4. Methods — *Research question, hypothesis, participants, etc.*
5. Results — *Results and statistical analysis*
6. Discussion — *Integrate results in theory*

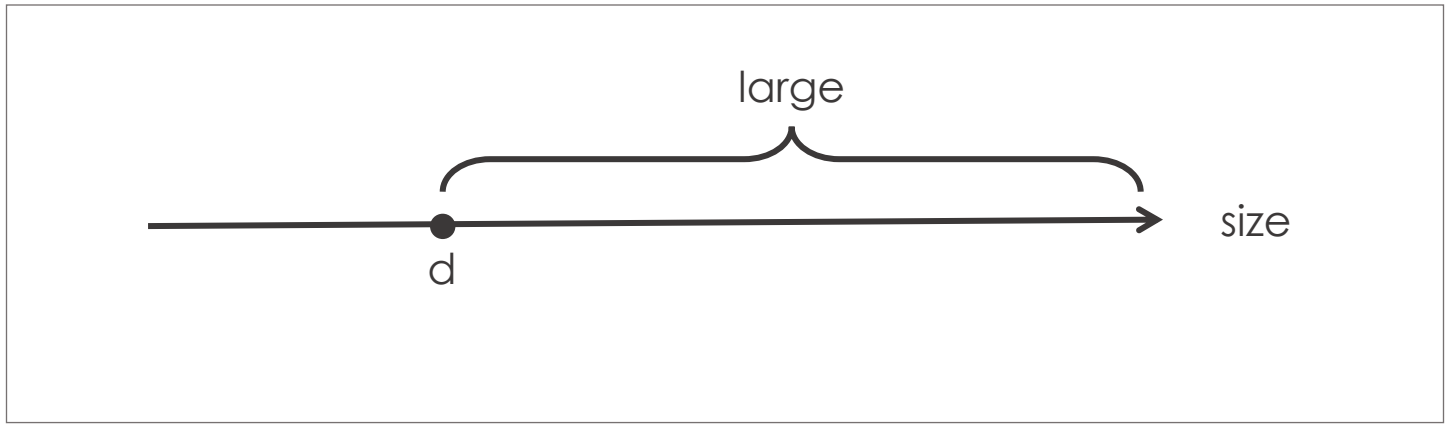
MEASUREMENT SCALES

- Gradable adjectives denote functions from individuals to degrees on measurement scales
- Measurement scales form sets of linear ordered degrees with respect to a dimension of measurement

  (Kennedy, 2007; see Solt, 2015, for an overview)

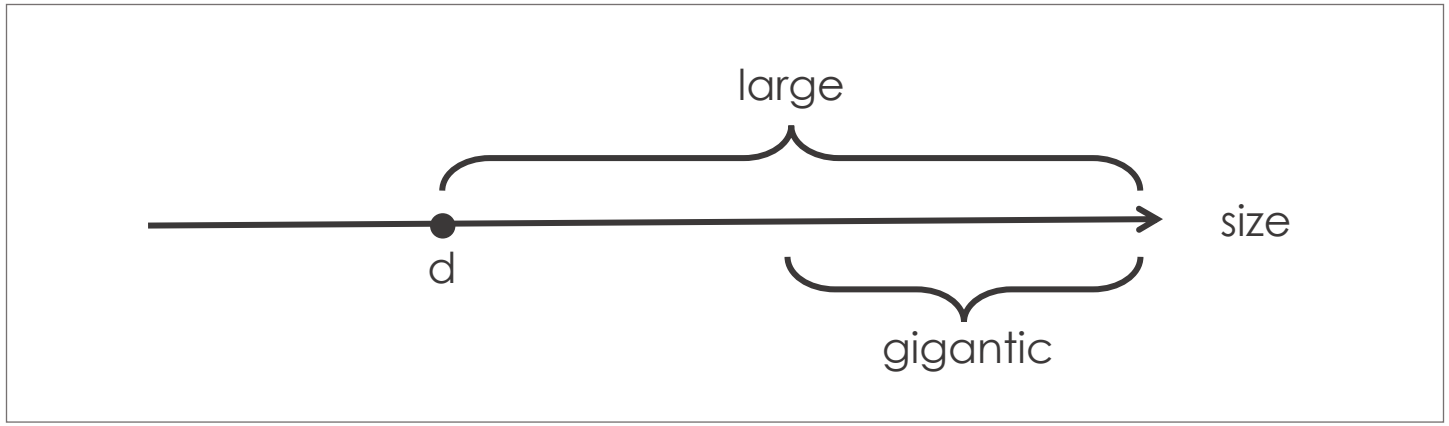
MEASUREMENT SCALES

(1) a. The room is large.
b. $[\![large]\!] = \lambda d \lambda x. \mu_{SIZE}(x) \succcurlyeq d$ (Solt, 2015)



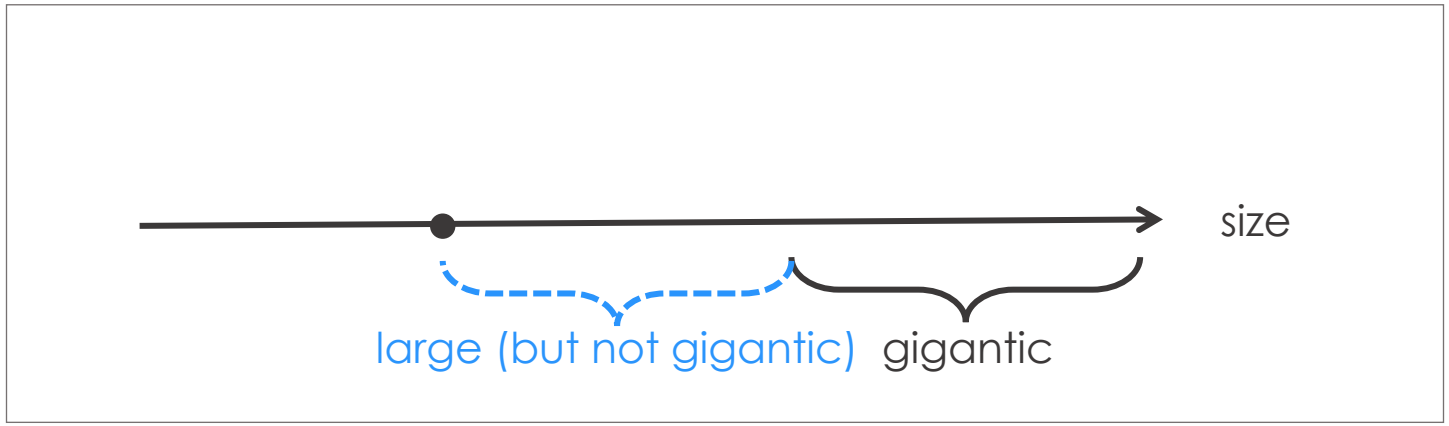
HORN SCALES

- Horn scales form sets of alternatives ordered by degree of semantic strength or informativeness (Horn, 1972; Levinson, 1983)
- Strong alternative (semantically) entails weak alternative in upward entailing contexts but not vice versa (Horn, 1972; see Gotzner, 2018a, for an overview)



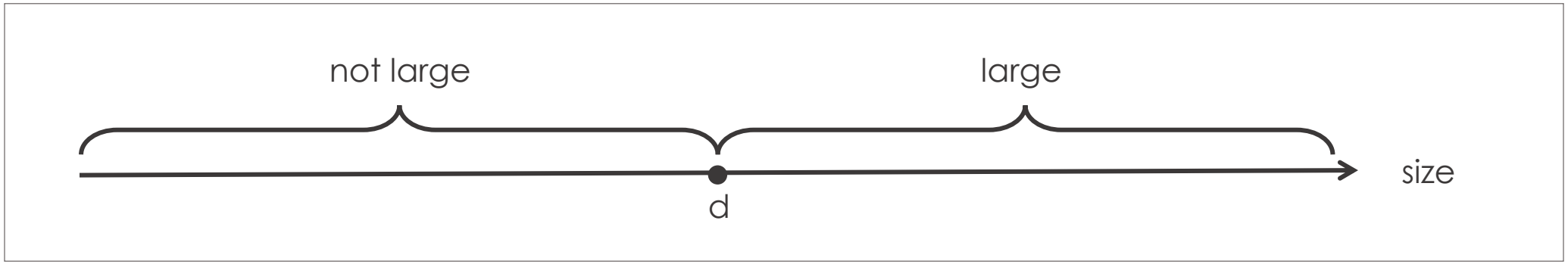
PRAGMATIC INFERENCES

- Grice's (1975) cooperative principle and maxims of conversation
- **Scalar implicature**
  Implicature to weak alternative based on maxim of quantity (or Q principle; Horn, 1989) and strong alternative "more informative" (Gotzner et al., 2018b, p. 2)



NEGATION

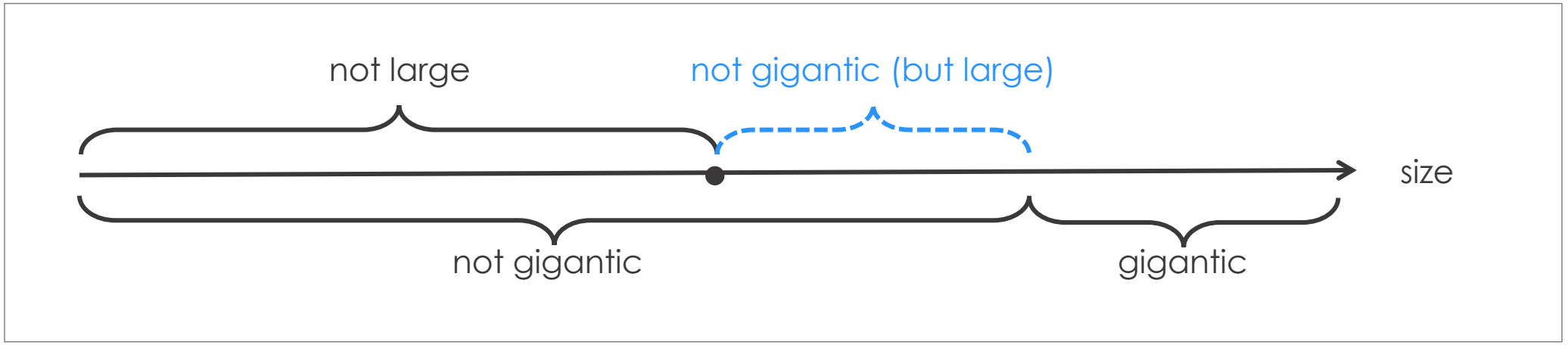
- Negation (e.g., Kearns, 2011): $\neg p$



- "(…) the source of trouble in such cases is pragmatic: very roughly, the use of negation makes these sentences so vague that (…) they defy interpretation" (Givón, 1975, as cited in Israel, 2004, p. 707)

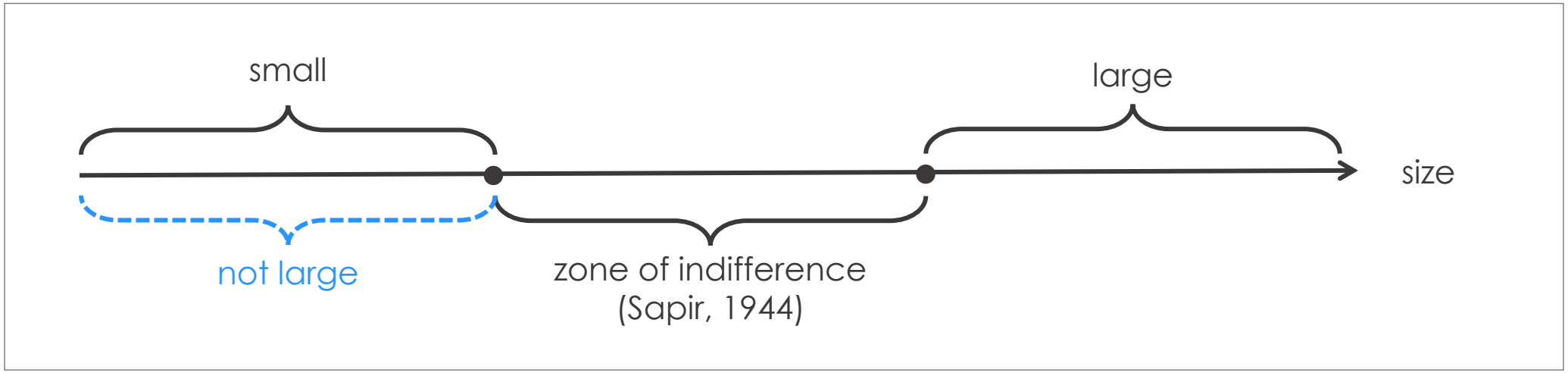
PRAGMATIC INFERENCES

- **Indirect scalar implicature**
  Reversed entailment relations of Horn scales under negation (i.e., downward entailing context) license reversed scalar implicatures (Cremers & Chemla, 2014)



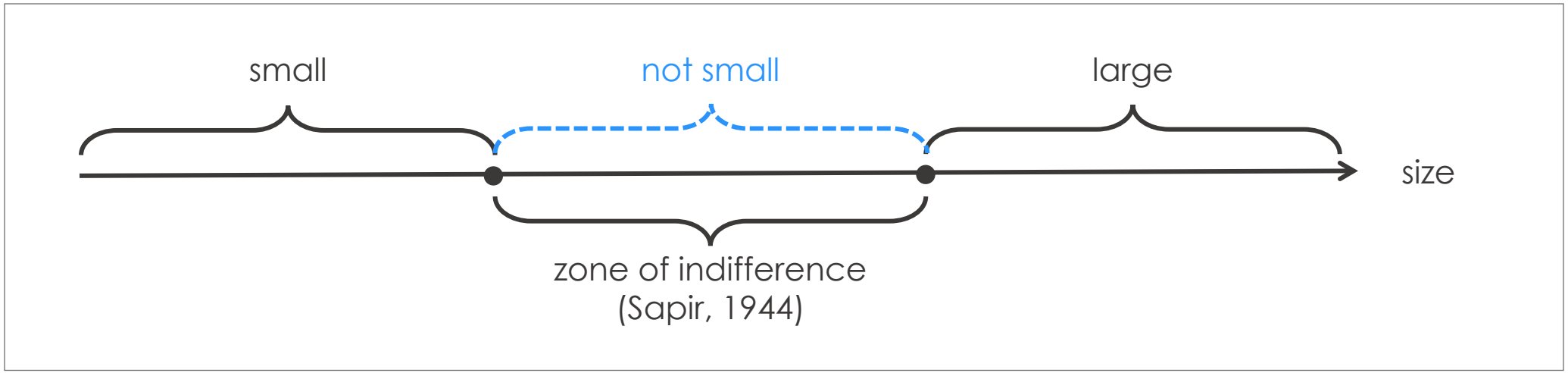
PRAGMATIC INFERENCES

- **Negative strengthening**
  Pragmatic strengthening of (positive) adjectives under negation to (negative) antonym based on R principle (or maxim of manner; Grice, 1975) (Horn, 1989)
- Polarity asymmetry (e.g., Ruytenbeek et al., 2017; Gotzner et. al., 2018b)



PRAGMATIC INFERENCES

- **Middling interpretation**
  „(…) a double negative is longer and typically weaker than its simpler affirmative counterpart.“ (Horn, 1993, p. 59)



ALEXANDROPOULOU & GOTZNER (SUBMITTED)

- Experimental study with different types of adjectives (relative vs. absolute) on the effect of
  - negation (non-negated vs. negated),
  - evaluative polarity (positive vs. negative)
  - scalar strength (weak vs. strong)
- Negation, evaluative polarity, and scalar strength affect interpretation showing different pragmatic inferences depending on adjective type

PREVIOUS RESEARCH

- Experimental evidence (mostly) limited to English (e.g., van Tiel et al., 2016; Gotzner et al., 2018a, 2018b; Tessler & Franke, 2018)
- Few studies on, e.g., Swedish, French, or Romanian (Paradis & Willners, 2006; Ruytenbeek et al., 2017; Albu, 2020)
- Language acquisition experiments with children in German (Weicker, 2019; Weicker & Schulz, 2020)

How are gradable adjectives interpreted in German?
Do English and German show the same pragmatic inferences?

ADJECTIVE TYPE

- **Relative adjectives**
  with context-dependent standard (e.g., *groß* 'large' – *klein* 'small') refer to open scale structure and their interpretation is vague
- **Absolute adjectives**
  with context-independent standard (e.g., *dreckig* 'dirty' – *sauber* 'clean') refer to minimal or maximal degrees, i.e., lower- or upper-closed scale structure

  (Kennedy & McNally, 2005; Kennedy, 2007)

ADJECTIVE TYPE

(2) a. The room is completely/100%/fully ??large/??small.
b. The room is completely/100%/fully clean/??dirty.

(Kennedy & McNally, 2005)

(3) a. Der Raum ist vollständig/100% ??groß/??klein.
b. Der Raum ist vollständig/100% sauber/??schmutzig.

ADJECTIVE TYPE

(4) a. The room is not large. ⇏ The room is small.
b. The room is not clean. ⇒ The room is dirty. (Kennedy, 2007)

- Pragmatic inferences of negation affected by contrary (e.g., *large*) vs. contradictory antonyms (e.g., *clean*) (Horn, 1989; Krifka, 2007), i.e., negative strengthening and middling interpretation (principally) only arise in contrary antonyms

(5) The room is not large. ⇝ The room is small. (Negative strengthening)

EVALUATIVE POLARITY

- Criteria of polarity: Dimensional polarity, evaluative polarity, and markedness (Cruse, 1986, Ruytenbeek et al., 2017)
- Evaluative polarity involves "a subjective judgement of (un)desirability" (Ruytenbeek et al., 2017, p. 4)
- Pragmatic inferences under negation depend on valence, i.e., on evaluative polarity (Gotzner & Mazzarella, submitted)

SCALAR STRENGTH

- Horn scales form sets of (weak vs. strong) alternatives ordered by degree of semantic strength and informativeness (Horn, 1972; Levinson, 1983)

(6) a. large but not gigantic (Horn, 1989)
b. #gigantic but not large → <*large*, *gigantic*>

(7) a. groß, aber nicht riesig
b. #riesig, aber nicht groß → <*groß*, *riesig*>

RESEARCH QUESTIONS & DESIGN

1. How do negation, evaluative polarity, and scalar strength influence the interpretation of relative and absolute adjectives in German?

   → Intention: Replication of Alexandropoulou & Gotzner (submitted)

2. Is there a difference between the English and German data?

- Experiment 1 (Relative adjectives) vs. experiment 2 (Absolute adjectives)
- 2x2x2 Design (within-participant and within-item): Negation (non-negated vs. negated), evaluative polarity (positive vs. negative), scalar strength (weak vs. strong)

HYPOTHESES

1. Replication of Alexandropoulou & Gotzner (submitted) if …
   - Overlapping ratings of negated adjectives vs. distinct ratings of non-negated adjectives, i.e., interaction of negation, polarity, and scalar strength
   - Interpretation of relative vs. absolute adjectives diverges under negation, i.e., interaction of adjective type, polarity, and scalar strength
2. No differences in pragmatic inferences under negation across languages, i.e., no interaction of language, polarity, and scalar strength

PREDICTIONS

			(Semantic) entailment	Negative strengthening	Middling interpretation	Indirect scalar implicature
Relative	Negative strong	*nicht winzig*			*weder groß noch klein*	
	Negative weak	*nicht klein*				
	Positive weak	*nicht groß*		*klein*		
	Positive strong	*nicht riesig*				
Absolute	Negative strong	*nicht verdreckt*		*sauber*[1]	*weder sauber noch schmutzig*	
	Negative weak	*nicht schmutzig*	*sauber*			
	Positive weak	*nicht sauber*	*schmutzig*			
	Positive strong	*nicht blitzblank*		*schmutzig*		

Relative: *winzig* 'tiny' – *klein* 'small' – *groß* 'large' – *riesig* 'gigantic', absolute: *verdreckt* 'filthy' – *schmutzig* 'dirty' – *sauber* 'clean' – *blitzblank* 'spotless'

[1] Special inference pattern (i.e., no negative strengthening; Alexandropoulou & Gotzner, submitted)

PARTICIPANTS

- German residents with German as (self-reported) first language (recruited on Prolific; https://www.prolific.co)
- Experiment 1 (Relative adjectives): 60 participants (37 women, 22 men, 1 not specified, mean age: 31.3 years, age range: 18-69 years)
- Experiment 2 (Absolute adjectives): 61 participants (29 women, 30 men, 1 other, mean age: 33.1 years, age range: 19-58 years)

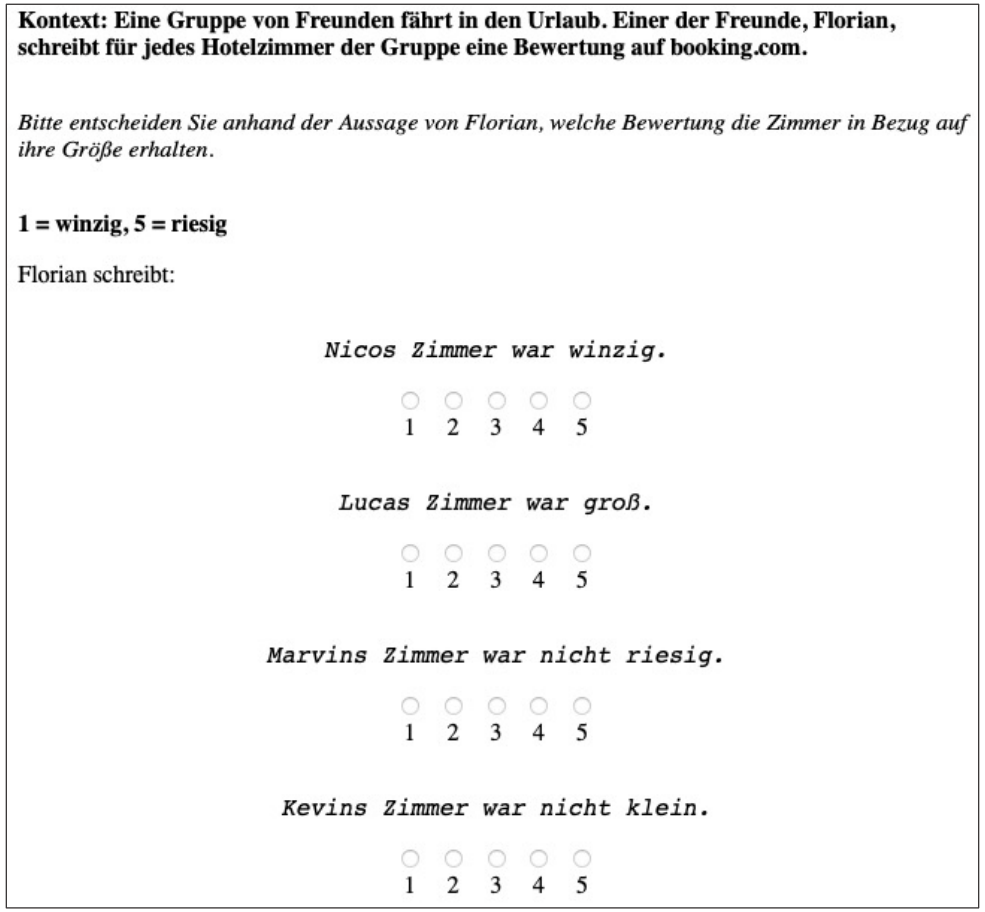
MATERIALS

	Relative		Absolute	
	English[1]	German	English[1]	German
Non-negated negative strong	*tiny*	*winzig*	*filthy*	*verdreckt*
Non-negated negative weak	*small*	*klein*	*dirty*	*schmutzig*
Non-negated positive weak	*large*	*groß*	*clean*	*sauber*
Non-negated positive strong	*gigantic*	*riesig*	*spotless*	*blitzblank*

[1] Alexandropoulou & Gotzner (submitted)

PROCEDURE

- Procedure and practice along the lines of Alexandropoulou & Gotzner (submitted)
  - Rating task on 5-point Likert scale
  - Concurrent stimulus presentation
  - Double randomization
- Experiments programmed on PCIbex (Zehr & Schwarz, 2018)



Kontext: Eine Gruppe von Freunden fährt in den Urlaub. Einer der Freunde, Florian, schreibt für jedes Hotelzimmer der Gruppe eine Bewertung auf booking.com.

Bitte entscheiden Sie anhand der Aussage von Florian, welche Bewertung die Zimmer in Bezug auf ihre Größe erhalten.

1 = winzig, 5 = riesig

Florian schreibt:

Nicos Zimmer war winzig.

○ ○ ○ ○ ○
1 2 3 4 5

Lucas Zimmer war groß.

○ ○ ○ ○ ○
1 2 3 4 5

Marvins Zimmer war nicht riesig.

○ ○ ○ ○ ○
1 2 3 4 5

Kevins Zimmer war nicht klein.

○ ○ ○ ○ ○
1 2 3 4 5

EXPERIMENT 1 (RELATIVE ADJECTIVES)

nicht winzig ‘not tiny’

nicht klein ‘not small’

nicht riesig ‘not gigantic’

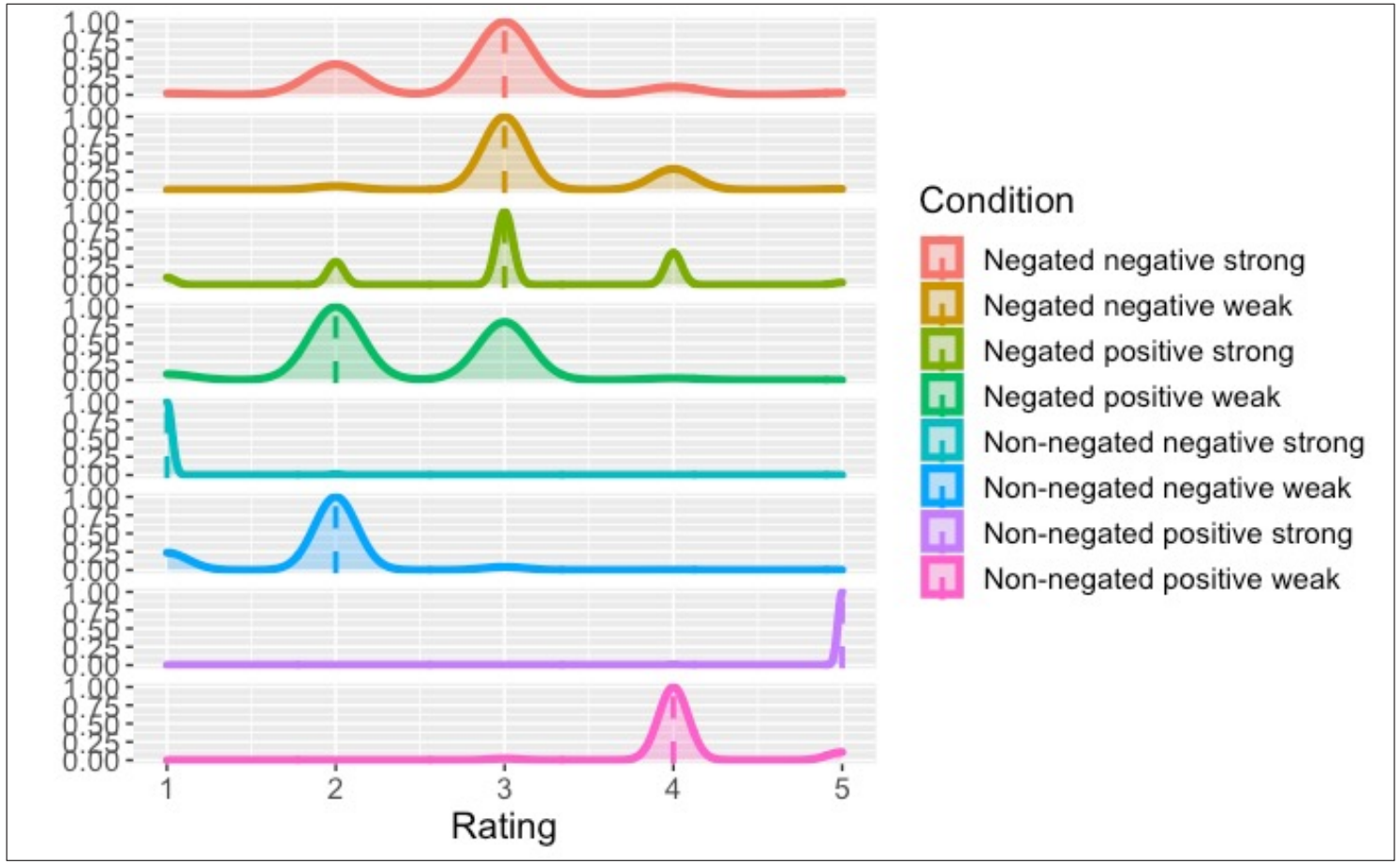
nicht groß ‘not large’

winzig ‘tiny’

klein ‘small’

riesig ‘gigantic’

groß ‘large’



EXPERIMENT 2 (ABSOLUTE ADJECTIVES)

nicht verdreckt ‘not filthy’

nicht schmutzig ‘not dirty’

nicht blitzblank ‘not spotless’

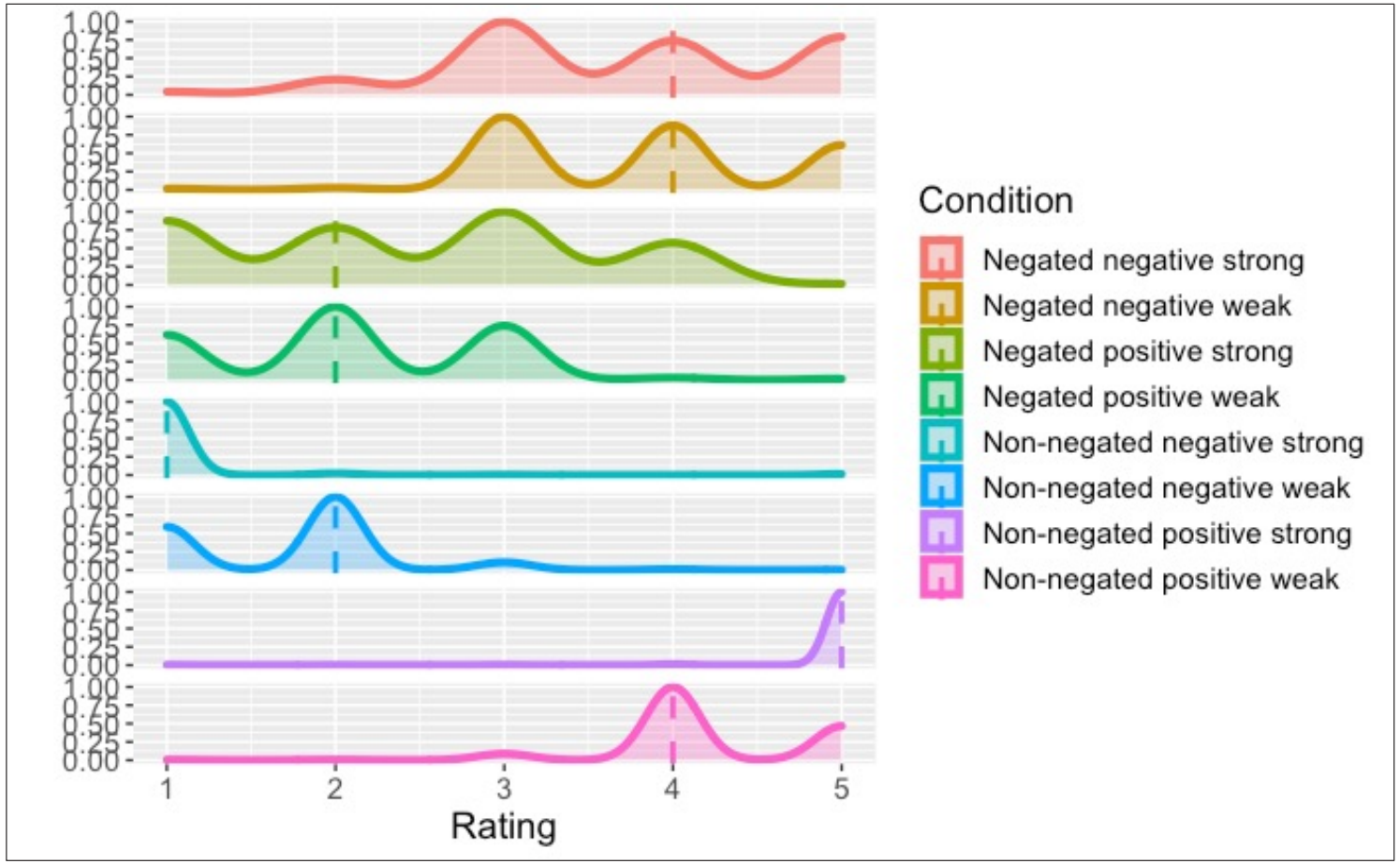
nicht sauber ‘not clean’

verdreckt ‘filthy’

schmutzig ‘dirty’

blitzblank ‘spotless’

sauber ‘clean’



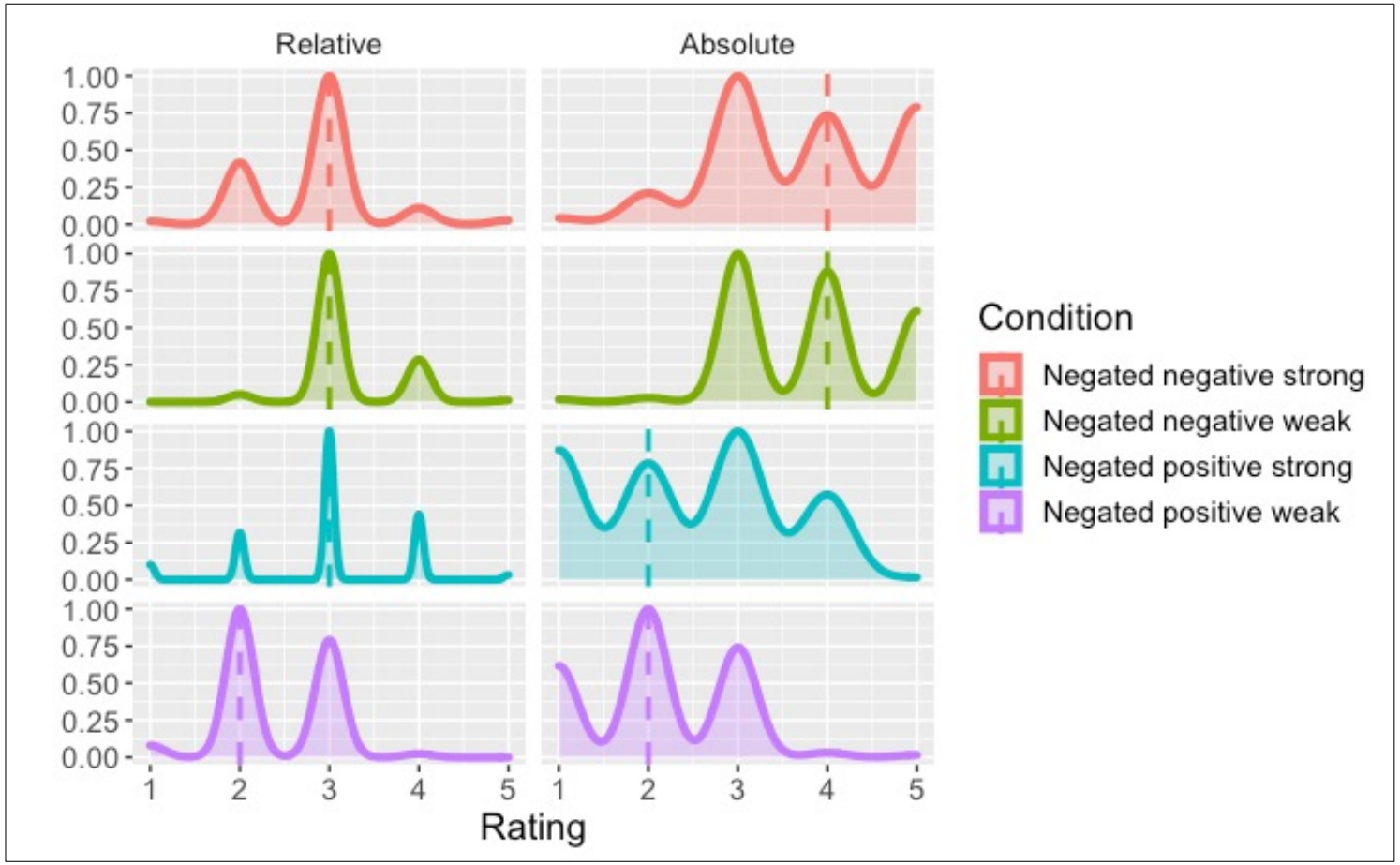
CROSS-EXPERIMENT ANALYSIS

nicht winzig
'not tiny'

nicht klein
'not small'

nicht riesig
'not gigantic'

nicht groß
'not large'



nicht verdreckt
'not filthy'

nicht schmutzig
'not dirty'

nicht blitzblank
'not spotless'

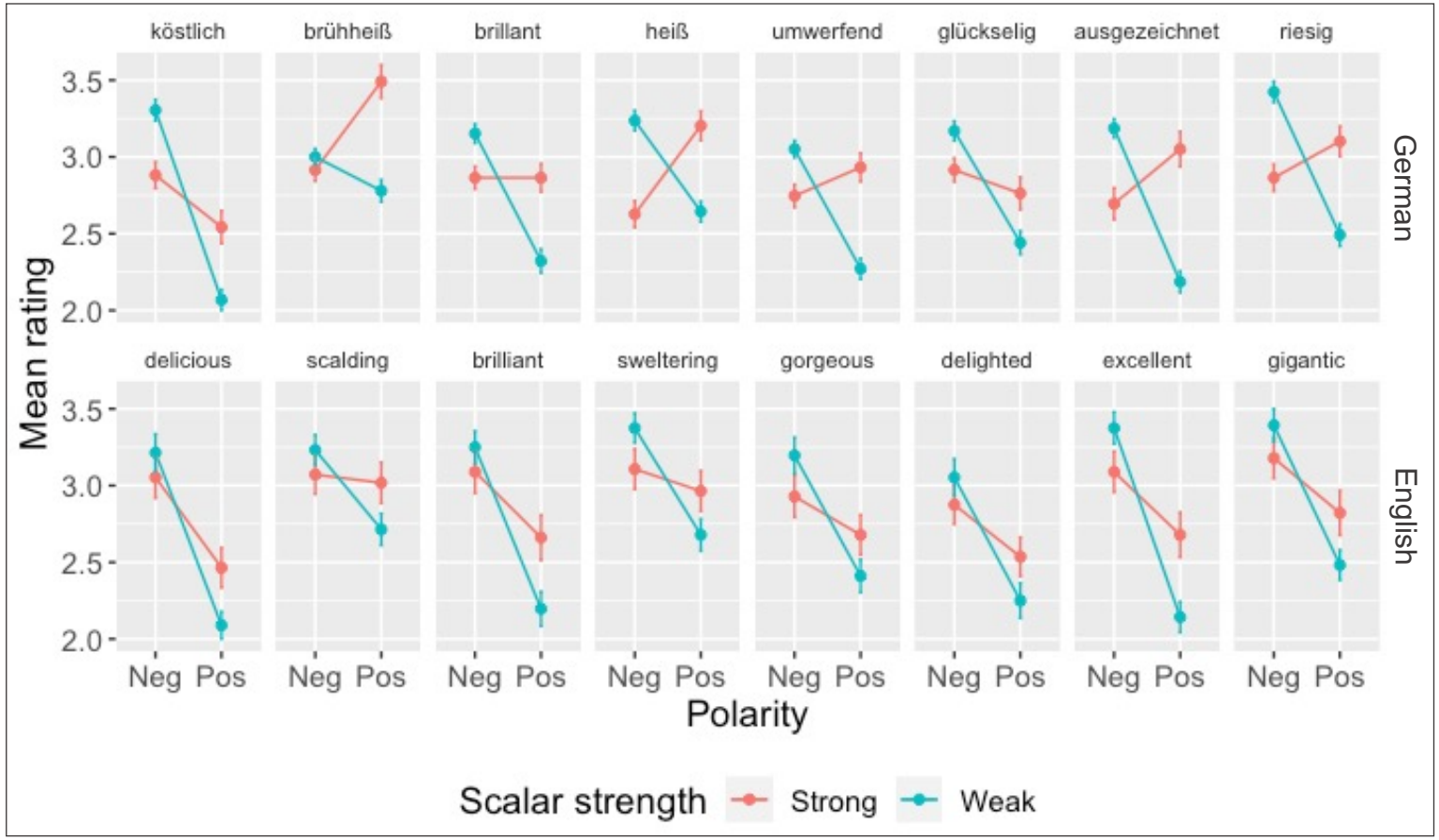
nicht sauber
'not clean'

RESULTS SUMMARY

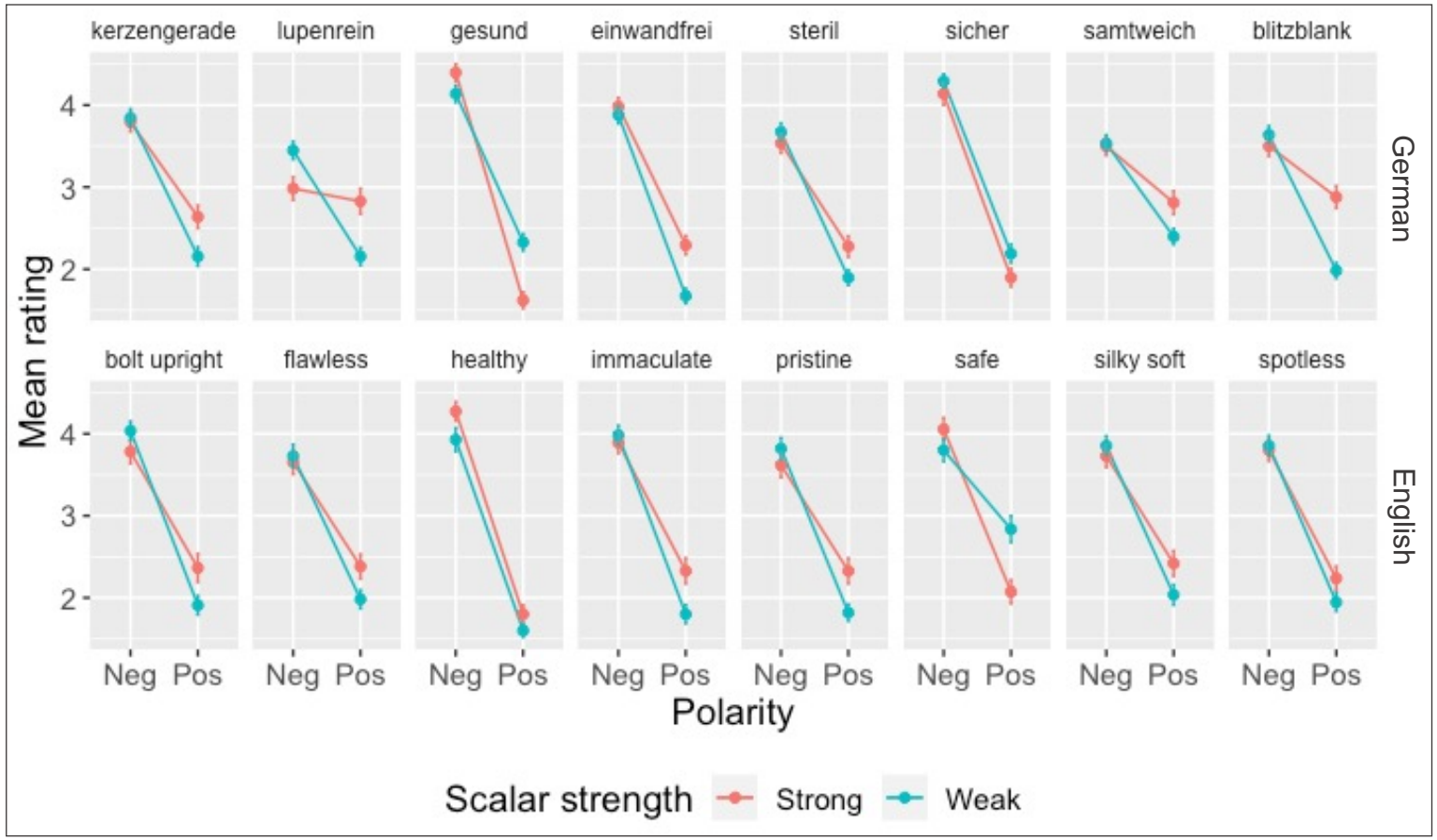
- Significant interaction of negation, polarity, and scalar strength for relative (z = -6.89, p < .0001) and absolute adjectives (z = -4.52, p < .0001)
- Significant interaction of adjective type, polarity, and scalar strength under negation (z = 2.36, p < .05)

→ Inferences depend on negation, polarity, and scalar strength and diverge for absolute vs. relative adjectives, i.e., replication of Alexandropoulou & Gotzner (submitted) in German

CROSS-LANGUAGE ANALYSIS (EXPERIMENT 1)



CROSS-LANGUAGE ANALYSIS (EXPERIMENT 2)

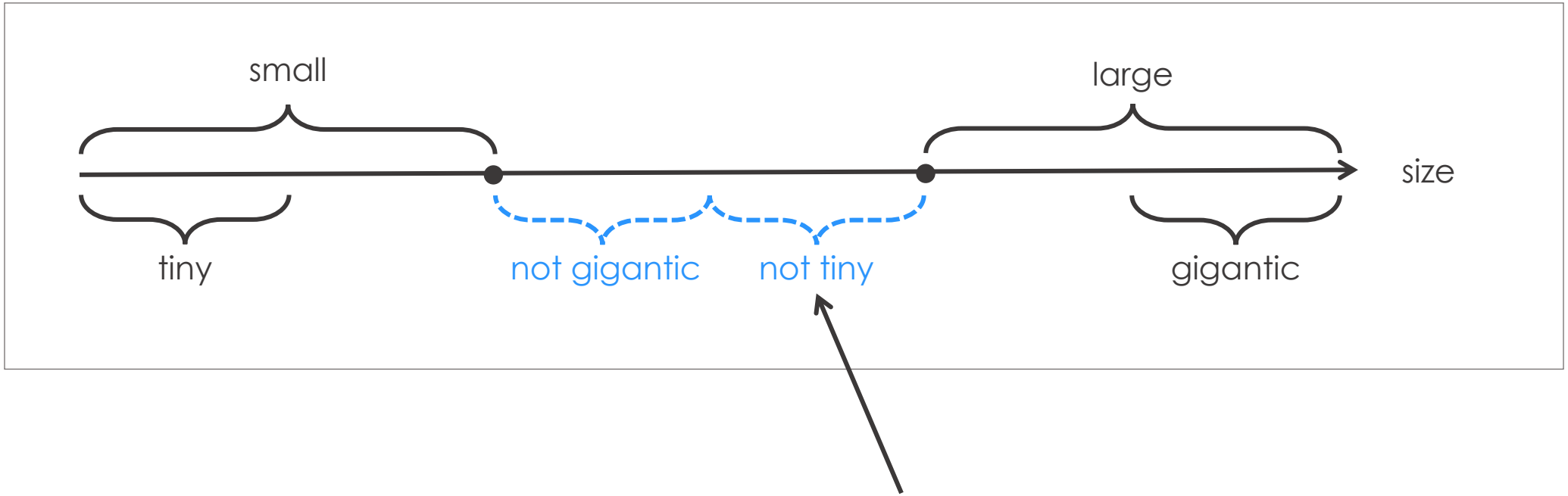


RESULTS SUMMARY

- Significant interaction of language, polarity, and scalar strength under negation for relative ($z = -3.61$, $p < .0001$) but not for absolute adjectives ($z = -1.13$, $p = .26$)
- Opposite direction of interaction for relative strong adjectives under negation across languages

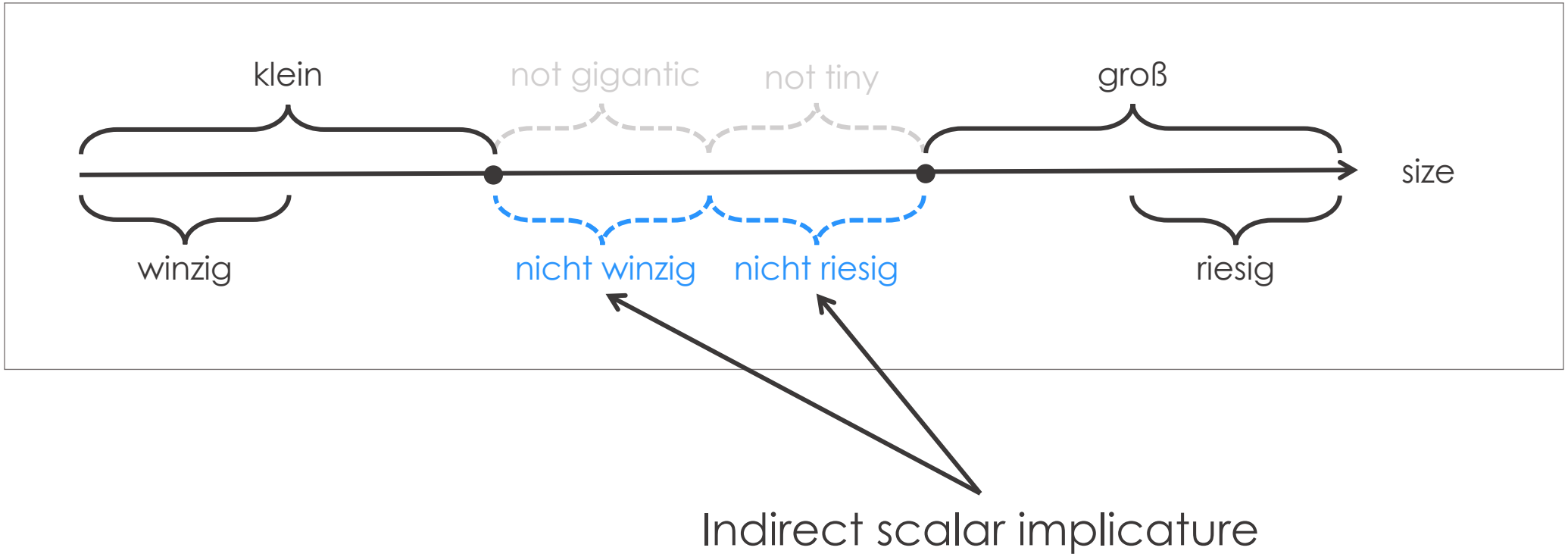
→ Interpretation of relative adjectives depends on language, polarity, and scalar strength, i.e., cross-linguistic differences between German and English

DISCUSSION



"mitigating effect of double negatives" (Krifka, 2007, p. 164)

DISCUSSION


klein
not gigantic
not tiny
groß
size
winzig
nicht winzig
nicht riesig
riesig
Indirect scalar implicature

DISCUSSION

How to explain the differences between relative and absolute adjectives?

- Context-dependent standard of relative adjectives allows for cross-linguistic variation (e.g., distinct lexical representations of threshold of strong adjectives)
- Finer granularity level for scales of absolute adjectives with weak and strong terms does not change scale structure per se (Sassoon & Zevakhina, 2012), i.e., minimally or maximal degrees of absolute adjectives

DISCUSSION

How to explain the differences between German and English?

- Experimental evidence of cross-linguistic differences in scalar inferences also for quantifiers (Stateva et al., 2019) and nouns (Dionne & Coppock, 2021)
- Presence of scalar implicatures is more related to productivity than to complexity of alternatives (Dionne & Coppock, 2021)

→ Differences between German and English caused by opposite productivity of strong adjectives due to varying lexical representation across languages

DISCUSSION

How to explain the differences between German and English?

- Lexical assimilation of strong and weak adjectives in (American) English (e.g., *I'm feeling good.* vs. *I'm feeling great.*)
- Lexical extremeness (subjective or evaluative) of strong adjectives in German (*e.g., Mir geht's gut.* vs. *Mir geht's großartig.*)

DISCUSSION

How to explain the differences between German and English?

- Relative strong adjectives receive a middling interpretation under negation with opposite scale ranges of positive vs. negative terms indicating that
  - Strong adjectives in (American) English license similar inferences as (lexically assimilated) weak counterparts, i.e., "mitigating effect of double negatives" (Krifka, 2007, p. 164) and negative strengthening of negated positives
  - Strong adjectives in German license inferences that are prototypically associated with strong adjectives, i.e., indirect scalar implicatures

CONCLUSION

1. How are gradable adjectives interpreted in German?
2. Do English and German show the same pragmatic inferences?

- Pragmatic inferences of gradable adjectives depend on negation, polarity, and scalar strength and diverge across adjective type, i.e., replication of results by Alexandropoulou & Gotzner (submitted)
- Cross-linguistic differences in the lexical representations of adjectives license distinct pragmatic inferences for relative strong adjectives, e.g., tendency of indirect scalar implicatures in German

THANK YOU!

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APPENDIX

	köstlich 'delicious'	**brühheiß 'scalding'**	**brillant 'brilliant'**	**heiß 'hot'**	**umwerfend 'gorgeous'**	**glückselig 'blissful'**	**ausgezeichnet 'excellent'**	**riesig 'gigantic'**
Non-negated negative strong	widerlich 'disgusting'	kalt 'cold'	idiotisch 'idiotic'	eisig 'freezing'	scheußlich 'hideous'	untröstlich 'heartbroken'	furchtbar 'terrible'	winzig 'tiny'
Non-negated negative weak	fade 'bland'	kühl 'cool'	dumm 'silly'	kalt 'cold'	hässlich 'ugly'	traurig 'sad'	schlecht 'bad'	klein 'small'
Non-negated positive weak	lecker 'tasty'	heiß 'hot'	klug 'intelligent'	warm 'warm'	schön 'pretty'	fröhlich 'happy'	gut 'good'	groß 'large'
Non-negated positive strong	köstlich 'delicious'	brühheiß 'scalding'	brillant 'brilliant'	heiß 'hot'	umwerfend 'gorgeous'	glückselig 'blissful'	ausgezeichnet 'excellent'	riesig 'gigantic'

	kerzengerade 'bolt upright'	**lupenrein 'flawless'**	**gesund 'healthy'**	**einwandfrei 'immaculate'**	**steril 'sterile'**	**sicher 'safe'**	**samtweich 'silky soft'**	**blitzblank 'spotless'**
Non-negated negative strong	krumm 'twisted'	unvollkommen 'imperfect'	krank 'sick'	kaputt 'broken'	verdreckt 'filthy'	gefährlich 'dangerous'	rissig 'cracked'	verdreckt 'filthy'
Non-negated negative weak	gebeugt 'bent'	unrein 'impure'	angeschlagen 'unwell'	lädiert 'damaged'	schmutzig 'dirty'	bedenklich 'dodgy'	rau 'rough'	schmutzig 'dirty'
Non-negated positive weak	aufrecht 'straight'	pure 'pure'	erholt 'recovered'	ganz 'intact'	sauber 'clean'	harmlos 'harmless'	glatt 'smooth'	sauber 'clean'
Non-negated positive strong	kerzengerade 'bolt upright'	lupenrein 'flawless'	gesund 'healthy'	einwandfrei 'immaculate'	steril 'sterile'	sicher 'safe'	samtweich 'silky soft'	blitzblank 'spotless'

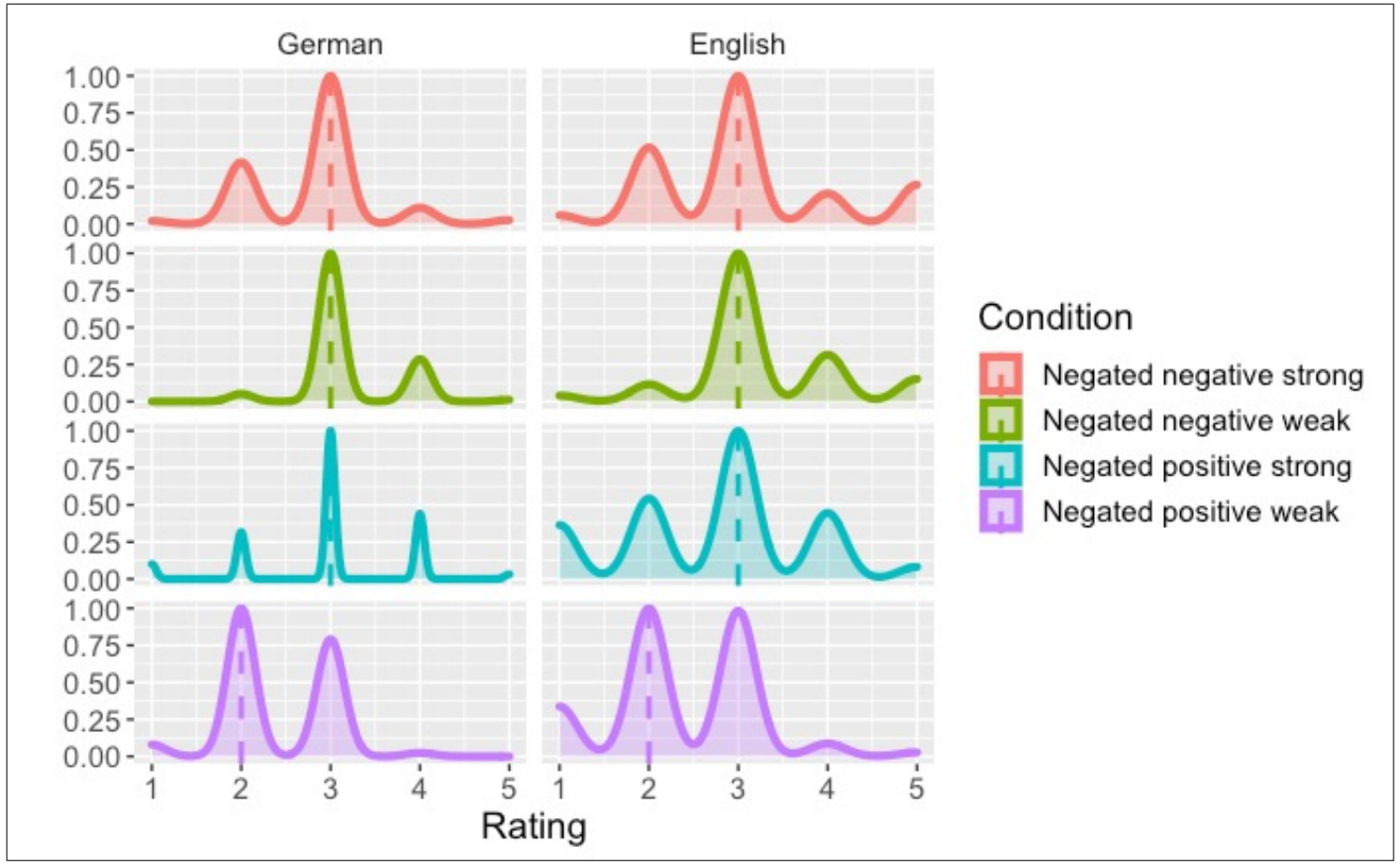
APPENDIX

nicht winzig — *not tiny*

nicht klein — *not small*

nicht riesig — *not gigantic*

nicht groß — *not large*



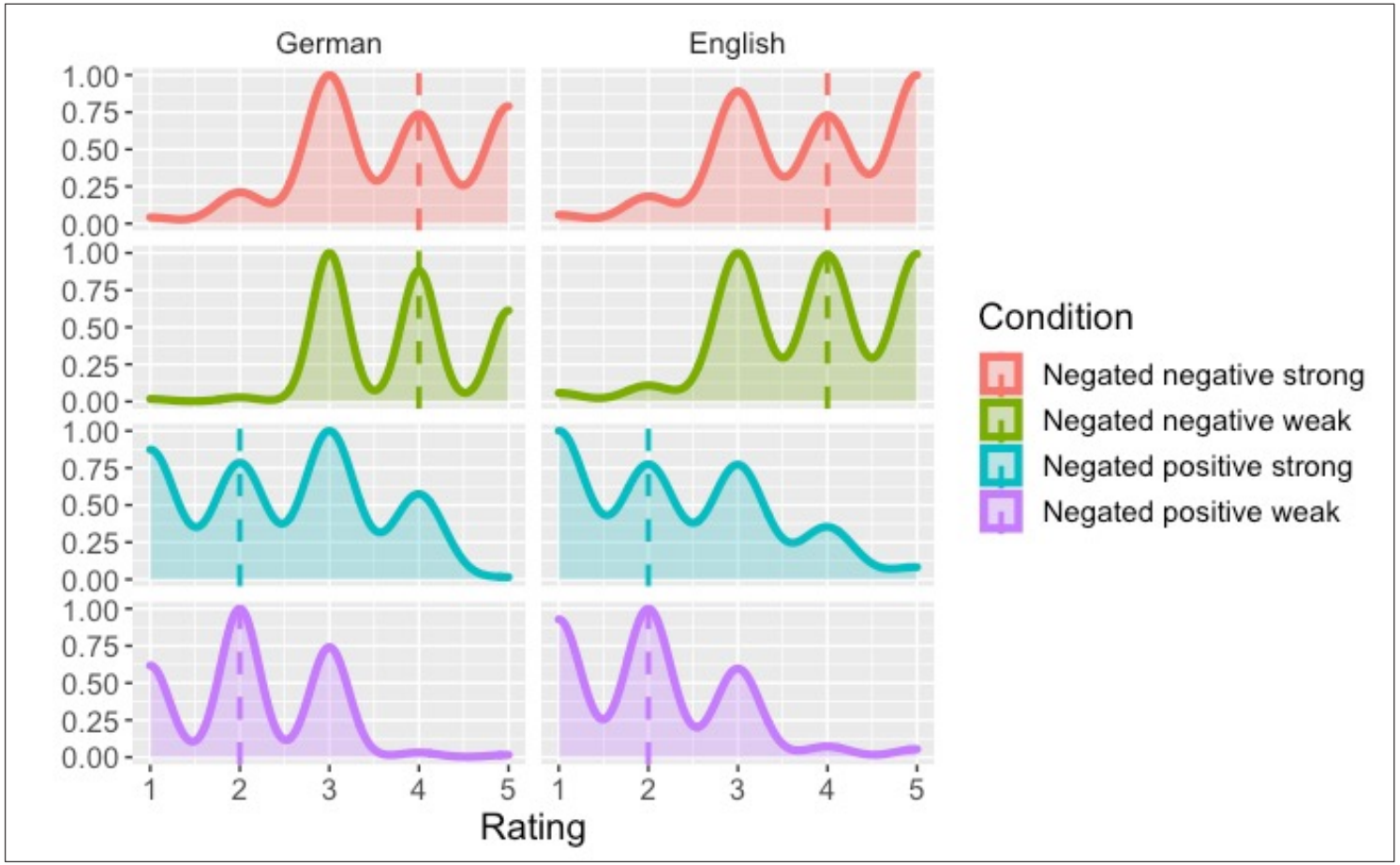
APPENDIX

nicht verdreckt — *not filthy*

nicht schmutzig — *not dirty*

nicht blitzblank — *not spotless*

nicht sauber — *not clean*



APPENDIX

	Estimate	SE	z-value	*p*-value	
Polarity	4.607537	0.254399	18.111	< 2e-16	***
Negation	0.517937	0.215219	2.407	0.0161	*
ScalarStrength	-0.245505	0.217074	-1.131	0.2581	
Polarity:Negation	5.375899	0.346534	15.513	< 2e-16	***
Polarity:ScalarStrength	-2.647176	0.237917	-11.126	< 2e-16	***
Negation:ScalarStrength	0.008763	0.189192	0.046	0.9631	
Polarity:Negation:ScalarStrength	-1.456224	0.211515	-6.885	5.79e-12	***

Experiment 1 (Relative adjectives): Output of cumulative link model.
clmm(Rating ~ Polarity * Negation * ScalarStrength + (1 + Polarity * Negation + ScalarStrength | Participant) + (1 + Polarity * Negation * ScalarStrength | Item), data = datarel)

APPENDIX

	Estimate	SE	z-value	*p*-value	
Polarity	2.1411	0.3867	5.536	3.09e-08	***
Negation	0.3084	0.3002	1.027	0.304	
ScalarStrength	-0.4510	0.3133	-1.440	0.150	
Polarity:Negation	4.7918	0.3794	12.630	< 2e-16	***
Polarity:ScalarStrength	-1.5936	0.3266	-4.879	1.07e-06	***
Negation:ScalarStrength	-0.2706	0.2990	-0.905	0.366	
Polarity:Negation:ScalarStrength	-1.3620	0.3016	-4.517	6.28e-06	***

Experiment 2 (Absolute adjectives): Output of cumulative link model.
clmm(Rating ~ Polarity * Negation * ScalarStrength + (1 + Polarity * Negation * ScalarStrength | Item) + (1 + Polarity * Negation * ScalarStrength | Participant), data = databs)

APPENDIX

	Estimate	SE	z-value	*p*-value	
AdjectiveType	0.30221	0.12821	2.357	0.0184	*
ScalarStrength	-0.20007	0.08791	-2.276	0.0229	*
Polarity	-1.80289	0.30485	-5.914	3.34e-09	***
AdjectiveType:ScalarStrength	-0.02289	0.08765	-0.261	0.7940	
AdjectiveType:Polarity	-1.19277	0.26655	-4.475	7.65e-06	***
ScalarStrength:Polarity	-0.61700	0.13765	-4.482	7.38e-06	***
AdjectiveType:ScalarStrength:Polarity	0.30725	0.13011	2.361	0.0182	*

Cross-experiment analysis: Output of cumulative link model for negated subset.
clmm(Rating ~ AdjectiveType * ScalarStrength * Polarity + (1 + AdjectiveType + ScalarStrength * Polarity | Item) + (1 + AdjectiveType * ScalarStrength * Polarity | Participant), data = dataneg)

APPENDIX

	Estimate	SE	z-value	*p*-value	
Polarity	-0.93582	0.20997	-4.457	8.31e-06	***
ScalarStrength	-0.14784	0.04751	-3.112	0.001859	**
Language	0.03218	0.11558	0.278	0.780697	
Polarity:ScalarStrength	-0.73013	0.04754	-15.358	< 2e-16	***
Polarity:Language	0.33996	0.20547	1.655	0.098020	.
ScalarStrength:Language	-0.03214	0.04701	-0.684	0.494130	
Polarity:ScalarStrength:Language	-0.16604	0.04605	-3.606	0.000311	***

Cross-language analysis: Output of cumulative link model for negated subset of relative adjectives. clmm(Rating ~ Polarity * ScalarStrength * Language + (1 + Polarity + Language + ScalarStrength | Participant) + (1 + Polarity * ScalarStrength * Language | Item), data = datarelNeg)

APPENDIX

	Estimate	SE	z-value	*p*-value	
Polarity	-2.62839	0.28399	-9.255	< 2e-16	***
ScalarStrength	-0.13170	0.07346	-1.793	0.073012	.
Language	0.04140	0.07883	0.525	0.599458	
Polarity:ScalarStrength	-0.17379	0.04882	-3.560	0.000371	***
Polarity:Language	0.31260	0.28088	1.113	0.265734	
ScalarStrength:Language	-0.02867	0.07338	-0.391	0.696054	
Polarity:ScalarStrength:Language	-0.05501	0.04866	-1.130	0.258300	

Cross-language analysis: Output of cumulative link model for negated subset of absolute adjectives. clmm(Rating ~ Polarity * ScalarStrength * Language + (1 + Polarity * Scalar Strength * Language | Participant) + (1 + Polarity + ScalarStrength | Item), data = databsNeg)