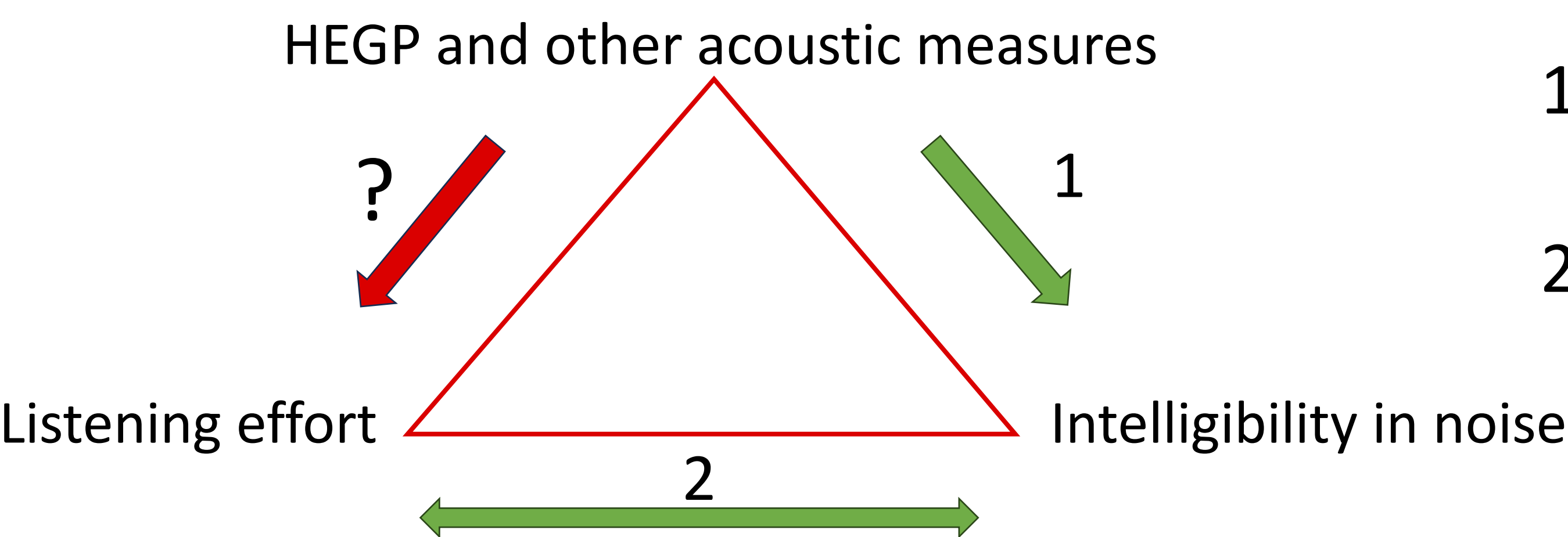


Listening effort ratings for habitual and clear-Lombard speech as predicted by a glimpse measure



Esther Janse¹, Chen Shen¹, & Martin Cooke²
¹ Radboud University Nijmegen, the Netherlands
² University of the Basque Country, Spain

Background and RQs



- 1 High-Energy Glimpse proportion (HEGP) measure is known to predict speech-in-noise intelligibility
- 2 Intelligibility and listening effort are inversely related

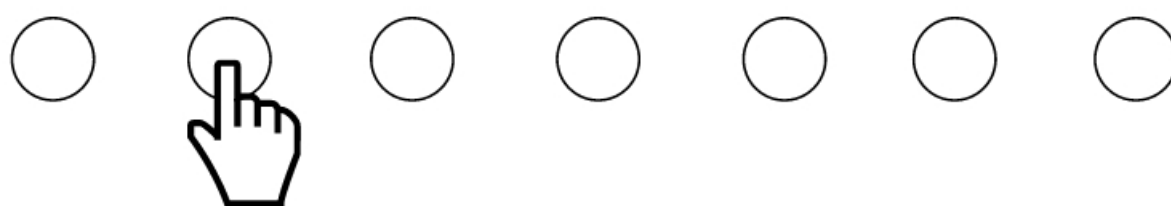
- RQ1a Does HEGP predict listening effort ratings for speech presented in noise? **YES**
- RQ1b If so, does HEGP predict effort differentially for habitual and clear-Lombard speech? **NO**
- RQ2 Do acoustic-phonetic measures explain additional variance in effort ratings? **YES**

Speech corpus and ratings

- Multi-talker Radboud Lombard Corpus (subsample of 48 talkers)
- Speech and listening effort ratings available on Zenodo (scan QR →)
- 48 talkers reading 48 sentences, in both habitual and clear-Lombard style (48*48*2=4608 sentences)
- Listening effort ratings collected online for sentences, presented in speech-shaped noise (-6 dB SNR)
- 230 online raters; each unique sentence rated by 2-3 raters
- Rating on 7-point listening effort scale



Not effortful at all
to understand



Extremely effortful
to understand

Acoustic measures

High-Energy Glimpse Proportion

- Speech-in-noise mixture passed through filter bank
- HEGP quantifies *speech-dominant High-Energy* glimpses from the noisy speech → HEGP score (0-1) per sentence

Additional acoustic-phonetic measures

- F₀ range (in semitone)
- F₀ median (in semitone)
- Articulation rate (syll/sec)
- Hammarberg Index (Δ energy LF (0–2 kHz) and HF band (2–5 kHz; *higher values index less vocal effort*)

Statistical modelling and results

Model 1 (HEGP)

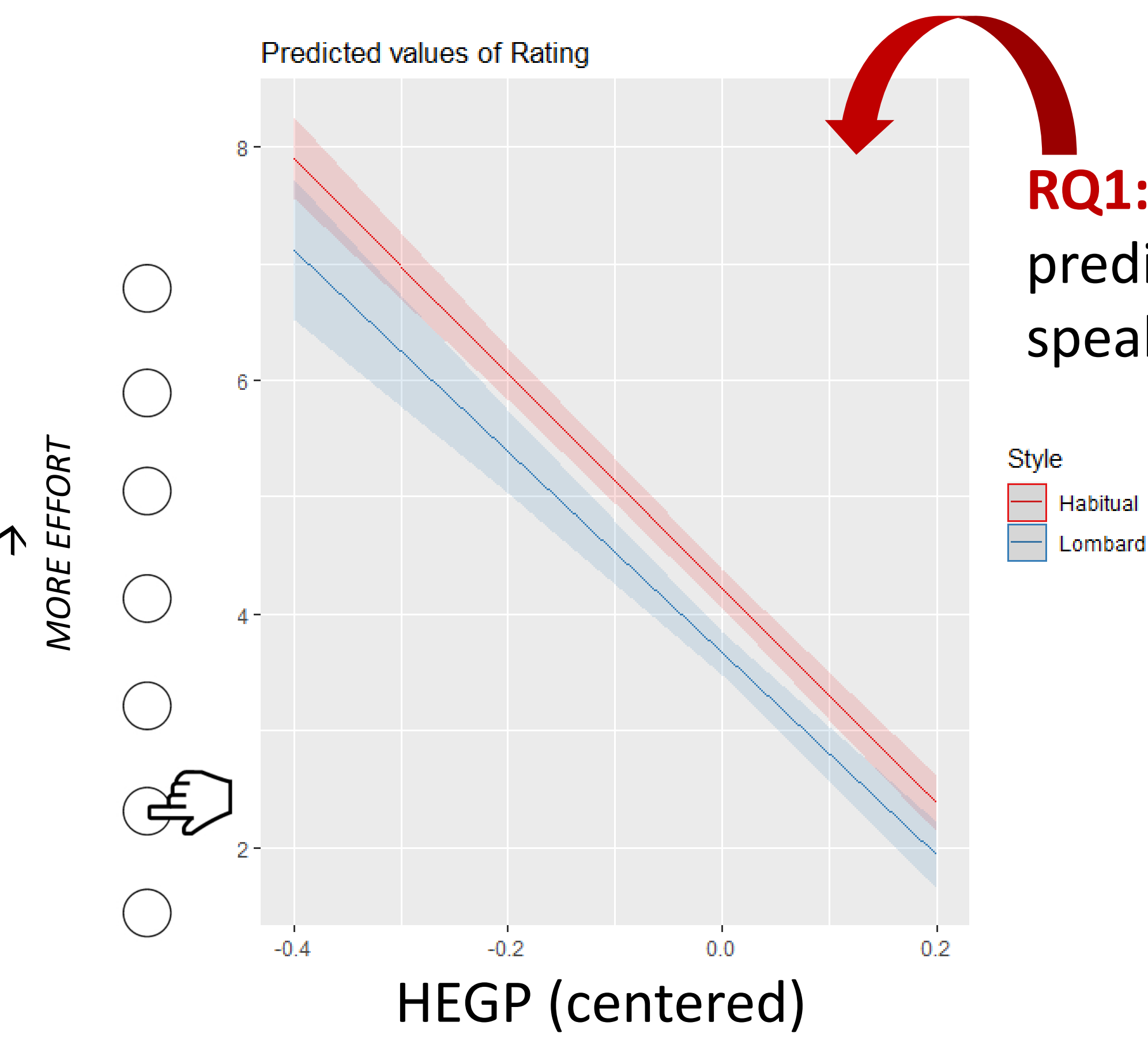
model1=lmer(Rating ~ hegpC*Style+ Gender + (1|SentenceID) + (1|Rater) + (1+Style|Speaker)
Number of obs: 11040, Rater, 230; Speaker, 48; SentenceID, 48 (sum coding for categorical variables)

Fixed effects	β	SE	t	p-level
HEGP	-8.93	0.41	-21.93	***
Style	-0.55	0.08	- 7.139	***
Gender (talker)	0.81	0.11	7.15	***
HEGP*Style			<1	n.s.
Marginal R ² (AIC)	0.34 (35159)			

Model 2 (HEGP plus additional acoustic measures)

model2= (same fixed and random structure as model 1) + scaled(F0range + F0median+artic_rate + HamI)
Identical dataset and contrast coding as for model 1

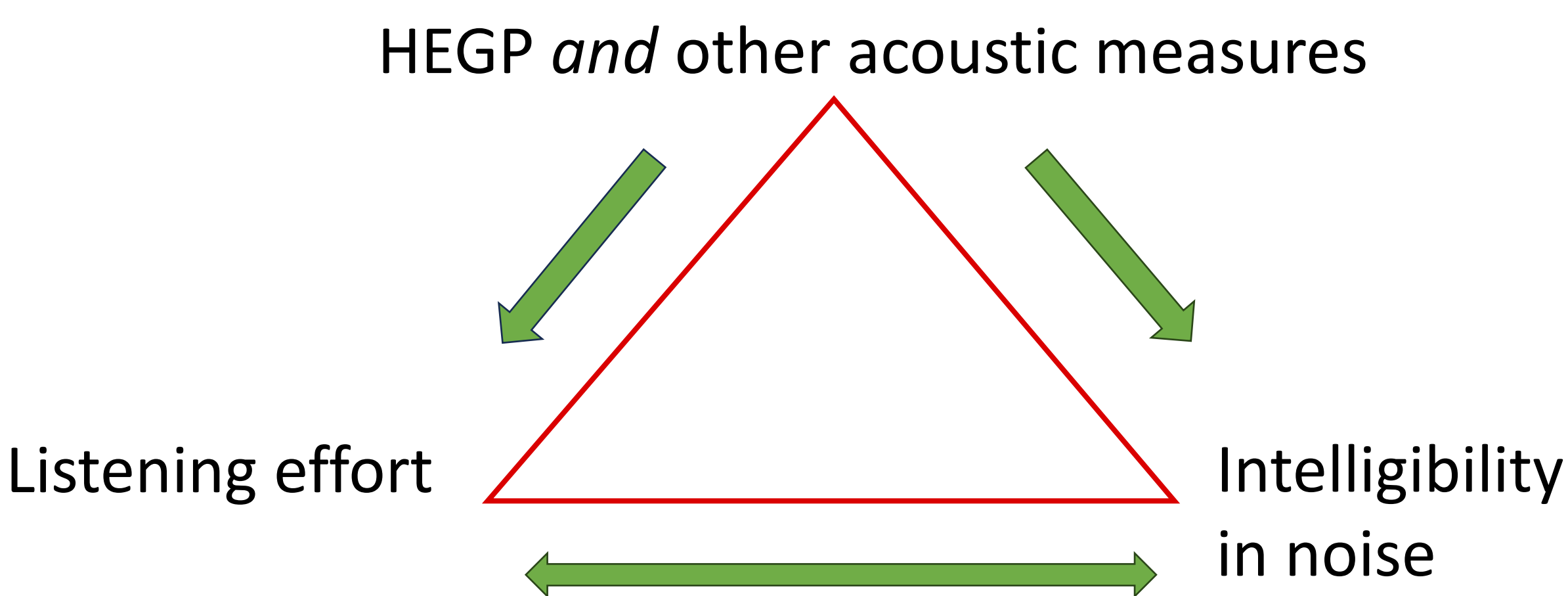
Fixed effects	β	SE	t	p-level
HEGP	-7.93	0.41	-21.93	***
Style	-0.44	0.08	- 5.31	***
Gender	0.77	0.12	6.38	***
HEGP*Style	0.69	0.62	1.12	n.s.
F ₀ range	-0.08	0.02	- 3.61	***
F ₀ median	0.06	0.03	1.91	. (<0.1)
Articulation_rate	0.10	0.03	3.33	***
Hammarberg Index	0.06	0.03	2.22	*
Marginal R ² (AIC)	0.35 (35136)			



RQ1: HEGP equally strong predictor of effort across speaking styles

RQ2: acoustic-phonetic measures explain some additional variance in listening effort

Bottom line



This project has received funding from the European Union's Horizon 2020 research innovation program under the Marie Skłodowska-Curie Grant No. 675324 (ENRICH).