Crossmodal Correspondence Between Auditory Timbre and Visual Shape

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Supplementary Material

For all 12 ANOVAs presented in this document, p-values were measured against an alpha of 0.05. The purpose of these ANOVAs is primarily descriptive - we are not using them to test specific hypotheses. That noted, readers interested in the influence of multiple comparisons may want to measure the reported p-values against the Bonferroni corrected alpha of 0.004 (0.05/12). However, this correction does not affect the significance of any effects reported here.

S1: Shape: Recognizable-Arbitrary scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
baseshape	3	141	37734.37	91966.72	19.28	.000	.07
sptransform	5	235	131205.70	97038.87	63.55	.000	.25
baseshape x sptransform	15	705	21634.05	144730.04	7.03	.000	.04

| Recognizable (Lower)	Arbitrary (Higher)	Shape			
		Bug	Curves	Jagged	Star
	Base	69.5	55.4	50	58
	Familiar	50.9	27.7	21.8	33.4
	Fuzzy	71.7	66.6	57.7	66.2
Transform	Hollow	69.2	58.9	50.6	61.1
	Smooth	67.8	50.2	49.3	61.4
	Symmetrical	42.2	50.8	46.4	43.9
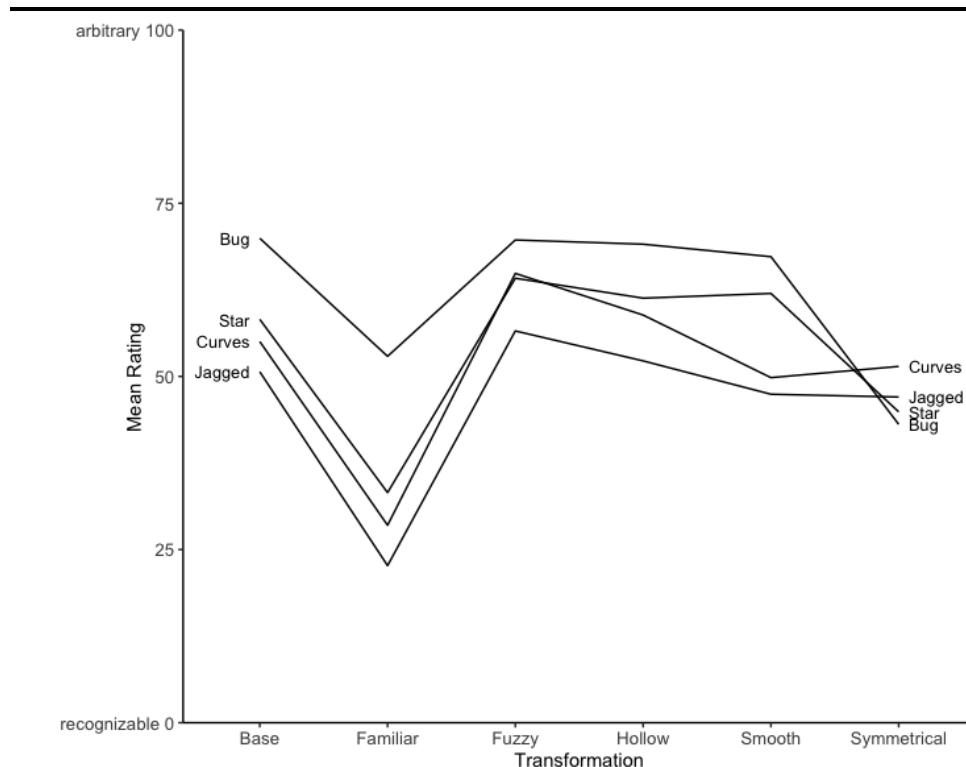
The familiar transformation made shapes more recognizable. This effect was less marked for the Bug shape. The symmetrical transform made the Star and Bug shapes more recognizable.

S2: Shape: Soft-Harsh Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
baseshape	3	141	112343.23	69420.44	76.06	.000	.22
sptransform	5	235	29483.25	119663.20	11.58	.000	.06
baseshape x sptransform	15	705	46506.91	132935.50	16.44	.000	.09

| **Soft**	**Harsh**	**Shape**			
Lower	Higher	Bug	Curves	Jagged	Star
	Base	69.2	35.4	74.2	65.1
	Familiar	51.1	49.7	59.9	45.5
	Fuzzy	66.1	48.7	72.5	63.2
Transform	Hollow	69.4	42.6	74.8	66.5
	Smooth	67.3	33.9	42.9	59.4
	Symmetrical	59.7	35	70.8	58
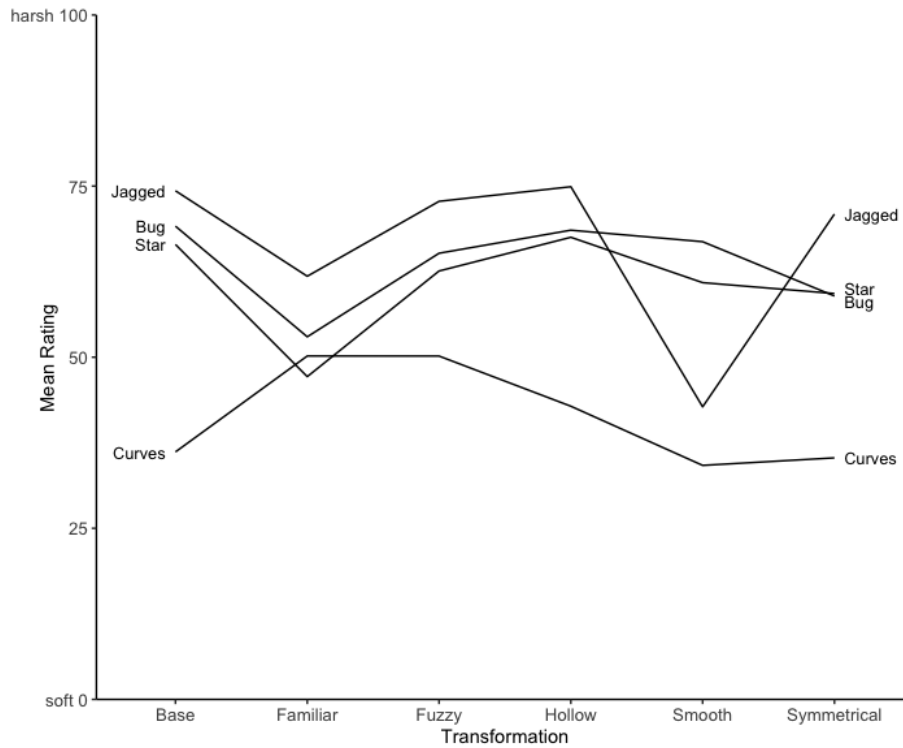
The familiar increased the softness of shapes except for the Curves shape which was already the softest. The smooth transform only increased the softness for the Jagged shape.

S3: Shape: Balanced-Unbalanced Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
baseshape	3	141	44793.57	44001.23	47.85	.000	.07
sptransform	5	235	293201.31	109012.99	126.41	.000	.46
baseshape x sptransform	15	705	44247.20	99415.71	20.92	.000	.07

| **Balanced**	**Unbalanced**	**Shape**			
Lower	Higher	Bug	Curves	Jagged	Star
	Base	77.7	60.4	73.5	67.2
	Familiar	64.2	31.1	24.9	31.2
	Fuzzy	80	67.8	73.2	73.5
Transform	Hollow	79.2	60.2	67.5	68.7
	Smooth	77.5	48.6	66	68.7
	Symmetrical	29.9	36.5	37.4	32.8
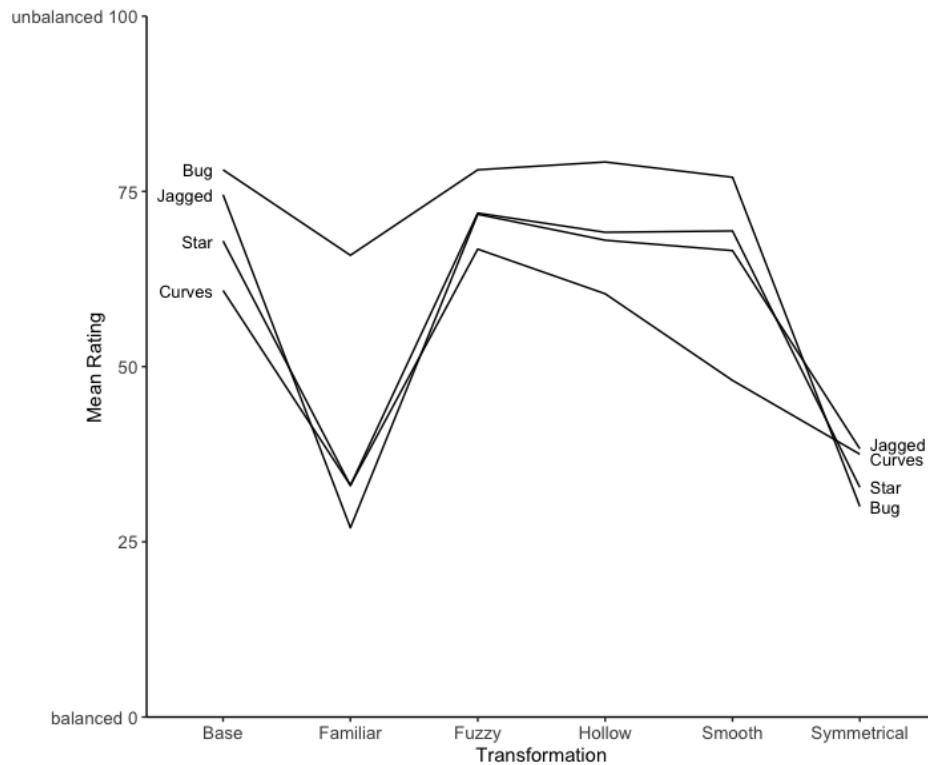
The familiar transform increased balance for all shapes, with the smallest effect for the Bug shape. The symmetrical transform increased balance for all shapes.

S4: Shape: Hollow-Solid Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
baseshape	3	141	12849.50	64658.72	9.34	.000	.02
sptransform	5	235	93165.08	220508.20	19.86	.000	.18
baseshape x sptransform	15	705	8346.72	115105.85	3.41	.000	.02

| **Hollow**	**Solid**	**Shape**			
Lower	Higher	Bug	Curves	Jagged	Star
	Base	68.2	61	74.8	68.1
	Familiar	68.2	76.1	82.8	70.3
	Fuzzy	53.1	56.5	61.4	53.7
Transform	Hollow	49.2	41.6	56	47.2
	Smooth	66.7	62.6	66.7	68.5
	Symmetrical	71.4	66.1	76	72.5
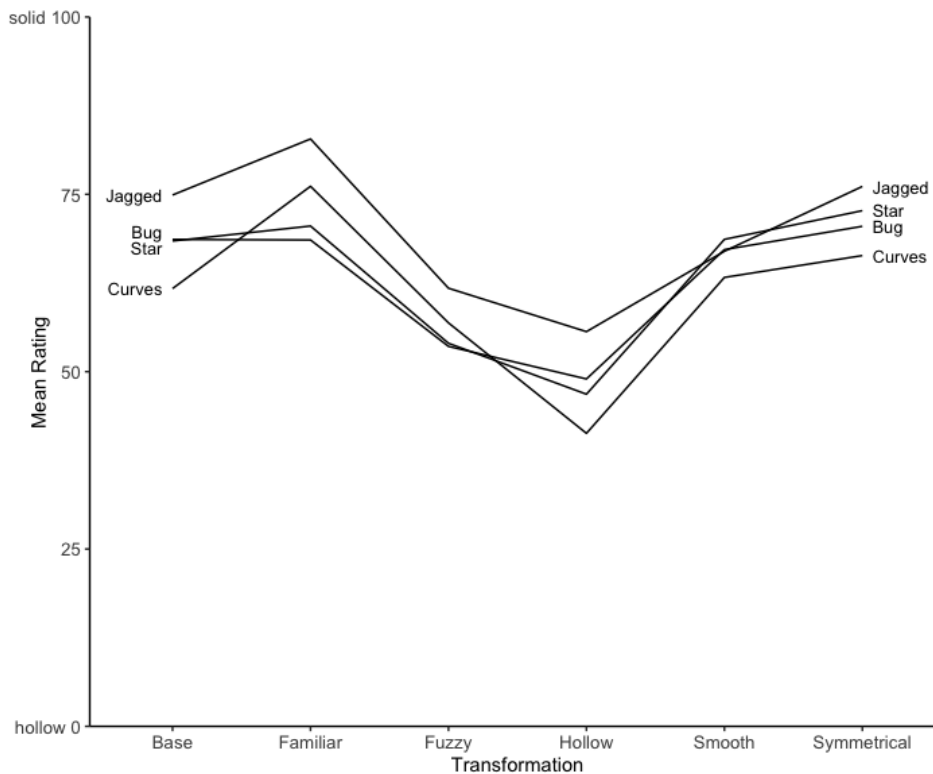
Solidness was decreased by the fuzzy and hollow transforms while the familiar transform tended to increase solidness for all shapes.

S5: Shape: Clear-Distorted Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
baseshape	3	141	21775.06	54359.99	18.83	.000	.04
sptransform	5	235	227288.73	146678.88	72.83	.000	.39
baseshape x sptransform	15	705	12728.68	126038.21	4.75	.000	.02

| **Clear**	**Distorted**		**Shape**		
Lower	Higher	Bug	Curves	Jagged	Star
	Base	51.3	47.9	43.5	46.5
	Familiar	51.4	32.2	25.4	34.6
	Fuzzy	81.6	71.9	79.2	77.6
Transform	Hollow	62.6	47.8	50.1	54
	Smooth	55.1	39.1	43.9	47.3
	Symmetrical	38.2	35.4	36.5	34.2
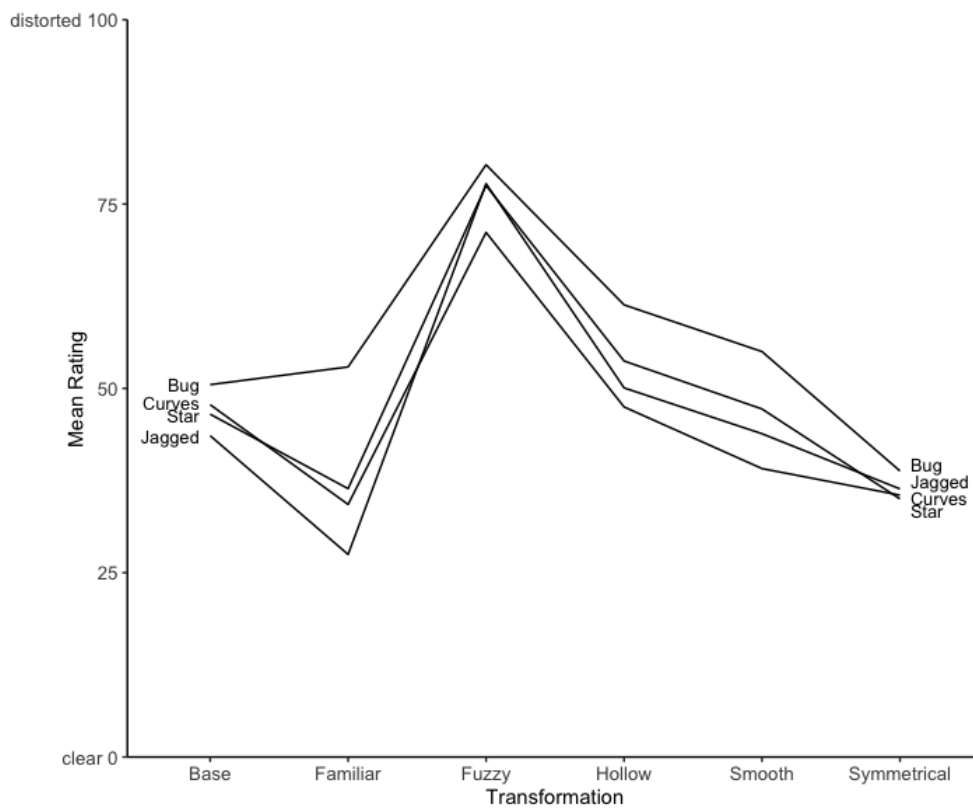
All shapes were rated as more distorted following the fuzzy transform while the familiar transform increases clearness for all shapes except the Bug.

S6: Shape: Simple-Complex Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
baseshape	3	141	168153.32	65147.20	121.31	.000	.31
sptransform	5	235	76124.91	84841.52	42.17	.000	.14
baseshape x sptransform	15	705	34285.36	107507.71	14.99	.000	.06

| **Simple** Lower	**Complex** Higher	Bug	Curves	**Shape** Jagged	Star
	Base	76.5	39.8	71.7	58.8
	Familiar	75	31.1	34.4	36.9
	Fuzzy	75.6	53	72.1	65.8
Transform	Hollow	77.9	51.1	72.4	68.2
	Smooth	71.6	32.5	61	53.4
	Symmetrical	67.6	37.2	63	45.3
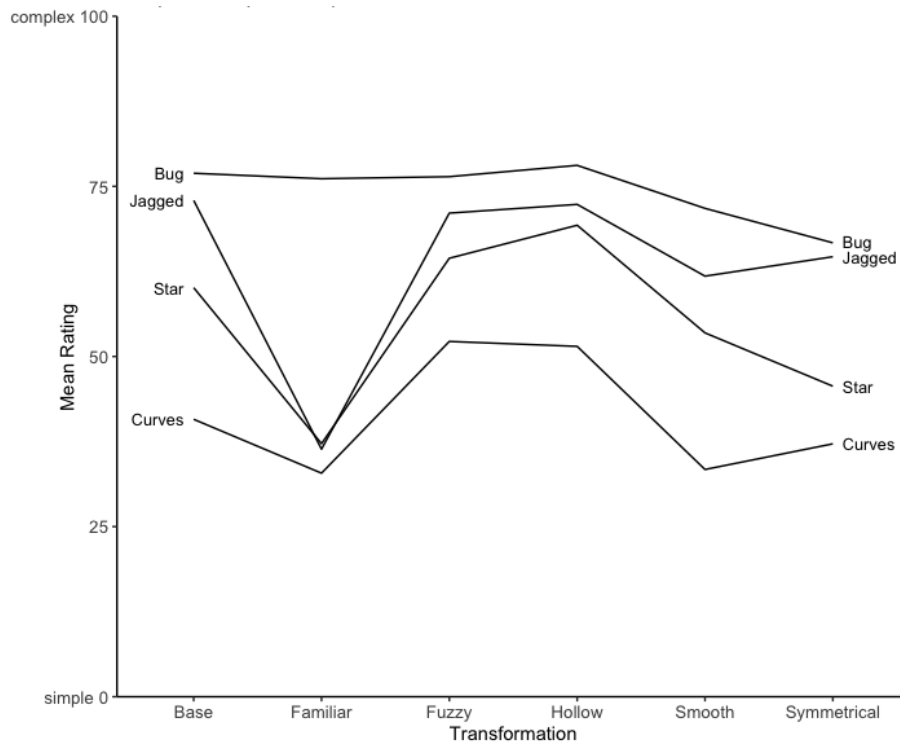
The familiar transform increased simplicity of all the shapes except the bug. The fuzzy transform moderately increased complexity for the Star and Curves, while the symmetrical transform increased simplicity for the Star.

S7: Sound: Recognizable-Arbitrary Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
basesound	3	141	24407.08	76037.29	15.09	.000	.07
sotransform	5	235	26377.28	78976.80	15.70	.000	.08
basesound x sotransform	15	705	9231.39	127625.24	3.40	.000	.03

| Recognizable	Arbitrary	Shape			
Lower	Higher	Bug	Curves	Jagged	Star
	Base	57	50.5	54.6	45.8
	Familiar	38.7	47.6	50.6	33.7
	Fuzzy	63.1	56.5	62.5	51.3
Transform	Hollow	58.8	51.7	58.2	45.6
	Smooth	59.8	51.1	63	44.5
	Symmetrical	51	49.1	55.5	49.7
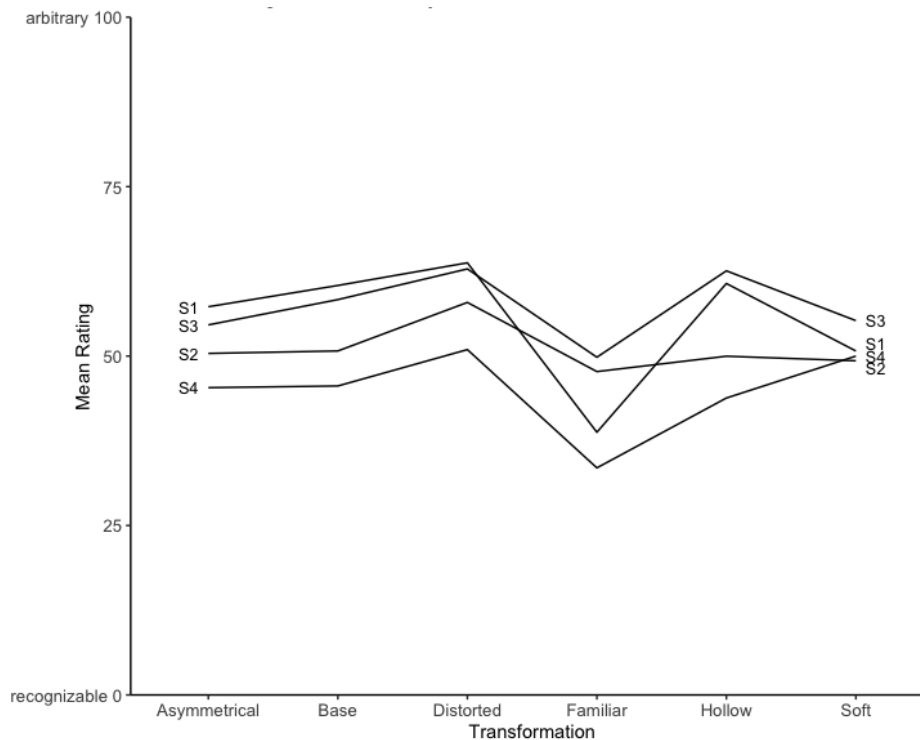
The familiar transform made sounds more recognizable. This effect was less marked for S2 and S3.

S8: Sound: Soft-Harsh Scale

Predictor	df$_{Num}$	df$_{Den}$	SS$_{Num}$	SS$_{Den}$	F	p	η²$_g$
basesound	3	141	155865.03	79636.34	91.99	.000	.27
sotransform	5	235	84617.11	56672.63	70.18	.000	.15
basesound x sotransform	15	705	72714.39	126658.13	26.98	.000	.13

| **Soft**	**Harsh**			**Shape**		
Lower	Higher	Bug	Curves	Jagged	Star
	Base	82.6	69.8	60.6	36.5
	Familiar	41.8	64.1	44.2	47.2
	Fuzzy	84.6	74.5	71.6	41.5
Transform	Hollow	80.5	69.8	58.1	34
	Smooth	71.3	67.5	55.8	33.8
	Symmetrical	38.3	46.6	51.9	32
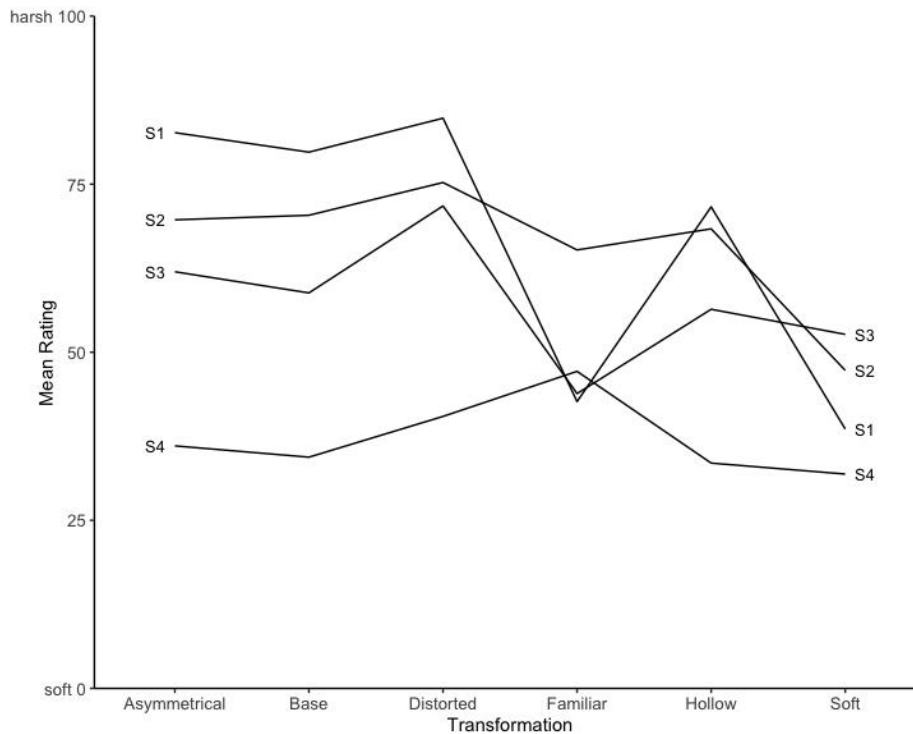
Softness was increased by the familiar transform for S1 and S3 sounds. The soft transform increased softness relative to the base for all sounds but the least for S3.

S9: Sound: Balanced-Unbalanced Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
basesound	3	141	69549.95	68006.28	48.07	.000	.17
sotransform	5	235	27486.68	82196.16	15.72	.000	.07
basesound x sotransform	15	705	29110.29	140341.32	9.75	.000	.07

| **Balanced** | **Unbalanced** | | | **Shape** | | |
|---|---|---|---|---|---|
| Lower | Higher | Bug | Curves | Jagged | Star |
| | Base | 61 | 54 | 56.8 | 35.4 |
| | Familiar | 46.1 | 70 | 63.5 | 43.3 |
| | Fuzzy | 72.2 | 57.9 | 61.8 | 42.6 |
| **Transform** | Hollow | 57.5 | 51.7 | 53.1 | 37.8 |
| | Smooth | 61.5 | 57.9 | 60.9 | 37.7 |
| | Symmetrical | 41.1 | 44.3 | 51.1 | 36.6 |
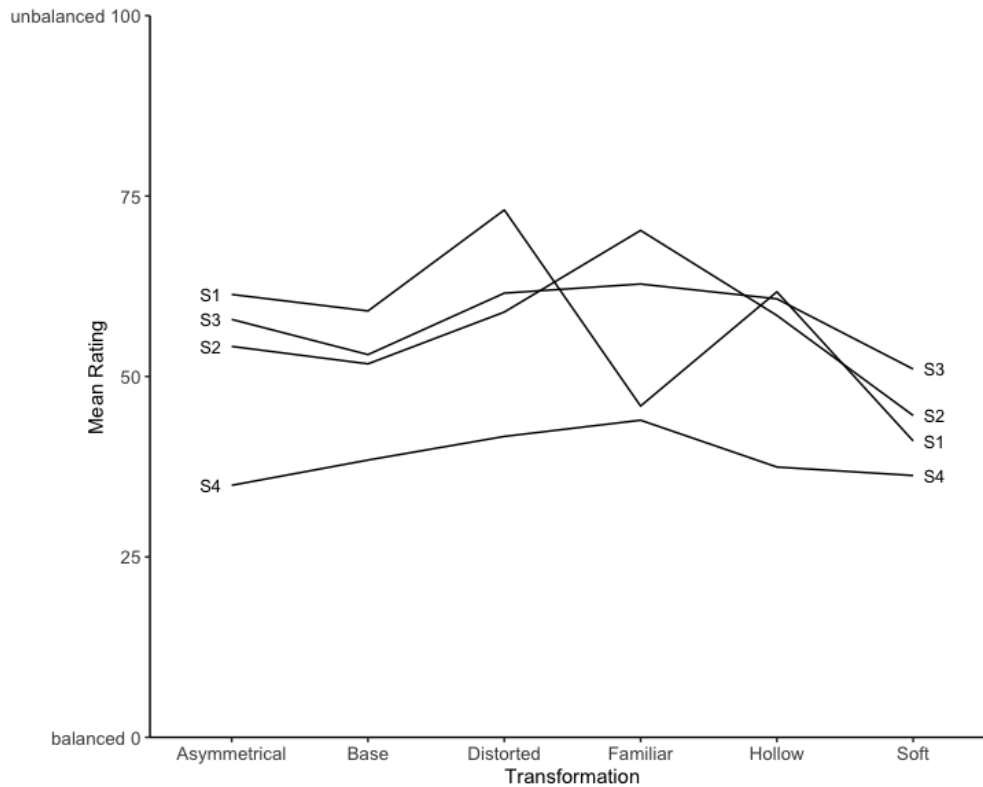
The familiar transform decreased balance for S2 while increasing it for S1.

S10: Sound: Hollow-Solid Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
basesound	3	141	38897.56	146788.02	12.45	.000	.08
sotransform	5	235	26566.47	89378.66	13.97	.000	.06
basesound x sotransform	15	705	20102.07	140357.99	6.73	.000	.04

| **Hollow**	**Solid**		**Shape**		
Lower	Higher	Bug	Curves	Jagged	Star
	Base	65.3	62.9	56.3	45.7
	Familiar	54.3	49.1	30.8	48.7
	Fuzzy	64.2	64.1	53.2	49.1
Transform	Hollow	66.5	65.3	53.1	44.9
	Smooth	54.8	58.1	52.3	40.9
	Symmetrical	48.8	51.8	47.1	45.8
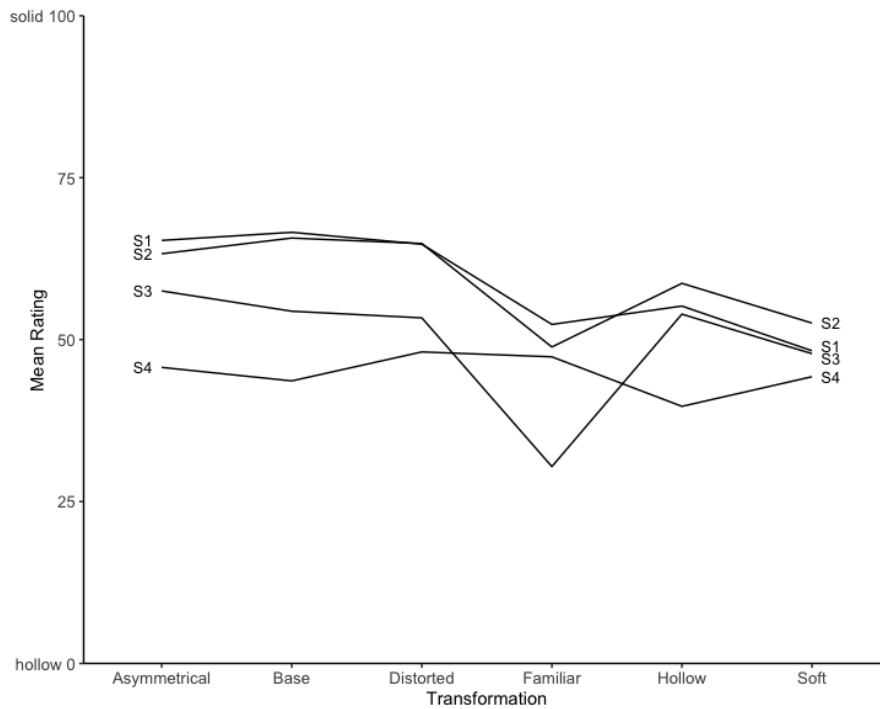
Hollowness was increased by the familiar transform for all sounds except S4.

S11: Sound: Clear-Distorted Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
basesound	3	141	57794.73	120012.64	22.63	.000	.12
sotransform	5	235	21608.97	81201.18	12.51	.000	.05
basesound x sotransform	15	705	29035.43	155912.16	8.75	.000	.06

| **Clear**	**Distorted**			**Shape**		
Lower	Higher	Bug	Curves	Jagged	Star
	Base	65.6	57.7	61.2	41.8
	Familiar	40.3	63.6	61	40.3
	Fuzzy	73.8	60.6	69.9	51.8
Transform	Hollow	65	54.5	59.5	43.3
	Smooth	65.2	54.1	67.4	44.1
	Symmetrical	49.7	51.6	59	44.9
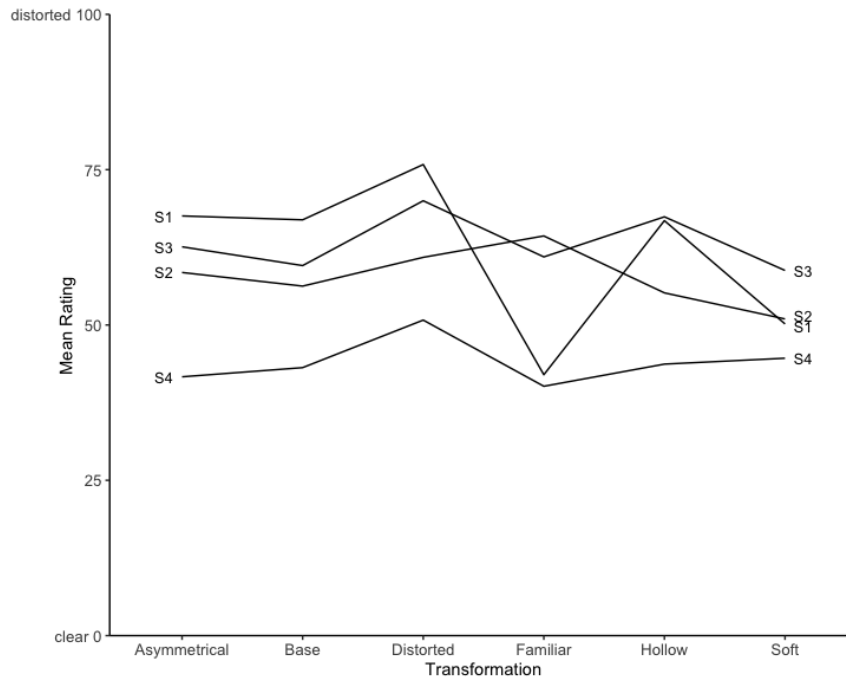
Only S1 was strongly affected by the familiar and soft transforms which increased S1's clearness. The distorted transform increased distortion moderately for all sounds.

S12: Sound: Simple-Complex Scale

Predictor	df_{Num}	df_{Den}	SS_{Num}	SS_{Den}	F	p	η^2_g
basesound	3	141	26949.13	58527.78	21.64	.000	.08
sotransform	5	235	37341.45	73682.22	23.82	.000	.11
basesound x sotransform	15	705	37131.97	120852.74	14.44	.000	.10

Note. df_{Num} indicates degrees of freedom numerator. df_{Den} indicates degrees of freedom denominator. SS_{Num} indicates sum of squares numerator. SS_{Den} indicates sum of squares denominator. η^2_g indicates generalized eta-squared.

Simple Lower	**Complex** Higher	Bug	**Shape** Curves	Jagged	Star
	Base	56.4	50.4	49.6	34.9
	Familiar	45.3	56.9	53.9	63.5
	Fuzzy	67.1	53.7	57.3	41
Transform	Hollow	56.7	50.9	45.8	34.9
	Smooth	63	54.9	57.7	41.3
	Symmetrical	38.6	40.2	44	34.1
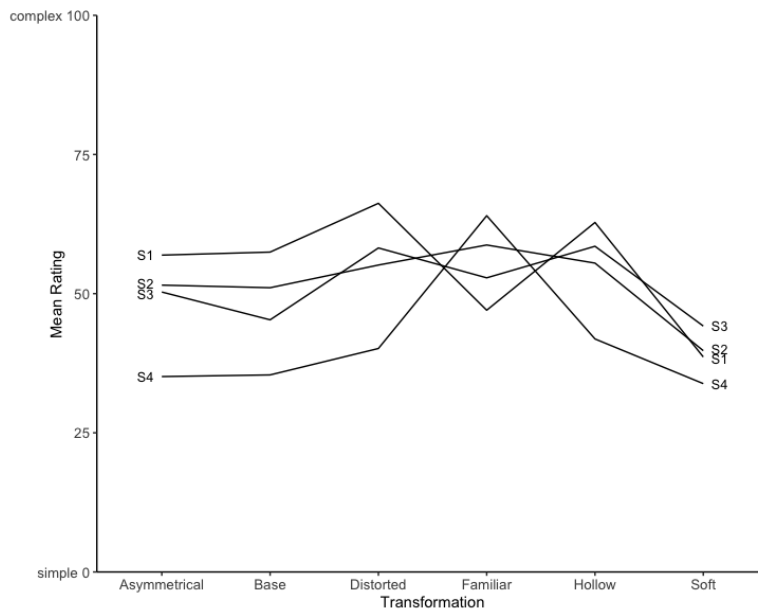
The distorted transform increased complexity moderately for all sounds while the familiar transform had opposite effects on S4 (increasing complexity) and S1 (decreasing complexity). The hollow transform increased complexity for S3.

13