

INTRODUCTION

Few studies explore the relations between prosodic development and executive functioning skills. Executive function (EF) is a neuropsychological construct corresponding to a complex set of processes that are responsible for goal-directed behavior, such as planning, cognitive flexibility, inhibition, organization, and working memory. Both prosody and EF begin to develop during the early years and some aspects continue to develop throughout the individual's life. So far, little is known about the nature of the relationship between prosodic development and EF. In the present study we aim to understand how executive functions are related to different measures of prosody.

METHOD

Participants

109 European Portuguese native speakers

- ▶ 5/6 years ($n = 14$; $M = 5.14$; $SD = 0.36$)
- ▶ 7 years ($n = 19$; $M = 7.54$; $SD = 0.26$)
- ▶ 8 years ($n = 18$; $M = 8.14$; $SD = 0.38$)
- ▶ 9/10 years ($n = 20$; $M = 9.40$; $SD = 0.50$)
- ▶ 11/14 years ($n = 22$; $M = 12.91$; $SD = 1.06$)
- ▶ 15/18 years ($n = 16$; $M = 16.25$; $SD = 1.29$)

Material / Procedure

▶ **Portuguese version of the Profiling Elements of Prosody in Speech-Communication (PEPS-C, see Fig. 1) [1]:** addressing receptive and expressive prosodic skills in parallel. The tasks are at two levels: formal and functional. The formal level assesses auditory discrimination and voice skills required to perform the tasks, whereas the functional level evaluates receptive and expressive prosodic skills in four domains: (1) Affect – liking vs. disliking; (2) Turn-end – questions vs. statements; (3) Chunking – prosodic phrase boundaries; and (4) Focus – emphasis in a particular word.

▶ **Behavior Rating Inventory of Executive Function - Short Parental Version (BRIEF, see Fig. 2) [2]:** assessing EF behaviors in six clinical scales (Internal Emotion Regulation, External Emotion Regulation, Inhibition Control, Planning/Working Memory, Initiation/Flexibility, and Organization of Materials)

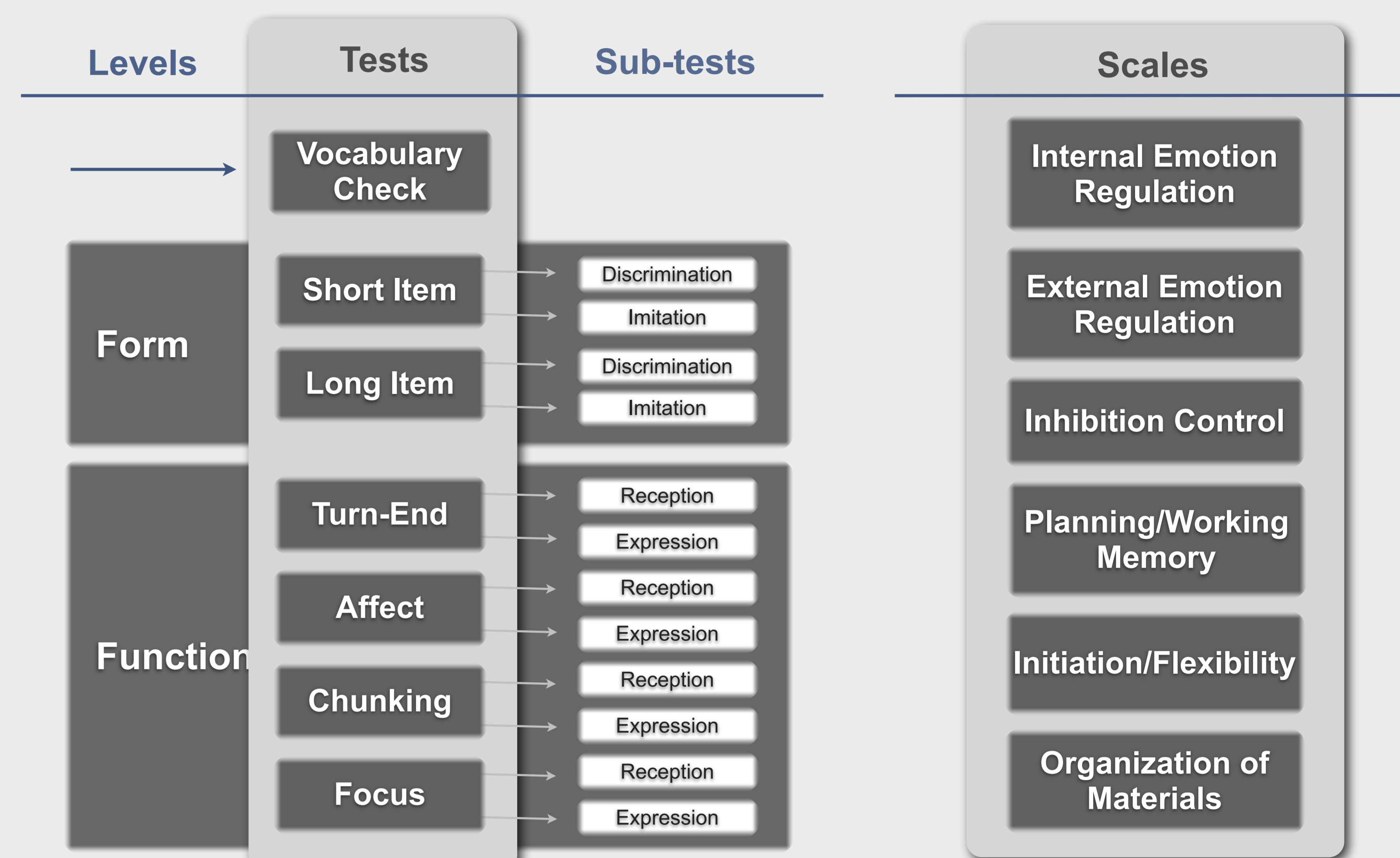


Figure 1. PEPS-C

Figure 2. BRIEF - Short Parental Version

RESULTS

Table 1. Correlations between EF and prosodic abilities

5 / 6 Years	External Emotion Regulation	Internal Emotion Regulation	Inhibition Control	Planning/Working Memory	Initiation/Flexibility	Organization of Materials
Short Item Reception	0.000	-0.025	-0.107	0.018	0.334	0.386
Short Item Expression	-0.067	0.114	0.097	-0.211	0.198	0.000
Long Item Reception	0.149	0.087	-0.062	0.142	0.603*	0.324
Long Item Expression	0.336	0.189	0.137	-0.187	0.173	-0.043
Turn-End Reception	0.137	0.132	0.141	-0.093	0.587*	-0.023
Turn-End Expression	-0.348	0.047	0.474	0.255	0.035	0.300
Affect Reception	-0.361	0.067	-0.167	-0.103	-0.156	-0.222
Affect Expression	-0.038	0.054	-0.044	-0.267	-0.199	0.086
Chunking Reception	0.081	0.465	0.200	0.083	0.347	0.036
Chunking Expression	0.117	-0.036	0.050	0.104	0.395	0.080
Focus Reception	0.036	0.127	0.301	0.626*	0.358	0.540*
Focus Expression	0.114	0.44	0.203	0.097	-0.285	0.155

8 Years	External Emotion Regulation	Internal Emotion Regulation	Inhibition Control	Planning/Working Memory	Initiation/Flexibility	Organization of Materials
Short Item Reception	-0.005	0.109	0.106	0.355	0.092	0.098
Short Item Expression	-0.012	-0.003	0.138	0.191	0.423	0.259
Long Item Reception	-0.174	0.440	-0.149	0.204	0.157	0.070
Long Item Expression	-0.312	0.024	-0.284	0.399	0.251	0.110
Turn-End Reception	-0.108	0.059	-0.174	0.168	-0.042	0.015
Turn-End Expression	-0.412	-0.091	-0.581*	-0.250	-0.152	-0.196
Affect Reception	-0.170	0.080	-0.294	-0.304	-0.165	-0.535*
Affect Expression	0.522*	-0.384	0.316	0.398	-0.080	0.473*
Chunking Reception	0.377	0.276	0.126	0.158	0.404	0.103
Chunking Expression	-0.371	0.516*	0.283	-0.206	0.411	-0.222
Focus Reception	-0.010	0.336	0.089	-0.056	0.753*	0.003
Focus Expression	0.183	0.249	0.231	0.313	0.433	0.250

11/14 Years	External Emotion Regulation	Internal Emotion Regulation	Inhibition Control	Planning/Working Memory	Initiation/Flexibility	Organization of Materials
Short Item Reception	-0.067	0.101	0.049	-0.065	-0.248	-0.429
Short Item Expression	0.246	-0.015	-0.148	-0.260	-0.076	-0.115
Long Item Reception	-0.017	-0.029	0.122	-0.008	-0.268	-0.156
Long Item Expression	0.116	0.048	-0.076	-0.095	0.040	-0.135
Turn-End Reception	0.235	-0.267	-0.133	0.045	0.034	0.321
Turn-End Expression	0.144	0.186	0.063	-0.068	-0.251	-0.148
Affect Reception	0.219	0.349	0.038	-0.310	0.171	0.003
Affect Expression	-0.230	0.146	0.104	0.047	-0.195	-0.432
Chunking Reception	-0.105	0.087	-0.023	-0.124	-0.188	-0.012
Chunking Expression	0.160	-0.056	-0.146	-0.196	-0.024	0.018
Focus Reception	0.090	0.206	0.071	-0.113	-0.065	-0.527
Focus Expression	0.311	0.027	0.063	0.048	0.128	0.094

7 Years	External Emotion Regulation	Internal Emotion Regulation	Inhibition Control	Planning/Working Memory	Initiation/Flexibility	Organization of Materials
Short Item Reception	0.093	0.366	0.190	0.302	0.549*	0.528*
Short Item Expression	0.024	0.474*	0.183	0.245	0.640*	0.489*
Long Item Reception	0.091	0.088	0.029	0.006	-0.015	0.049
Long Item Expression	-0.076	0.493*	0.335	0.559*	0.397	0.614*
Turn-End Reception	-0.069	-0.265	-0.120	0.002	-0.226	-0.321
Turn-End Expression	0.222	0.046	0.035	-0.115	0.081	-0.292
Affect Reception	0.128	0.159	0.306	-0.060	0.058	0.065
Affect Expression	0.382	0.030	0.077	0.038	-0.038	-0.217
Chunking Reception	0.350	0.172	0.285	0.086	0.317	0.082
Chunking Expression	-0.253	-0.064	-0.264	0.219	0.027	0.057
Focus Reception	0.392	0.039	0.096	-0.199	0.014	-0.130
Focus Expression	0.199	0.079	0.156	0.122	0.133	-0.105

9/10 Years	External Emotion Regulation	Internal Emotion Regulation	Inhibition Control	Planning/Working Memory	Initiation/Flexibility	Organization of Materials
Short Item Reception	-0.205	-0.131	0.312	0.319	-0.006	0.007
Short Item Expression	0.094	0.097	0.060	-0.034	-0.017	-0.328
Long Item Reception	-0.061	-0.347	-0.012	0.406	0.561*	0.476*
Long Item Expression	0.019	-0.147	0.063	0.362	0.454*	0.075
Turn-End Reception	-0.081	-0.420	0.248	0.064	0.234	0.075
Turn-End Expression	0.327	0.224	0.387	0.246	0.078	0.01
Affect Reception	0.642*	0.181	0.407	0.455*	0.455*	0.434
Affect Expression	0.342	0.233	0.442	0.113	0.033	-0.042
Chunking Reception	-0.208	-0.156	0.156	0.164	0.212	-0.072
Chunking Expression	0.026	0.223	0.198	0.247	0.169	0.241
Focus Reception	0.087	0.192	0.431	0.153	0.186	0.144
Focus Expression	-0.087	-0.105	0.001	-0.056	0.231	-0.218

15/18 Years	External Emotion Regulation	Internal Emotion Regulation	Inhibition Control	Planning/Working Memory	Initiation/Flexibility	Organization of Materials
Short Item Reception	-0.145	-0.162	-0.329	0.081	-0.099	-0.516
Short Item Expression	-0.021	0.157	0.221	-0.183	0.087	0.005
Long Item Reception	0.003	0.150	0.264	-0.286	-0.011	-0.264
Long Item Expression	0.198	0.357	0.563*	-0.316	0.113	0.024
Turn-End Reception	-0.145	-0.241	-0.329	0.081	-0.231	-0.181
Turn-End Expression	-0.027	0.131	0.068	0.221	0.267	-0.164
Affect Reception	0.000	0.000	0.000	0.000	0.000	0.000
Affect Expression	0.218	0.326	0.356	-0.067	0.110	0.051
Chunking Reception	-0.242	-0.327	0.144	-0.255	-0.158	-0.087
Chunking Expression	0.000	-0.074	-0.084	-0.202	-0.124	-0.105
Focus Reception	0.114	0.031	0.098	0.339	0.411	0.186
Focus Expression	-0.209	0.060	0.380	-0.374	-0.102	-0.007

Note. * $p < 0.05$.

Our findings showed significant correlations between EF and prosodic abilities, more visible between 5 and 10 years, ranging from small ($r = .42$) to strong ($r = .75$) in different ages (see Table 1).

Specifically, correlations were observed between problems in the affective-behavioral index (external / internal emotion regulation and inhibition control) and difficulties in affective or expressive prosodic difficulties.

Also, correlations were observed between problems in the metacognitive index (planning/working memory, initiation/flexibility, and organization of materials) and some prosodic difficulties (in both receptive and expressive skills).

Metacognitive strategies increase individual's awareness of their thought processes and actions while completing tasks [3].

One possible explanation is that prosodic performance signals the abilities to use metacognitive strategies.

DISCUSSION

In sum, our findings suggest a possible correlation between prosody and some aspects of executive functioning. Therefore, the nature of this association should be considered in future research. These results may be of considerable interest for clinical practice, since executive function difficulties and prosodic deficits are characteristic of many neurodevelopmental disorders [4], such as autism.

REFERENCES

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